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by

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Remaking the Science of Mind:

Psychology as Natural Science*

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Let us agree that "psychology" may be defined as the science of the mind or of mental phenomena, and that the subject matter of this science includes sense perception, imagination, memory, understanding or reasoning, feeling, and will.[1] If we then interpret the term "natural science" (or "natural philosophy") as it was understood in the early modern period, psychology considered as a natural science already had a long history as the eighteenth century began. The prescribed domain of subject matter was investigated by Aristotle under the name "logon peri tes psyches," of which it formed a proper part. This Aristotelian discipline was widely studied and taught in the early modern period under the title of "de anima," or, with some frequency, "psychologia."[2] Aristotelian textbooks of philosophy placed the study of the soul, including the rational soul and intellect, under the rubric of physics or natural philosophy, together with the study of basic physical principles,

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1. "Psychology" was so defined in major textbooks into the 1920s: Eduard Beneke, Lehrbuch der Psychologie als Naturwissenschaft, 2d ed. (Berlin, 1845), 1; Theodor Waitz, Grundlegung der Psychologie, 2d ed. (Leipzig, 1878; reprint of 1st ed., Hamburg, 1846), 8-9; Wilhelm Fridolin Volkmann, Grundriss der Psychologie (Halle, 1856), 2-3; Wilhelm Wundt, Grundzüge der physiologischen Psychologie (Leipzig, 1874), 1-3; William James, Psychology, Briefer Course (New York, 1892), 1; George Trumbull Ladd, Psychology, Descriptive and Explanatory (New York, 1895), 1-2; Harvey A. Carr, Psychology: A Study of Mental Activity (New York and London, 1925), 1.

2. On the origin of the terms "psychologia" and "psychology": Francois H. Lapointe, "Who Originated the Term 'Psychology'?" Journal of the History of the Behavioral Sciences 8 (1972): 328-35.

body in general, and the heavens.[3] Although the "new philosophers" of the seventeenth century uniformly rejected (in their various ways) the Aristotelian theory of the soul as the substantial form of the body,[4] they did not always deviate from the Aristotelian conception of physics as the science of nature in general, including the human mind. As the eighteenth century opened, then, it was an academic commonplace that the science of the mind or soul belongs to physics or the science of nature.

Eighteenth-century writers made many proposals for changing or newly founding the study of the human mind. A few contended that the study of the mind could not be made sufficiently rigorous to rank as a science.[5] The most famous was Immanuel Kant, though he nonetheless put empirical psychology under the rubric of physics (physiologia) and remained committed to the applicability of the law of cause to all psychological phenomena.[6] But many

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3. Seventeenth-century textbooks, early and late: Franco Burgersdijck (1590-1636; professor of physics at Leiden), Collegium physicum, disputationibus XXXII absolutum, totam naturalem philosophiam proponens, 4th ed. (Oxford, 1664); Pierre Barbay (d. 1664; professor of philosophy at Paris), In universam Aristotelis philosophiam introductio, 6th ed. (Paris, 1700), "Compendii physici"; idem, Commentarius in Aristotelis physicam, 5th ed., 2 vols. (Paris, 1690); Eustace of St. Paul (1573-1640; a Feuillant within the Cistercian Order), Summa philosophiae quadripartita (Cologne, 1638), part 3, "Physica"; Bartholemew Keckermann (ca. 1571-1608; Lutheran theologian, professor of philosophy at Danzig), "Systematis physici," in vol. 1 of his Opervm omnivm, 2 vols. (Geneva, 1614); Philipp Melanchthon, Initia doctrinae physicae, in his Opera, 28 vols. (Halle, 1834-60), 13:197; idem, Liber de anima, ibid., 13:5-9. The Aristotelian concept of soul (psyche, anima) extended to vegetative (e.g., nutritive and reproductive), as well as sensory and intellectual, powers and capacities.

4. Seventeenth-century challenges to the Aristotelian theory of the soul included Hobbes's materialistic treatment of mind, the substance dualism of Descartes and his followers, and Leibniz's theory of monadic substances in preestablished harmony.

5. Julius B. von Rohr, Unterricht von der Kunst, der menschen Gemüther zu erforschen (Leipzig, 1721); Charles de Secondat, Baron de Montesquieu, De l'esprit des loix (Geneva, 1748), book I, chap. 1, pp. 3-5.

6. Gary Hatfield, "Empirical, Rational, and Transcendental Psychology: Psychology as Science and as Philosophy," in Cambridge Companion to Kant, ed. Paul Guyer (Cambridge: Cambridge University Press, 1992), 200-27. Wundt, Grundzüge, 6, credited J. F. Herbart with discrediting Kant's objection that psychology cannot be a natural science because mathematics cannot be applied to "inner sense," through Herbart's observation that

authors, British, French, Swiss, and especially German, proposed and sought to practice an "experimental"--that is, an "empirical" and "observational"--"science of the mind," a scientific psychology. Quantitative study, though rare, was not entirely absent, and there was a large body of systematic theorizing based on appeals to immediate experience and to observations of ordinary behavior. This activity was surveyed by F. A. Carus in his Geschichte der Psychologie of 1808, in which he discussed more than 125 eighteenth-century authors, mostly German, but also British, French, Swiss, Italian, Spanish, and Swedish, who wrote psychological works of some type, the majority placing psychology under the rubric of natural science.[7] Max Dessoir, writing a century later in his history of modern German psychology, maintained that "in the eighteenth century psychology assumed the same position as natural science in the seventeenth century and epistemology in the nineteenth," that is, the position as the central "philosophical" discipline.[8] The psychologies of the eighteenth century retained vitality, especially in Britain and Germany, into the second half of the nineteenth century, when a "new psychology" was proclaimed.

This description of psychology in the seventeenth and eighteenth centuries contradicts received historiography. Recent general histories of psychology, written by psychologists, agree that natural scientific psychology arose only in the second half of the nineteenth century.[9] Other historians,

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sensations have both temporal position and intensive magnitude; oddly, Kant was himself committed to the assertion that all sensations have intensive magnitude: see Kritik der reinen Vernunft, 2d ed. (Riga, 1787), 207, which makes this methodological objection, expressed in the preface of his Metaphysische Angangsgründe der Naturwissenschaft (Riga, 1786), especially difficult to understand.

7. Friedrich A. Carus, Geschichte der Psychologie (Leipzig, 1808), 522-760.

8. Max Dessoir, Geschichte der neueren deutschen psychologie, 2d ed. (Berlin, 1897-1902), 358.

9. Edwin G. Boring, History of Experimental Psychology, 2d ed. (New York: Appleton-Century-Crofts, 1950); Duane P. Shultz and Syndney Ellen Schultz, History of Modern Psychology (San Diego, Harcourt Brace Jovanovich, 1987);

taking their cue from this historiography, have sought to explain why psychology did not arise in the previous centuries.[10] Only a few recent studies treat the earlier calls for a "natural scientific" psychology as anything but empty rhetoric.[11] And I have found no recent author who acknowledges that psychology was considered a natural science as the eighteenth century opened, that it had been so considered in Europe for several centuries, and that offshoots of the tradition in which it was so considered remained vital, even among figures deemed important in the standard historiography, into the second half of the nineteenth century.

The contradiction between my description of eighteenth-century psychology and the traditional historiography arises partly from differing understandings of the concepts psychology and natural science. In the past half-century, since the writings of E. G. Boring, there has been a decided tendency to equate "natural scientific psychology" with "quantitative, experimental psychology," and to contrast the "scientific" character of this psychology with the "metaphysical" character of its earlier namesake.[12] This tendency is

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Richard Lowry, Evolution of Psychological Theory: A Critical History of Concepts and Presuppositions, 2d ed. (New York, Aldine Publishing Co., 1982); Daniel N. Robinson, Intellectual History of Psychology, rev. ed. (New York, Macmillan Publishing Co., 1981).

10. Graham Richards, "The Absence of Psychology in the Eighteenth Century: A Linguistic Perspective," Studies in History and Philosophy of Science 23 (1992): 195-211.

11. Christopher Fox, "Defining Eighteenth-Century Psychology: Some Problems and Perspectives," in Psychology and Literature in the Eighteenth Century, ed. Christopher Fox (New York: AMS Press, 1987), 1-22; Rolf Jeschonnek, introduction to the reprint of Carus's Geschichte (Berlin and New York: Springer Verlag, 1990), 17-37; Eckart Scheerer, "Psychologie," in Historisches Wörterbuch der Philosophie, ed. Joachim Ritter (Basel: Schwabe, 1971-), vol. 7, col. 1599-1653; Fernando Vidal, "Psychology in the 18th Century," History of the Human Sciences 6 (1993): 89-119.

12. The history of psychology may be told from different perspectives depending on the current understanding of psychology itself; cognitive or mentalistic studies are differently valued in histories written by behaviorist as opposed to cognitive psychologists: e.g., compare J. R. Kantor, Scientific Evolution of Psychology, 2 vols. (Chicago: Principia Press, 1963-69), with Robinson, Intellectual History of Psychology.

not surprising: the growth of psychology as a scientific discipline has been built on its claim to have applied quantitative experimental rigor to subject matters about which philosophers and metaphysicians only talked and speculated. If one equates modern science with quantitative science, then there seemingly was no scientific psychology prior to the well-known uses of quantitative experimental techniques after 1850. If one attempts to confine modern science to its ostensibly nonmetaphysical moments, then patently metaphysical theorists and experimentalists must be excluded, or their work must be "sanitized" of the offending content. These two constraints on legitimacy conjointly explain why the great body of eighteenth-century literature claiming to found a natural scientific psychology has been ignored by historians of psychology, despite the historical continuity between the eighteenth and nineteenth centuries in the faculty tradition in Germany, and in the associationist traditions in both Germany and Britain.

The equation of natural science with antimetaphysical, quantitative experimentation is problematic on two counts. As an approach to history, it partakes of the worst failings of "presentism" or "Whig" history: it ignores the self-understanding of earlier figures who considered themselves practitioners of natural science, and it redescribes their cognitive activity and intellectual products from the standpoint of the presently ruling party, in this case, the community of experimental psychologists and their historians and apologists. Philosophically, it makes a crude positivist assumption that all progress in science is progress in the quantitative description of natural phenomena. This philosophical position should be resisted: not all natural scientific achievements are fundamentally quantitative, including achievements in two sciences that are closely related to psychology, namely, physiology and biology (consider the discovery of neurons, or the development of the theory

of evolution). Moreover, in the early history of physics an important role was played by conceptual innovation as opposed to quantitative prediction or modeling, as exemplified in Descartes' contribution to the development of the concept of a unified celestial and terrestrial physics, (metaphysically) grounded on a small set of basic concepts, laws, and patterns of explanation.[13] One should not rule out the possibility that in psychology, too, important conceptual work preceded quantitative experimentation. Moreover, we may well find that although quantitative, experimental psychology became widespread under that name only in the second half of the nineteenth century, a continuous tradition of quantitative observation in sensory physiology and psychology stands behind that development.

A Contextualist Approach to the Origin of "Natural Scientific" Psychology

My approach to the historical question of whether there was an eighteenth-century scientific psychology[14] is to begin with the concepts of psychology and natural science as they were understood in that century. During that time, psychology was the science of mind or soul, or of mental phenomena; as such, it was known under many names, deriving from "psyche," "anima," "soul," "mind," and their cognates.[15] Mind and soul were often, but

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13. I. B. Cohen, Newtonian Revolution (Cambridge: Cambridge University Press, 1980), 182-9; Gary Hatfield, "Metaphysics and the New Science," in Reappraisals of the Scientific Revolution, ed. David Lindberg and Robert Westman (Cambridge: Cambridge University Press, 1990), 93-166.

14. In essence, I am asking about the presence of the discipline of psychology. The term "discipline" can be understood in several ways, e.g., as the province of members of a professional society, as the province of the members of a recognized institutional administrative structure such as a university department, as a subject taught in school, or as a division of knowledge characterized by its subject matter and methodology. Here I am emphasizing the latter two senses of the word.

15. Many historical investigations, including Vidal's helpful "Psychology in the Encyclopedias," have focused on the origin of the word "psychology," as opposed to the origin of psychology as a discipline. But the etiology of concepts must be distinguished from the (allied) histories of word usage. The science of the mind was known under many titles in the eighteenth century, including "the science of the mind," "the theory of mind,"

not always, equated. The mind or soul was considered by many to be a natural being, a thing in nature. "Science" was applied to any systematic body of thought, and need not have connoted an empirical basis. "Natural science" was equated with "physics," in the etymological sense of that term; it was the science of nature.[16] In the seventeenth and throughout much of the eighteenth centuries this science included the whole of nature, comprising a subject matter that we would now range under the headings of physics, physical astronomy, chemistry, biology, physiology, and psychology. It might or might not have been ascribed metaphysical foundations by its practitioners.

Given these understandings of the terms and the areas of study they denote, psychology was considered by a great many eighteenth-century authors to be a science. This was so whether psychology was treated as a science of mental phenomena or of mental substance. Many considered it to be a natural science based on experience, including those who considered themselves to be studying an immaterial substance. A minority of the latter group followed Christian Wolff in placing psychology under the rubric of metaphysics rather than physics. This fact, however, requires careful interpretation, for Wolff also placed cosmology (general physics, including planetary astronomy and the laws of motion) under metaphysics, and he allowed that metaphysical principles could and should be established empirically.[17] Thus, if one takes

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"psychology," "psychologie," "Psychologie," and "Seelenlehre." Related disciplines included "anthropology," or the "science of man," which often included "psychology" as a subdiscipline, and "pneumatics," "pneumatology," or "Geisterlehre," which considered spirits (immaterial beings).

16. For eighteenth-century definitions (explicit and implicit) of the terms in quotation marks in this paragraph, see Ephraim Chambers, Cyclopaedia, or An Universal Dictionary of Arts and Sciences, 2d ed. (London, 1738), 2 vols.; Kant, Kritik der reinen Vernunft, Methodenlehre, part 3 (Kant uses the Latin term "physiologia" for the science of nature).

17. Christian Wolff, Philosophia rationalis sive logica, 3d ed. (Frankfurt am Main/Leipzig, 1740): philosophical cognition requires "historical" cognition of facts (#50) and metaphysics is a species of philosophy (#79). Further, psychology is a part of metaphysics, and it requires cognition of facts from experience in both its empirical and rational branches:

eighteenth-century conceptions of psychology seriously across the board, as I intend to do, one is committed to allowing immaterial substances as a (putative) object of empirical study.

This last observation, even cushioned as it is by the surrounding contextualist historical methodology, is likely to shock modern sensibilities. This shock is another manifestation of our use of present standards (and mythologies) to judge past materials. Immaterial substances are not in the list of likely theoretical posits in current psychology and physiology. One way of interpreting this fact is to think that such posits were part of a religious worldview that was overcome with the Enlightenment rejection of superstition and authority.[18] "Reason," so the story often goes, has shown us that dualism and other mind-positing ontologies are empty or incoherent.

This way of understanding the Enlightenment and the dictates of reason is itself unreflective and simplistic. It is true that many an Enlightenment philosophe is justly portrayed as rejecting God and the soul on rational grounds, in opposition to tradition and authority. But one should not leap to the converse conclusion, for it is not true that all those who posited immaterial substances were blind followers of tradition and authority. Indeed, a chief characteristic of many who were metaphysical realists about the soul was their appeal to reason or intellect in establishing their ontologies: Descartes is the most notorious example. In any event, if one believes that immaterial entities exist and that some of them inhabit human bodies, it makes good sense to seek to determine the powers and capacities of such substances empirically, by studying the manifestation of the mind in the behavior of others and in one's own experience of mental phenomena. From this

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Psychologia empirica, new ed. (Frankfurt am Main/Leipzig, 1738), ##1-4.

18. Roy Porter, The Enlightenment (Atlantic Highlands, N.J.: Humanities Press International, 1990), especially chaps. 4, 8.

point of view, taking an empirical approach to immaterial substances is an extremely rational undertaking. How else is one to determine their powers?[19]

My thesis in this chapter is that psychology as a natural science was not invented during the eighteenth century, but remade. As the century opened, the science of the mind included several dimensions: charting the "faculties"--the capacities and powers--of mind was foremost. Associated with this task were metaphysical questions about the ontology of the mind and its faculties, and about their relation to body and to specific bodily organs, especially the brain. These questions were posed within various metaphysical frameworks; the three most widely discussed were the Aristotelian, Cartesian, and Leibnizian. As the century proceeded, new conceptions of psychology were proposed or implicitly adopted. The Aristotelian ontology of form and matter faded; most psychological authors adopted some version of mind-matter dualism. But the faculty-based approach continued to dominate the most prevalent form of dualistic psychology, "Ehrfahrungsseelenlehre," or the empirical doctrine of the soul or mind. Ontological questions were bracketed in order to concentrate on study of mental faculties through their empirical manifestations in mental phenomena and exteral behavior. This approach arose prior to midcentury in Britain, Switzerland, France, and Germany. It was

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19. Aristotelians also quite reasonably took an empirical attitude toward the powers of the soul, considered as powers of an animating principle. A similar point might be made about the study of an immaterial supreme being; hence, the extensive practice of "natural theology" during the eighteenth century. There is a tension between characterizations of the Enlightenment as "the Age of Reason" and as anticlerical and secular. "Enlightenment" has two distinct connotations, one based on cognitive attitude or "method," another on content and conclusion. According to the first, it means "thinking for one's self"; to the second, it includes rejection of the immaterial beings posited in many religions. Tension arises because supreme rationalists such as Descartes and Leibniz "thought for themselves" and claimed to establish the existence of God and the soul through reason. This apparent conflict should, I think, serve to sensitize us to the changing content assigned to reason or "the rational" in the modern period.

pursued most extensively in the latter, where there were numerous calls for an autonomous empirical psychology. Psychological theorizing was only rarely pursued as part of an attempt to cast doubt on (or to secure) the existence of immaterial souls or their connection with things divine.[20]

An alternative to faculty psychology began to be widely discussed in the middle of the eighteenth century: the associationist theory of mind. Hume, David Hartley, and others attempted to explain many or all phenomena of mind by appeal to laws of association.[21] The organization of their discussions largely followed the faculty-based division of psychological phenomena into sense perception, imagination, memory, and will, but a new explanatory schema was applied to these phenomena, one that promised explanatory unification under a few basic laws. Associationists reduced the powers of the mind to one, the ability to receive impressions, and they sought to explain the interactions among these impressions by appeal to the laws of association (which often numbered three). At first pursued most vigorously in Britain and France, with the translation of associationist works into German this approach came to be acknowledged in German psychology and found several German adherents. A variant of the associationist approach found a vigorous German proponent just after the turn of the century, in a quantitative statement by

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20. The most notable exceptions are the French materialists, including Diderot, La Mettrie, d'Holbach, and Helvetius, though their actual contribution to the development of psychological theory is questionable. Another exception is Samuel Strutt, whose A Philosophical Enquiry into the Physical Spring of Human Actions, and the Immediate Cause of Thinking (London, 1732) argues that the only conceivable cause of motion in the human body is material.

21. David Hume, A Treatise of Human Nature, Being an Attempt to Introduce the Experimental Method of Reasoning into Moral Subjects, 3 vols. (London, 1739-40), I.i.4, pp. 10-13; David Hartley (1705-57; physician, philosopher, and Christian apologist), Observations on Man, His Frame, His Duty, and His Expectations, 2 vols. (London, 1749), I.i, 1:5-114. On the background to associationism, emphasizing its roots in Aristotle, see William Hamilton's notes in his edition of the Works of Thomas Reid, 2d ed. (Edinburgh, 1849), note D**, 889-910 (thanks to Suzanne Senay for this reference).

J. F. Herbart.[22]

In support of my thesis I first describe the state of psychology as the eighteenth century opened, and then chart the development of various new or modified natural scientific conceptions of or approaches to psychology and its subject matter.

Psychology Circa 1700

The science of the soul in its De anima-inspired form was discussed in four literatures in the seventeenth century: it constituted a considerable chunk of the typical seventeenth-century university textbook in Aristotelian physics, occupying from a fourth to a third of the total number of pages;[23] it was the subject of numerous commentaries on Aristotle's De anima;[24] it was

22. In Britain, beyond Hume and Hartley, associationism received a thorough statement by Erasmus Darwin (1731-1802), M.D., in his Zoonomia; or, The Laws of Organic Life, 2 vols. (London, 1794-96), who used the more general term "habit," of which association formed a species (II.ii.11, 1:12-13); this work went through three German editions between 1795 and 1805. Charles Bonnet, Essai de psychologie (London, 1755 [1754]), chaps. 4, 8, 20, 29 (pp. 11-12, 19-20, 45-9, 87-8), discussed a principle of association, under the title "réproduction des idées," which he explained via an interaction between the soul and vibrating fibers in the brain; see also his Essai analytique sur les facultés de l'ame, 2d ed., 2 vols. (Copenhagen and Geneva, 1769), chaps. 25-26, and his "Sur l'association des idées en géneral," preliminary essay to his Palingénésie philosophique, in his Oeuvres d'histoire naturelle et de philosophie, 18 vols. (Neuchatel, 1779-83), 15:143-56. Johann Friedrich Herbart (1776-1841) published two important works in psychology, Lehrbuch der Psychologie (Königsberg and Leipzig, 1816) and Psychologie als Wissenschaft neu gegründet auf Erfahrung, Metaphysik und Mathematik, 2 vols. (Königsberg, 1824-25); he sought to construct mental life using a "law of reproduction," which was itself derived from interactions among representations, on which, see Gary Hatfield, The Natural and the Normative: Theories of Spatial Perception from Kant to Helmholtz (Cambridge, Mass.: MIT Press, 1990), 122-3.
23. Burgersdijck, Collegium physicum, 198-343 (out of 353 pages); Barbay, In Aristotelis philosophiam introductio, 210-219 (within 191-219); Barbay, In Aristotelis physicam, 2:305-558 (out of 985 pages); Eustace of St. Paul, Summa philosophiae, 3:174-308 (out of 308 pages); Bartholemew Keckermann, "Systematis physici," cols. 1478-1657 (within 1357-1764).
24. Francisco Toledo, S.J. (1532-1596), Commentaria una cum quaestionibus in tres libros Aristotelis De anima (Cologne, 1594); Coimbra College, In tres libros De anima, 2d ed. (Lyon, ca. 1600); Antonio Rubio, S.J., Theol.D. (1548-1615; Professor of theology, Commentarium in libros Aristotelis De anima (Lyon, 1620).

found in separate treatises labeled "psychologia," which might or might not be closely tied to an exposition of Aristotle's De anima;[25] and it constituted one part of works on "human nature" or "anthropology" intended for the natural philosophy curriculum, which part was sometimes labeled "psychologia," by contrast with anatomy or "somatotomia."[26] "Soul" or "anima" was, in the

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25. For the earliest free-standing "psychology," see Rudolph Goclenius (1547-1628; professor of physics, logic, and mathematics at Marburg), Psychologia: hoc est, de hominis perfectione, animo (Marburg, 1594), which had little "psychological" (in our sense) content by comparison with the standard De anima literature, being a collection of twelve disputations, each by a different author, ten of which discussed whether the soul is transferred from the father in the semen or is infused by God, one of which discussed the philosophical perfection of man in connection with an interpretation of Plato's Timaeus, and one of which discussed the seat of the human soul, and particularly whether the whole is in the whole and in each part of the whole; similarly, Fortunio Liceti (1577-1657), Psychologia anthropine, sive de ortu animae humanae (Frankfurt am Main, 1606), focused on the origin, substantial nature, and reproductive status of the soul. While both of these works treat topics pertaining to the soul or "psyche," they are narrowly focused compared to the usual range of De anima topics such as was covered under the title of "psychology" in a disputation by Johann Conrad Dannhauer (1603-1666; Lutheran theologian, professor of theology at Strassburg, 1633-66), Collegium psychologicum, in quo maxime controversae quaestiones, circa libros tres Aristotelis de Anima, proponuntur, ventilantur, explicantur (Argentoranti, 1630). Christoph Scheibler (1589-1653), Liber physicus de anima, in his Opera philosophica, 2 vols. (Frankfurt am Main, 1665), vol. 2, also discussed the usual range of Aristotelian topics on the soul. "Psychology" served as a thesis topic, e.g., Petrus Liungh (d. 1679), examining Laurentius Preutz, Theoremata psychologia generalia (Upsalla, 1655), which focused primarily on ontological, reproductive, and postmortem questions; sometimes particular topics from the subject matter of De anima were examined, e.g., Abraham Georg Thauvonius (ca. 1622-1679), examining Petrus Joannis, Disputatio physica de sensibus (Aboae, 1655), which discussed the external and internal senses; Albert Linemann (1603-53; mathematician in the Academy of Regiomantus), examining Benjamin Crusius, Exercitatio philosophica visiionis naturam physicis & octicis rationibus explicatam (Regiomantus, 1662), which discussed the doctrine of visual species in connection with Kepler's theory of retinal images.

26. Otto Casmann (d. 1607; schoolmaster in Steinfurt), Psychologia anthropologia, sive animae humanae doctrina (Hannover, 1594), first treated "psychologia," covering the usual Aristotelian topics, and then, in Secunda pars anthropologiae: Hoc est, fabrica humani corporis (Hannover, 1596), Casmann discussed "somatotomia," or the anatomy and physiology of the body, including the sense organs; Fabiano Hippio (professor of physics at Leipzig), in Psychologia physica, sive de corpore animato, libri quatuor, toti ex Aristotle desvmti, morborum saltem doctrinis ex medicis scriptis adiecta (Frankfurt am Main, 1600), defined "psychologia physike" as "scientia corporis animati," explicitly leaving out any discussion of souls

Aristotelian tradition, understood quite broadly, to include the principles of growth and development, or the "substantial forms," of both plants and animals, including the human animal. The Aristotelian physics textbook began with a discussion of general physical principles, such as the four causes, and the general properties of bodies, including their constitution from form and matter. It then divided all bodies into "specific kinds": first, into celestial and terrestrial; terrestrial into simple (namely, the four elements) and mixed; mixed into inanimate and animate. Animate beings were then divided according to the type of soul, which was denominated by its highest power. Thus, plants have only a vegetative soul, while nonhuman animals have

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not operating naturally in a body; Psychologia physica was divided into four books, the first treating the parts of the body, including the brain and animal spirits (largely free from Aristotle, including his theory of the brain); the second treating general questions about the soul, its faculties, and its relation to the body; the third treating the natural operations of the soul in the body, from nutrition through intellection and appetite; and the fourth treating medical topics concerning morbidity; Gregor Horst (1578-1636), in De natvra hvmana, libri duo, quorum prior de corporis structura, posterior de anima tractat (Frankfurt am Main, 1612), treated the usual Aristotelian topics on the soul in the second part (which originated as an excercise "peri tes psyches," Wittenberg, 1602) and affirmed that the soul is part of physics only when considered as an act of the body, but not as a separated substance; Tobias Knobloch (M.D. and Professor of physics), in Disputationes anatomicae et psychologicae (Leipzig, 1612), surveyed human anatomy in 613 of the book's 713 pages, then treated the usual topics on the soul; Johann Sperling (1603-58; professor of physics at Wittenberg), in Physica anthropologia (Wittenberg, 1668), contended that "anthropologia" is part of physics because human beings are a physical species, and then in book 1 treated the usual topics (pp. 59-302), to which he added chapters on laughter and speech, and surveyed the human body in book 2 (pp. 303-780). Samuel Haworth (medical student and later M.D.), in Anthropologia, or, A Philosophical Discourse Concerning Man: Being the Anatomy both of his Soul and Body (London, 1680), focused in his "pneumatology" (pp. 14-73) on the ontology, immateriality, and immortality of the soul, giving scant attention to the operation of its faculties (pp. 67-73), and in his "somatology" surveyed anatomy and physiology, adding chapters on the sexes and the ages of man. The practice arose early of including "anthropologia," treating body and soul, in physics texts: Johann Freig (1543-83), Quaestiones physicae (Basel, 1579), book 35, "De anthropologia et anatome" (pp. 1147-1237), book 36, "De anthropologia et anima hominis" (pp. 1237-90). The relation between the sixteenth-, seventeenth-, and eighteenth-century discipline of "anthropology" and the physical and cultural anthropology of the nineteenth and twentieth centuries needs further study.

sensitive souls (also possessed of vegetative powers), and human animals have rational or intellective souls (also possessed of sensitive and vegetative powers).

As is apparent, the Aristotelian concept of soul did not entail consciousness or rationality; at its most general, it required only life. For this reason, the seventeenth-century Aristotelian discipline named "de anima" cannot strictly be equated with the "science of mind," and hence with "psychology" as defined herein. But the science of the phenomena that we now denominate as "mental" dominated this discipline. In standard textbooks and commentaries, the vegetative soul received comparatively brief coverage; much greater space was given to the sensitive and rational souls.[27] More importantly, the activities of the sensitive and rational souls were grouped together under the denomination "cognitive," and the sensitive and intellectual faculties were seen as cooperating in the process of cognition. Indicative of their close relation, their modes of operation were often compared and contrasted.[28] So although the Aristotelian discipline of the

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27. Toledo, Commentaria, devoted folios 65rb-73vb to the vegetative soul, 73vb-129ra to the sensitive, 129ra-169ra to the intellect, and 169rb-179rb to appetite, will, and motion; Coimbra College, In tres libros De anima, devoted pp. 148-61 to the vegetative soul, 160-361 to the sensitive, 360-469 to the intellect, 460-98 to appetite, will, and motion, with separate treatises on the separated soul (499-596) and on additional problems pertaining to the five senses (597-619); Rubio, Commentarium in libros Aristotelis De anima, devoted pp. 278-305 to the vegetative soul, 305-632 to the sensitive, 633-735 to the rational, and 735-57 to appetite, will, and motion, adding a treatise on the separated soul (758-94). The coverage was slightly more balanced in the textbooks: Burgersdijck, Collegium physicum, devoted 229-39 to nutrition and growth, 239-71 to reproduction, 271-302 to the sensitive soul, 302-13 to appetite and motion, 313-33 to the intellect, and 333-43 to the will and freedom; Barbay, In Aristotelis physicam, devoted 374-436 to the vegetative soul and power of generation, 437-529 to the sensitive soul, including appetite and motion, and 529-58 to the rational soul; Eustace of St. Paul, Summa philosophiae, "Physica," devoted 197-228 to the vegetative soul, 228-77 to the sensitive, including motion, and 278-308 to the rational soul, including will.

28. Toledo, Commentaria, II.12, quest. 32, folios 109vb-110ra, III.3, quest. 7, folios 127ra-128rb, III.7, q. 21, folios 164va-166ra; Coimbra College, In tres libros De anima, III.3, quest. 2, pp. 357-60, III.4, p.

soul is broader than the science of the mind, effectively it contained the study of the cognitive faculties as a subdiscipline.

The treatment of the sensitive and rational souls, exclusive of certain general (and significant) ontological questions, was organized so that the reader followed the chain of cognition according to the famous Aristotelian dictum "nothing in the intellect that was not first in the senses." Under the rubric of the sensitive soul, the five external senses were discussed first and at greatest length, including the transmission of color via light, its reception in the sense organ and the subsequent transmission along the optic nerve, and the discriminative acts of the sensitive power. Then came discussion of the internal senses, including the "common sense," imagination, memory, and the estimative power (the latter explained the undeniable, though limited, abilities of nonhuman animals to learn and to anticipate), followed by discussions of appetite and the motive power (which controls locomotion).[29] Under the rubric of the rational soul, considerable discussion often was devoted to problems about the spirituality and immortality of the soul; other questions concerned the production of the rational soul at the time of conception. Especially in the commentaries, the role of the intellectual faculty in cognition was analyzed extensively, focusing on its power to extract intelligible species (common natures, universals) from phantasms present in the internal senses. The power of abstraction was attributed to the "agent intellect," which, together with the phantasm, produces an intelligible species that is received in the "patient intellect," completing the act of intellection.[30]

362, III.8, quest. 5, article 3, p. 443; Rubio, Commentarium in libros Aristotelis De anima, II.5-6, quest. 1, p. 314, quest. 2, p. 323, III.3, quest. 5-6, 8, 11, pp. 606-13, 616-32, III.4-5, quest. 2, pp. 662-3.

29. The material treated in De anima, II.5-III, which was covered in the textbooks and commentaries mentioned in notes 23 and 24.

30. Toledo, Commentaria in tres libros Aristotelis De anima, III.4-7,

All of these discussions were considered to pertain to the physics or natural science of the soul, with the exception that some authors assigned to metaphysics discussion of the spirituality and immortality of the human soul.[31] Accordingly, most authors contended that the study of the soul could be approached through "natural human reason" alone, without appeal to scriptural authority or divine inspiration. The subject matter belongs in "natural science" on the simple grounds that it pertains to "natural" things, or things possessed of natures, that is, intrinsic principles of motion or change. The class of "natures" was somewhat wider than we now include within the proper scope of the terms "natural" and "physical," because it included the rational soul. At the same time, throughout the eighteenth century many authors included the soul, conceived as an immaterial substance distinct from the body, to be a thing in nature.

We would now classify the material covered in Aristotelian psychology under several headings, including physiology, psychology, metaphysics, and epistemology. The discussion of the external senses included the material characteristics of sensory qualities in bodies, the transmission of qualities to the sense organs, the characteristics of the sense organs and the physics and physiology of the reception of transmitted qualities, nervous transmission to the brain, and the experience and discrimination of the quality by the mind or soul. The discussions of the internal senses included what we would call

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quest. 9-23, folios 129ra-168vb; Coimbra College, In tres libros De anima, III.4-8, pp. 360-459; Rubio, Commentarium in libros Aristotelis De anima, III.4-5, pp. 633-735. The doctrine of the agent and patient intellects was regularly mentioned in the textbooks, e.g., Eustace of St. Paul, Summa philosophiae, "Physica," III.4, disputation 2, pp. 284-300.

31. Toledo, Commentaria in tres libros Aristotelis De anima, proem, quest. 2 (folio 4), subsumed the soul in all of its operations under physics; Coimbra College, In tres libros De anima, proem, quest. 1, article 2 (pp. 7-8) and Rubio, Commentarium in libros Aristotelis De anima, proem, quest. 1 (pp. 10-11), subsumed the study of embodied souls under physics, and the separated soul under metaphysics.

the physiology and psychology of memory, imagination, feeling, appetite; many would today consider these discussions as properly "naturalistic." The theory of the rational soul seems least properly naturalistic from our perspective. Within the Aristotelian tradition, there had been a dispute over whether intellection is a natural function of the human soul, or derives from a higher intelligence. The majority opinion, however, included intellection among the natural, if immaterial, powers of the human mind, and hence as proper to the subject matter of the part of physics that treats of the human animal.[32] In sum, although only a portion of the material found in the De anima discussions would now be considered proper to the natural science of psychology, in Aristotelian terms these discussions did constitute a natural science of soul, including the cognitive powers of the soul.

Although the Aristotelian physics continued to be taught well into the eighteenth century (especially in France), it was being displaced. The force for this displacement came first from the "mechanical philosophy," championed by Hobbes and Descartes (among others). Although in general the advocates of the new mechanical philosophy understood the scope of physics along Aristotelian lines, to encompass all of nature, they differed among themselves

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32. The orthodox view was that intellection is a natural power of the human soul, but that it differs from the sensitive powers in being immaterial; it is an immaterial power of the form of the human being, and hence of a form informing a material body. It was ascribed immateriality "in its operation" on the grounds that, in order to receive "common natures" (which are universals) it must be capable of "becoming all things," and that any power that was tied to a corporeal organ for its operations would be limited by the materiality of the organ. Orthodox authors nonetheless considered this immaterial power to be a natural power of the form of the human animal. Unorthodox authors denied that these powers could be produced by the rational soul considered as the form of the human body precisely because of its association with a body; they ascribed either the agent or both it and the patient intellects to a higher being, which the early seventeenth century commentator Jacopo Zabarella contended was God itself. Thus, as the eighteenth century opened there was in the recent Christian Aristotelian corpus a minority opinion that the intellectual powers of the mind are not "natural" to the human psyche, but must be attributed to a divine power.

on where to place mental phenomena or mental substance. Their differing ontologies partly explain their divergent attitudes toward psychology: the materialist Hobbes unproblematically placed the phenomena of mind under the rubric of physics, while substance dualists who distinguished mental from bodily substance faced a decision about where to put mind in the system of sciences. Ontology was not determining: some substance dualists placed mind under physics, some assigned it to metaphysics, and some baptized a new science of mind, coordinate with but distinct from physics.

In his Elements of Philosophy (1656), Hobbes forthrightly placed the treatment of "Sense and Animall Motion" in part 4, "Physiques, or the Phaenomena of Nature."[33] On the surface, this placement of the text was unremarkable; it departed not in the least from Aristotelian practice. But given the content of Hobbes's discussion, it was a radical departure. In this chapter he discussed the phenomena of sense and imagination, the faculties that Aristotelians (and Cartesians) held to be shared by humans and beasts. He departed from the Aristotelians in contending that these phenomena should be equated with material motions in the bodies of animals and humans.[34] Hobbes's thorough break with both Aristotelian and Cartesian theory becomes apparent when we recall that in his Leviathan of 1651 he had reduced understanding or intellect to imagination: "The Imagination that is raysed in man (or any other creature indued with the faculty of imagining) by words, or other voluntary signes, is that we generally call Understanding; and is common to Man and Beast."[35] The only major materialist in the seventeenth century,

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33. Thomas Hobbes (1588-1679), Elements of Philosophy, the First Section, Concerning Body (London, 1656; translation from Latin edition of 1655), chap. 25.
34. Ibid., chap. 25, article 2, pp. 291-2.
35. Hobbes, Leviathan, or the Matter, Forme and Power of a Commonwealth Ecclesiasticall and Civil (London, 1651), part 1, chap. 2, p. 8.

Hobbes took the radical step of bringing the science of mind within the domain of physics by reducing physics to matter in motion and equating mental activity with the latter. Of greater importance for the history of psychology, though, was his analysis of the regularities of imagination. As later authors were to notice, Hobbes described the activity of the imagination in terms of a principle of association: the faculty governs the production of "traynes" of images according to the principle that "we have no Transition from one Imagination to another, whereof we never had the like before in our Senses."[36] Current transitions in imagination are limited to prior actual transitions, though, by Hobbes's lights, this was not much of a limitation, because of the great variety of successions found in the senses: the combinations presented to the senses are so diverse, he thought, that "when by length of time very many Phantasmes have been generated within us by Sense, then almost any thought may arise from any other thought."[37] As Hobbes explained, the development of rational thought depends not on any special faculty of the mind or immaterial agency but on proper control of the trains of imaginations, through their regimentation under the rules of language or the use of signs. This attitude toward the human mind was to serve as an inspiration to several eighteenth-century thinkers (in Britain and on the continent), though a direct debt to Hobbes is difficult to establish because of citation practices (including penalties of disfavor for acknowledging Hobbesian influence).

The most prominent body of seventeenth-century physics was that spawned by Descartes and spread in numerous books by his followers. In his Principia philosophiae, Descartes had intended to cover the full range of the

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36. Ibid., part 1, chap. 3, p. 8.
37. Hobbes, Elements, part 4, chap. 25, article 8, p. 297.

traditional physics, including "the nature of plants, of animals, and above all, of man." He was forced to cut his treatment short because of lack of means to carry out "all the experiments that I would need in order to support and justify my reasonings."[38] In the extant portions of the Principia devoted to physics (parts 2-4), he discussed the bodily side of sensory activity and the creation of sensations in the mind, but not the essentially mental faculties of intellect and will.[39] The latter were discussed in his "metaphysical Meditations" and in the corresponding part 1 of the Principia, and it is not clear whether they would have been discussed under the rubric of "physics" in a completed version of the latter work. But there is evidence to suggest that Descartes had intended his earlier book on physics, entitled Le Monde, to extend at least to the union of soul and body: the posthumously published Traité de l'homme (originally part of Le Monde) covered human physiology, including the bodily mechanisms involved in sense perception, imagination, memory, bodily motion, sleep, dreams, and emotions, and was to have examined the mind-body union.[40] Further, in his Dioptrique, Descartes

38. The quoted phrases are from Descartes' "Lettre de l'avthevr," which first appeared in the French translation, Principes de la philosophie (Paris, 1647, translated from the Latin edition, Amsterdam, 1644), 26, 29; English translation, Valentine Rodger Miller and Reese P. Miller, Principles of Philosophy (Dordrecht, Boston, and Lancaster: D. Reidel, 1983), xxiv, xxvi. "Experiment" includes appeals to both sense experience and controlled observation.

39. Descartes, Principia, part 4, articles 189-98. René le Bossu, Parallele des principes de la physique d'Aristote, & de celle de René des Cartes (Paris, 1674; reprint, Paris: J. Vrin, 1981), noted that "l'homme même, & son ame, au moins en qualité d'ame sensitive, sera l'objet de la Physique de M. des Cartes, aussi bien que tout ce qu'il y a de matériel & d'étendu dans le monde qu'il nomme Corps" (p. 46).

40. René Descartes, L'Homme de René Descartes (Paris, 1664), 1, 29; English translation by Thomas Steele Hall, Treatise of Man (Cambridge, Mass.: Harvard University Press, 1972), 1, 36. It is likely that the discussion of mind-body union would have occurred after the lost or unwritten section of Le Monde on the soul, as described in Descartes' Discours de la methode (Leiden, 1637), part 5; nonetheless, it would have been a part of what Descartes termed his "physics," to Marin Mersenne, March 1637, in Oeuvres, 11 vols., ed. Charles Adam and Paul Tannery (Paris: J. Vrin, 1968-74), 1:348.

examined the physiological processes and mental judgments involved in the perception of size, shape, distance, and motion.[41] Subsequent Cartesian treatises on physics incorporated discussion of sense perception--including its mental aspect--within physics, but they split on whether to place discussion of the rational soul in physics or metaphysics.

Jacques Rohault produced the most widely distributed textbook of Cartesian physics, which was used well into the eighteenth century. He followed the extant Principia in limiting physics primarily to the material world, though he included discussion of both the bodily and mental aspects of sensory perception in treating of the qualities of bodies. Among the senses, he again followed Descartes (and tradition) in treating of vision most extensively, including the perception of color, size, and distance, the production of an "immaterial Image" in the soul through brain activity, and the "judgments" based on that image which result in size and distance perception.[42] Antoine Le Grand produced the first comprehensive rendering of Descartes' philosophy.[43] Within physics, he followed scholastic practice in dividing physics into general and special, and inanimate and living.[44] Following the Aristotelian order, Le Grand included the whole of what he termed the science of "Man" in his physics, divided into two parts, considering first the human

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41. René Descartes, Dioptrique, part 6, published with the Discours in 1637.

42. Jacques Rohault (1618-72), Traité de physique (Amsterdam, 1676); idem, trans. John Clarke (Samuel's brother), System of Natural Philosophy, 2d ed., 2 vols. (London, 1728-29; reprint, New York: Garland Publishing, 1987), 1:248-57.

43. Antoine Le Grand (d. 1699), Institutio philosophiae secundum principia de Renati Descartes, new ed. (London, 1678); trans. Richard Blome, An Entire Body of Philosophy, According to the Principles of the Famous Renate Des Cartes (London, 1694; reprint, New York: Johnson, 1972).

44. As Descartes had himself done, Le Grand was not averse to presenting Cartesian philosophy using the Aristotelian terms, and so he attributed a "soul" to plants and animals, which turned out to be "a Heating, but not a Shining Fire" (Descartes' "fire without light"): Le Grand, Body of Philosophy, book 1, part 7, introduction, article 3, p. 229b.

body, then the mind (agreeing with the usual division in the literature on "anthropologia"). The part on the body covered various bodily functions as well as the operation of the senses, including the production of sensations, or "Spiritual Images," in the soul.[45] The chapter on "Mind" proper covered the essential nature of the mind, its union with the body, and its faculties, taking care to observe that its acts of intellection can be exercised independently of brain processes.[46] In academically orthodox fashion, Le Grand classed these discussions under the rubric of physics or natural philosophy. Pierre Regis produced a popular "system" or "entire course" of Descartes' philosophy, again covering logic, metaphysics, physics, and morals.[47] Five of seven volumes were devoted to physics, and of these, two and one-half to living things, of which more than one full volume was devoted to the senses, the other cognitive faculties, and the passions. He emphasized especially the brain processes--or as he put it, the "causes physiques"--associated with sense, imagination, judgment, reason, and memory. Of these topics, Regis devoted the greatest attention to vision, including extensive discussion of color perception, the formation of a "spiritual image," the basis of binocular single vision, size and distance perception, and the so-called moon illusion. He treated all of these "psychological" topics under physics; he reserved discussion of the existence and nature of mind (and body), and the mind-body union, for metaphysics (three-fourths of one volume).

Cartesian textbook philosophy fostered the development of psychology as the science of the mind in two ways. Implicitly, its dualist ontology abetted

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45. Ibid., book 1, part 8, chap. 19, article 1, p. 300a. This placement of the senses mimics the Aristotelian treatises by grouping sense perception together with other bodily functions.
46. Ibid., book 1, part 9, chap. 5, article 3, p. 329a.
47. Pierre Sylvain Regis (1632-1707), Systême de philosophie: contenant la logique, metaphysique, physique & morale, 7 vols. (Lyon, 1691).

the perception that the phenomena of mind form a single disciplinary unit. Descartes' starkly drawn dualism grouped the phenomena of sensation and intellection (and feeling, and willing) together as "thoughts" or "mental" states, joined by virtue of their common containment in "consciousness," and united ontologically as modifications of thinking substance. Although most of these phenomena were associated in Aristotelian philosophy under the rubric of "cognitive operations," they were not ontologically divorced from other bodily functions. Second, Cartesian textbook physics reinforced the inclusion of at least portions of the science of the mind within natural science by including the study of the corporeal and bodily conditions of sense perception, and especially vision, within the "physics" part of the curriculum. In the Aristotelian curriculum, optics was a "mixed mathematical" science (which meant that it applied mathematical principles to physical subject matter); although optical treatises themselves typically included extensive discussion of the "psychological" portions of the theory of vision (such as size, shape, and distance perception), very little discussion of such topics was included when the senses were examined in De anima commentaries and the corresponding portions of the physics textbook, which focused on the ontology of sensible species and of the act of sensing. By contrast, all three of the major Cartesian textbooks placed the psychology of vision--which would later be the mainstay of the new experimental psychology--squarely within physics or natural science. This second contribution stands in tension with the first, because it mixes the discussion of a purely mental subject matter (perceptual experience itself) with the discussion of brain processes. This fact can serve to remind us that despite substance dualism, Cartesian physics treated those mental processes that depend on the bodily processes in the chapters on body.

Near the end of the seventeenth century, Newton's new mechanics presented itself as a rival to Cartesian physics. It would be several decades before it clearly displaced the Cartesian physics, and several more (until near the century's end) before the older conception of physics as the science of nature in general, including psychology, was displaced by the narrower conception of experimental, mathematical physics familiar to us now.[48] Newton himself wrote as if his work in mechanics and optics were just two instances of a new approach that could be extended to other areas of the science of nature.[49] He promoted this extension to physiology in the Queries to the Opticks, where he speculated on the vibratory character of both sensory and motor nervous transmission. Also in the Queries, he expressed a commitment to a "sensitive substance" that he implicitly characterized as "incorporeal."[50] Newton thus opted for mind-matter dualism. The most prolific textbook writers among his followers, 'sGravesande and Musschenbroek, made this commitment explicit. Willem Jacob 'sGravesande equated the subject matter of physics with "natural things," by which he meant "all bodies"; within the division of sciences, he placed the human mind under metaphysics.[51] His Netherlandish friend and

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48. William R. Shea, "The Unfinished Revolution: Johann Bernoulli (1667-1748) and the Debate between the Cartesians and the Newtonians," in Revolutions in Science: Their Meaning and Relevance, ed. William R. Shea (Canton, Mass.: Science History Publications, 1988), 70-92; Thomas Hankins, Science and the Enlightenment (Cambridge: Cambridge University Press, 1985), chap. 3; Gary Hatfield, "Was the Scientific Revolution Really a Revolution in Science?" in Tradition, Transmission, and Transformation, ed. Jamil Ragep and Stephen Livesay (Amsterdam: E. J. Brill, in press).
49. Isaac Newton, Mathematical Principles of Natural Philosophy, 2 vols., trans. Florian Cajori (Berkeley and Los Angeles: University of California Press, 1966), 1:13, where he stated a wish to "derive the rest of the phenomena of nature by the same kind of reasoning from mechanical principles," and acknowledged that the needed principles remained unknown.
50. Isaac Newton, Opticks, or, A treatise of the Reflections, Refractions, Inflections & Colours of Light, after the 4th ed. (London, 1730), ed. Duane H. D. Roller (New York: Dover Publications, 1952), Queries 12, 14-16, 23-24, 28, pp. 345-7, 353-4, 370.
51. Willem Jacob van 'sGravesande (1688-1742; professor of mathematics at Leiden), Mathematical Elements of Natural Philosophy, Confirm'd by Experiments, or An Introduction to Sir Isaac Newton's Philosophy, 6th ed., 2

colleague Petrus van Musschenbroek developed a more elaborate partition of philosophy, which included the logic, metaphysics, physics (limited to space and body), and moral philosophy of the traditional curriculum, augmented by teleology and by pneumatics, or the science of spirits.[52] Unlike scholastic Aristotelian psychology, pneumatics comprehended all spirits, finite and infinite. It also comprehended the union of spirit with body, which Cartesian dualists had sometimes placed in physics, sometimes in metaphysics.

In displacing the reigning Aristotelian natural philosophy, the Cartesian and Newtonian systems affected psychology in two ways. First, they ushered in dualism as the reigning ontology of the mind-matter relation. Second, they disrupted the traditional classification of mental phenomena under physics, creating uncertainty about where the study of the mind fit into the system of sciences; some placed it within physics, while others distributed the discussion between physics and metaphysics, and still others subsumed the human mind under pneumatics. Substance dualism thus did not necessarily lead to the divorce of psychology from its previous position within natural science: it did among the close followers of Newton, but not among all Cartesians.

The physics curriculum proper was not the only locus for discussion of the mind or mental phenomena. Throughout the seventeenth century and into the eighteenth these phenomena were discussed in a great many disciplinary

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vols., trans. J. T. Desaguliers (London, 1747), 1:1-2. In his Introductio ad philosophiam; metaphysicam et logicam continens, 2d ed. (Leiden, 1737), he discussed the human mind in book 1, "Metaphysica," part 2, "De mente humana," covering intellect, freedom, the mind-body nexus, and the origin of ideas (pp. 38-105); in book 2, "Logica," he discussed how the mind should be directed in order to acquire a cognition of things (pp. 106-342, with an appendix on the syllogism, pp. 345-75).

52. Petrus van Musschenbroek (1692-1761; professor of philosophy and mathematics at Utrecht), Essai de physique, 2 vols., trans. Pierre Massuet (Leyden, 1739), chap. 1, section 2, 1:2; Elements of Natural Philosophy, trans. John Colson (London, 1744), chap. 1, section 2, pp. 2-3.

contexts. In the traditional philosophical curriculum, moral philosophy applied the physics of mind in moral psychology; logic (Aristotelian and non-Aristotelian) discussed the faculties or powers of the mind in relation to their proper use, including especially the cognitive faculties relevant to the logical acts of conception, judgment, and reasoning. In other contexts, the mind and mental phenomena were studied empirically as part of the domain of nature, but the relation to physics proper was indefinite or secondary. Optics, which was classically defined as the theory of vision, was throughout the eighteenth century considered by many to be a branch of applied mathematics.[53] Long after Newton published his own Opticks, which focused narrowly on the physics of light, optics continued to be pursued as a complete theory of vision, including perceptual phenomena and the mind's contribution to perception.[54] Further, medical physiology had long included discussion of the operation of the senses and other cognitive faculties. Others studied the mind in order to determine the grounds and limits of human knowledge. Locke's Essay is the most noted example of an empirically based ("plain, historical") approach to the human mind considered as a cognitive power. Although his project has often been characterized as an early attempt at natural scientific psychology, Locke himself clearly distinguished his inquiry into the "Original, Certainty, and Extent of humane Knowledge" from a "Physical

53. E.g., Johann Samuel Traugott Gehler (1751-95), Physikalisches Wörterbuch, new ed., 6 vols. (Leipzig, 1798-1801), "Optik," 3:385.
54. Even the Newtonians continued to include the theory of vision in the optical portions of their physics books: 'sGravesande, Mathematical Elements of Natural Philosophy, though patterning his treatment of optics after Newton's narrow view, so that he treated motion, inflection, refraction, and reflection (vol. 2, book 5), nonetheless provided a summary discussion of visual perception (2:175-81); Musschenbroek, Essai de physique, discussed the properties of light, refraction, and reflection (chaps. 27-31), followed by a discussion of the eye and vision, including optical anatomy and physiology and visual judgments (chaps. 32-3), to which he added the traditional optical topics of dioptrics and catoptrics, or vision by means of refracted and reflected light (chaps. 34-5).

Consideration of the Mind," as well as from the (metaphysical) consideration of the mind's essence and its interaction with body.[55] More generally, Descartes had called for an investigation of the knowing power in the Regulae (circulated in manuscript and published in 1701), without implying that this was a "physical" or "natural philosophical" investigation.[56]

Psychological Loci in the Eighteenth Century

The study of the mind, displaced from its subdisciplinary status in the Aristotelian curriculum, was refounded and pursued along many lines in the eighteenth century. A Christian apologetical approach was pursued in works by gentlemen and divines on the soul.[57] In discussions of Enlightenment psychology, the diametrically opposed materialism of the philosophes and their Scottish counterparts--including Diderot, d'Holbach, Helvetius, Priestley, and Bentham--has received recent attention, as part of the conventional story of the Enlightenment banishment of spirits and the alliance of materialism with progressive thought and politics.[58]

Between these two extremes lay the largest and richest body of literature, that of the manifold programs for adopting an empirical approach to mind and its relation to body. There was not one program for studying the mind empirically, and there was not a single disciplinary matrix for doing so.

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55. John Locke, An Essay Concerning Humane Understanding (London, 1690), I.i.2; further discussion in Hatfield, Natural and Normative, 28-31.
56. Descartes, Regulae ad directionem ingenii, in Opuscula posthuma (Amsterdam, 1701), rules 8, 12, pp. 23, 32-5. A translation of the Regulae into Netherlandish had appeared in 1684.
57. E.g., T. E., "a gentleman," Vindiciae mentis: An Essay of the Being and Nature of Mind (London, 1702), and John Broughton (ca. 1673-1720; chaplain to the Duke of Marlborough), Psychologia: or, An Account of the Nature of the Rational Soul (London, 1703), which sought to show the immateriality and immortality of the soul by means of natural reason.
58. Simon Schaffer, "States of Mind: Enlightenment and Natural Philosophy," in Languages of Psyche, ed. G. S. Rousseau (Berkeley, Los Angeles, Oxford: University of California Press, 1990), 233-90.

Rather, in diverse established, relocated, and newly created disciplinary matrices, the empirical study of mental phenomena was proposed, projected, recounted from books, attempted for real, and sometimes achieved. The disciplinary matrices included the traditional Aristotelian structure and the various replacements for it, including the study of the mind as an attempt to understand the basis of human knowledge; the newly founded and widely influential Wolffian matrix in Germany; various midcentury projects to bring new methods to the study of the soul, including that of the Swiss naturalist Charles Bonnet and those of the French physician Guillaume-Lambert Godart and the German physician Johann Gottlob Krüger; the "science of the mind" allied with Scottish moral philosophy; the avowedly nonmetaphysical "Ehrfahrungsseelenlehre"; and treatments of mind in the established contexts of medical physiology, optics, and anthropology. The contexts in which new empirical or conceptual results were achieved included medical physiology and optics, appeals to common experience organized by new theoretical structures, and demonstration measurements to illustrate the possibility of quantitative handling of mental phenomena. Appeals to Newtonian method were legion and varied, exemplifying the many possibilities for claiming "Newtonian" heritage in the eighteenth century, many of which did not require quantitative data or mathematical derivations, but simply an empirical (Newtonian) as opposed to a metaphysical (Cartesian) starting point.[59] Medical physiology provided an even more general model for natural science: that of natural history and clinical observation. This model was operative in Locke, David Hartley, and Thomas Reid, and in physiologists such as Albrecht von Haller and Johann

59. For an appreciation of the variety of senses in which a "Newtonian" approach to natural philosophy might be understood, see Chambers, Cyclopaedia, vol. 2, "Newtonian Philosophy"; also, I. B. Cohen, Newtonian Revolution (Cambridge: Cambridge University Press, 1980), part 1.

Blumenbach, who discussed the mental faculties extensively in their physiological lectures.

Charting a detailed road map through this diverse material would require discussion of nearly one hundred different works. What I aim for here is a survey of the most visible empirical approaches to the mind, an account of their main features, and a report and analysis of their self-ascribed disciplinary locations. This survey will provide a reasonably accurate overview of natural-scientific psychology remade during the eighteenth century. Omitted are some self-avowed empirical approaches to the mind that treat it as a knowing or truth-discerning power rather than as an object of natural science, even if such approaches contain psychological material. Especially noteworthy among those omitted are the purely naturalistic analyses of the abbé de Condillac and Johann Christian Lossius. Also omitted are nonnaturalistic considerations of the knower, such as that of Kant.[60]

Wolffian Psychology

Christian Wolff created the paired disciplines of empirical and rational psychology, which he ordered coordinately with ontology, rational cosmology, and natural theology under metaphysics.[61] His efforts have been the butt of many jokes in the history of psychology, most notably of Wilhelm Wundt's famous jest that Wolff's rational psychology "contains about as much experience as the empirical, and the empirical about as much metaphysics as the rational."[62] In the standard historiography, Wolff is part of the metaphysical past of psychology's prehistory. In fact, Wolff's work was of

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60. On Lossius and Kant, see Hatfield, Natural and Normative, chap. 3.
61. Wolff, Philosophia rationalis, #79; see also Alexander Gottlieb Baumgarten (1714-1762; professor of philosophy at Halle), Metaphysica, 7th ed. (Halle, 1779).
62. Wilhelm Wundt, Grundzüge der physiologischen Psychologie, 3d ed. (Leipzig, 1887), 7.

paramount importance for the development of empirical psychology during the eighteenth century and beyond.

Wolff's imposing row of textbooks (in German and Latin) contain an interesting conception of philosophical method and a novel division of the sciences. Wolff separated all knowledge into three types: historical, or knowledge of bare facts; philosophical, or knowledge of reasons; and mathematical, or knowledge of the quantities of things. According to Wolff, philosophy is related to the other two sorts of knowledge in the following way: it is grounded in facts, and its method of reasoning is like that of mathematics.[63] Wolff's works are organized according to a highly articulated division of the sciences (or the branches of demonstrative knowledge). Most generally, he retained the Aristotelian division between "philosophical" disciplines, which in his case included "physics," and "mathematical" disciplines, in which he included "mechanics" (taken as the theory of machines).[64] Central components of the philosophical disciplines included "logic" (or "the science of directing the faculty of cognition in cognizing truth"), metaphysics, physics, and practical philosophy. Physics was the science of corporeal nature in general and included general physics, empirical cosmology, orycthology (science of fossils), hydrology, phytology, physiology and pathology, and teleology. Metaphysics was much expanded over its Aristotelian and Cartesian counterparts, to include ontology, general

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63. Wolff, Logica, preliminary discourse, chaps. 1-2.
64. Christian Wolff's most general division of philosophy and its distinction from mathematical disciplines is given in his Cognitiones rationales de viribus intellectus humani, new ed. (Frankfurt and Leipzig, 1740; first translated from German in 1730), prolegomena, ##10-15; mechanics and statics, considered as the sciences of motion and equilibrium, were considered together, Elementa matheseos universae, new ed., 5 vols. (Halle, 1733-42), vol. 2, "Elementa mechanicae et staticae." As Wolff understood the mathematical division of knowledge, it also contained portions depending on facts: the "mixed" mathematical sciences of optics, astronomy, chronologie, geography, etc.

cosmology, psychology, and natural theology (the latter two comprising pneumatology).[65] General cosmology extended to the nature of body and of the elements, the laws of motion, and the distinction between natural and supernatural.[66] Ontology, general cosmology, and psychology, although classed as divisions of metaphysics, were nonetheless advertised as empirically based. Metaphysics did not imply for Wolff, as it had for Descartes and would for Kant, a body of knowledge known through reason alone, independent of experience. Rather, it was defined by its subject matter, as "the science of being, of the world in general, and of spirits."[67] Metaphysics, as all philosophical knowledge, is based in "historical cognition," that is, in the cognition of facts.[68] Wundt's jest about the intermixture of empirical and metaphysical content, as clever as it may seem, betrays a total lack of comprehension of Wolff's position, simply repeating an earlier and mistaken interpretation that most likely resulted from reading Kantian terminology (regarding metaphysics and the pure a priori) back onto Wolff.

Thus, although Wolff placed psychology within metaphysics rather than physics, he nonetheless held it to be an empirical science. Indeed, contrary to later interpretations of his work, Wolff maintained that empirical was more basic than rational psychology, because it provided the first principles from which the latter constructed its demonstrative arguments. Within empirical psychology, the chief problem was to chart the faculties of the soul.

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65. Wolff, Logica, preliminary discourse, chap. 3.
66. Christian Wolff, Cosmologia generalis, new ed. (Frankfurt, 1737).
67. Wolff, Logica, preliminary discourse, #78. In Wolff's view metaphysics uses some principles, including the principles of sufficient reason and contradiction, that are grounded in the powers of mind and not derived from observations of external objects, but the attribution of these principles as basic logical and metaphysical principles is, according to Wolff, empirically based on the mind's reflective awareness of its own operations in making judgments: Ontologica, ##27-9.
68. Wolff, Logica, preliminary discourse, #10.

Rational psychology then sought to find principles in empirical psychology such as could guide demonstrative explanations of the phenomena. Thus, where empirical psychology established that the soul or mind perceives or represents external objects, it fell to rational psychology to give an account of the representational relation, which Wolff explained in terms of similitude (drawing liberally on other portions of empirical psychology and on ontology).[69] And where empirical psychology established that sensations arise through alterations in the sense organs and that light causes alterations in the organ of sight, rational psychology explained the basis of spatial representation in general, gave an account of the means by which external objets affect the sense organs, and sought to explain vision by appealing to the relation between such effects and the consequenses for sight (drawing on optics).[70] Psychological topics pertaining to individual mental faculties and their empirical characteristics were considered under other divisions of Wolffian philosophy: Wolff's physics provided a summary discussion of the senses, as did his experimental physics for selected problems. His optics examined the theory of vision, including optical anatomy; color; the perception of size, shape, position, and motion; and single vision with two eyes. His physiology, understood as the study of the uses of the parts of living things, discussed the construction of the senses, nerves, and brain and their service as instruments of sensation.[71]

Wolff's psychology is paradigmatic of the allegedly regressive tendencies

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69. Wolff, Psychologia empirica, ##23-4; Psychologia rationalis, ##83-91.
70. Wolff, Psychologia empirica, ##65-9; Psychologia rationalis, ##103-45.
71. Wolff, Vernünfftige Gedancken von den Würckungen der Natur (Halle, 1723), chap. 14; idem, Allerhand Nützliche Versuche, dadurch zu genauer Erkäntniss der Natur und Kunst der Weg gebähnet wird, 3 vols. (Halle, 1727-29), part 3, chap. 8 (vol. 3); idem, Elementa matheseos, "Elementa opticae" (3:1-100); idem, Vernünfftige Gedancken von dem Gebrauche der Theile in Menschen, Theiren und Pflantzen (Frankfurt and Leipzig, 1725), chap. 5.

of prescientific, speculative or metaphysical psychology: it is organized around the study of mental faculties, and it adopts a realistic attitude toward the soul considered as an immaterial substance. Histories of psychology typically take a dismissive attitude toward faculty psychology, an attitude that usually stands without argumentative backing, except as conveyed through allusions to Molière's joke about the dormitive virtue of opium. Such histories are also openly dismissive of the posit of immaterial substances, sometimes "explaining" such posits by mentioning the assumed religious convictions of past thinkers.[72] In each case, historians have failed to take a properly empirical and contextualist approach to past thinkers.

In the context of the eighteenth century, Wolffian psychology was a progressive research program. It promulgated an empirical approach to the mind, a kind of empiricist realism. It was "realistic" in that it took seriously its theoretical posits; it was empiricist in that it claimed to base its posits on repeatable observation or "stable experience." In organization, the general framework of Wolffian empirical psychology was similar to that of Cartesian psychology: it divided the faculties of the soul into cognitive and appetitive and distinguished "higher" and "lower" species of each. In content, however, it was closer to Aristotelian theory, because it treated volition as a species of cognition rather than as a separate mental power. Its basic conformity to the Aristotelian and Cartesian denumeration of faculties, including sense, imagination, memory, and intellect, does not conflict with the empirical nature of Wolff's psychology; the attribution of these faculties to humans is surely based on experience. But this much empirical content was shared by many discussions of the soul or mind from

72. Boring, History of Experimental Psychology, 162; Robinson, Intellectual History of Psychology, 259, 265, 301.

Aristotle onward. What, then, was new with Wolff?

Wolff's psychology had novel features in both content and methodology. Its major methodological innovation was the explicit enjoinder to adopt a metaphysically modest empiricist attitude toward mental faculties and phenomena: they were to be studied by attending to their operations while holding metaphysical speculation in abeyance. When rational psychology seeks to explain the facts thus attained, it draws upon empiricaly established generalizations rather than allegedly pure a priori metaphysical insights into the essences of things in order to determine appropriate explanatory (we would say "theoretical") principles.[73] Within this scheme, the empirically based attribution of mental faculties to human cognizers is not intended to be explanatory (as was the dormitive virtue of Molière's joke), but to be descriptive of a unified capacity of the mind. Such descriptions, being classificatory, are not atheoretical; but because they were not intended to be explanatory, they are not subject to Molière's joke (any more than are current psychological investigations of cognitive and perceptual capacities).[74] Within his empiricist program, Wolff claimed that psychological states, and particularly those pertaining to pleasure and pain, are subject to quantitative measurement and mathematical laws, although he did not himself formulate a calculus of pleasure. He also suggested that the goodness of

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73. Wolff, Psychologia empirica, ##1-4; Psychologia rationalis, ##1-3. For English translation and discussion, see Robert J. Richards, "Christian Wolff's Prolegomena to Empirical and Rational Psychology: Translation and Commentary," Proceedings of the American Philosophical Society, 124 (1980): 227-39.

74. Jerry Fodor jocularly defends faculty psychology in his Modularity of Mind (Cambridge, Mass.: MIT Press, 1983). More seriously, the organization of psychology textbooks has long born the stamp of the traditional division of faculties, as psychologists have studied the functionally characterized faculties of cognition, including perception, learning, and memory, and more specific capacities, such as visual perception, and within vision, color, shape, and motion perception.

one's memory can be estimated by the temporal latency of response to a memory demand, from the number of tries it takes to retrieve from memory, and from the number of acts it takes to fix an item in memory. He suggested a corresponding quantitative estimate for the size of memory.[75]

In content, the Wolffian psychology was noteworthy for its analysis and discussion of the faculties of imagination, attention, and reflection. Wolff distinguished imagination proper, which simply reproduces sensory materials, from the faculty of "feigning" or producing new representations (faculte figendi). He described the "law of imagination," a law of association through simultaneity. And he discussed attention and its subspecies, "reflection" (or attention to the content of one's perceptions), including impediments to their exercise.[76]

The Wolffian system was widely influential on the Continent, where it displaced the fading Aristotelian and Cartesian school philosophies. Its influence was strongest in Germany, where Wolff's works or the numerous textbooks that arose in their wake were used even by authors who no longer subscribed to their precepts, including Immanuel Kant.[77] The system was rendered into French by the Berlin Wolffian, Jean Deschamps.[78] Wolff's psychology was discussed with appreciation in the article on the soul (Ame) in

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75. Wolff, Psychologia empirica, ##190-194.
76. Wolff, Psychologia empirica, part 1, section 2, chaps. 3-4; section 3, chap. 1; Psychologia rationalis, part 1, section 1, chaps. 3-4.
77. The following textbooks follow Wolff in the disciplinary placement and the basic content of his empirical and rational psychology: Georg Bernhard Bilfinger, Delucidationes philosophicae de Deo, anima humana, mundo, et generalibus rerum affectionibus (Tubingen, 1725); Ludwig Philipp Thümmig, Institutiones philosophiae Wolfianae, 2 vols. (Frankfurt and Leipzig, 1725-26); Johann Peter Reusch, Systema metaphysicum (Jena, 1735); Friedrich Christian Baumeister, Institutiones metaphysicae: Ontologiam, cosmologiam, psychologiam, theologiam denique naturalem complexae (Wittenberg and Zerbst, 1738); Baumgarten, Metaphysica. Kant used Wolff's mathematics texts, and Baumgarten's Metaphysics (including psychology).
78. Jean Deschamps, Cours abrégé de la philosophie wolfienne, 2 vols. (Leipzig and Amsterdam, 1743-47).

the Encyclopédie, and his classification of psychology under metaphysics and his division of the discipline into empirical and rational were featured prominently in the article on "Psychologie."[79]

New Empirical Approaches to Mind: Krüger, Godart, Bonnet

Near midcentury there was a burst of new psychological activity in Scotland, France, Switzerland, and Germany, with various authors essaying to apply the methods of natural history, natural philosophy, or medicine to the study of the mind. I will take up the Scottish work, including that of Hartley, in the section following. In the present section we will consider the new psychologies of the physicians Krüger and Godart and the naturalist Bonnet.

Johann Gottlob Krüger, in his Versuch einer Experimental-Seelenlehre of 1756,[80] set himself the task of showing "how the soul can be known through experiment," that is, of creating an experimental science of mind coordinate with the experimental science of body. This was, he recognized, a formidable task. At the same time, he believed that his experience as a physician would be of help, for it gave him access to "natural experiments" that arise in brain-damaged patients. More generally, he wanted to show philosophers that medicine could make a contribution to philosophical knowledge of the soul, and also that mathematics could be applied to this subject matter. Indeed, in his earlier Naturlehre (1740-49), he had already proposed a mathematical (proportional) formulation of the relations among the force with which external objects affect the nerves, the resultant nerve activity, and the

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79. Encyclopédie, ou Dictionnaire raisonné des sciences, des arts et des metiers, eds. Denis Diderot and Jean Le Rond d'Alembert, 17 vols. (Paris, 1751-65), 1:338, 13:543.

80. Johann Gottlob Krüger (1715-59), Versuch einer Experimental-Seelenlehre (Halle and Helmstädt, 1756). Krüger studied philosophy and medicine at Halle, receiving degrees in 1737 and 1742, becoming doctor and professor of philosophy and medicine in 1743; in 1751 he became professor of philosophy and medicine at Helmstädt.

liveliness of the resulting sensation.[81] In essence, he attempted to bring the methods and results of physics (in the broad sense), the knowledge of the brain provided by physiology, and the case-history knowledge of the clinic together in order to form an experimental psychology, one that eschewed (as too difficult) metaphysical questions about the substance of the soul or its immortality.[82] At the same time, he openly acknowledged his admiration for Wolff's work in philosophy (including psychology), dedicating to Wolff his medical dissertation, which treated the "physical" topic De sensatione (1742), and praising Wolff in his later "physical" works on sensation and his experimental work on the soul.[83]

Krüger expected his experimental psychology to be met with skepticism: "Experiment, one will say, can be done only with bodies. Is it being suggested that spirits [Geister] be brought under the airpump, that their shapes be viewed under the microscope, that their forces can be weighed?" This particular sort of skepticism, he countered, rests on the mistaken conception that "no other instruments can be used in experiments with the soul, except those that we find in the instrument cabinet of the physical scientist [Naturforschers]." But in Krüger's view, "if the soul is considered to be so very different from the things that one studies in physical science, then completely different experiments will have to be undertaken."[84] In any case, the skeptic might rejoin, experiment depends on observation. Is the soul observable? Certainly not by the senses, in the manner of external

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81. Krüger, Naturlehre, 3 vols. (Halle, 1740-49), part 2, ##316-17, 2:568-75.
82. Krüger, Experimental-Seelenlehre, iii-v.
83. Krüger, Dissertationem sollemnem de sensatione pro honoribus doctoris (Halle, 1742), 3-6, 8-9 (the dissertation was completed in 1742, two years after Wolff's return to Halle from Marburg); idem, Naturlehre, part 2, #9, 2:14-16; idem, Experimental-Seelenlehre, ix-x, in which he said he followed the Wolffian Baumeister in metaphysics (vi).
84. Krüger, Experimental-Seelenlehre, 1-2.

objects: we do not see, hear, taste the soul. Yet, Krüger maintained, we can become aware of the states of our soul through "inner sense." We can also know the soul through its connection with the body, as when we come to know someone's mental states through their reflection in her countenance.[85]

Krüger distinguished experiment from observation, and he did not intend to rely merely on observations of the soul's natural expression in inner experience and outer comportment; he was proposing a genuinely experimental study of the soul. Experiment, as he understood the term, differed from mere observation in the following way: observation requires only the possession of working sense organs and a willingness to pay attention, while true experiment requires that we "put things into circumstances in which they would not otherwise come to be, and thereby ask Nature to show us, what she had resolved to conceal from our eyes." Again, the link between soul and body makes it reasonable to seek such experiments: from changes in the soul, changes in the body are known (in perception), and from changes in the body, changes in the soul are known. There is also the close relation between mind and brain. Krüger allowed that the investigator could not cut open human heads and selectively invade the brain to see what happens, but he remarked that such experiments could be undertaken with animals, and also that physicians have a chance to observe the effects of natural "experiments" in patients who have suffered brain damage.[86]

An "experimental" science did not imply for Krüger, or for other eighteenth-century thinkers, an atheoretical collecting of facts, or the piece-wise construction of theory from facts. In good empiricist fashion,

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85. Ibid., 5-8.
86. Ibid., 15-21. Earlier Krüger spoke somewhat wistfully of the days when "experiments," such as cutting out pieces of the brain to see what happens, were performed on human "delinquents," Naturlehre, part 2, #427, 2:726.

Krüger held that all knowledge and all concepts derive from sensory experience. They arise, though, through the operation of reason.[87] Krüger did not develop a theory of scientific method to account for the interaction of sensory experience and reason in the development of scientific theory. From his practice, it is clear that he drew heavily on currently accepted theory in interpreting experimental results. In psychology, he drew on a physical understanding of external objects and their effects on the senses, on physiological knowledge of the nerves and brain as interpreted in accordance with a "mechanical" approach to nature, and on the theoretical framework available in previous works on psychology, including that of Wolff.

Krüger's debt to Wolff and his ability to press beyond his senior colleague are both evident in one of Krüger's applications of mathematical reasoning to psychology. Krüger adopted a vibratory conception of nerve activity, supporting his position with experimental results obtained by Giorgio Baglivi in vivisections of dogs.[88] Given that sensations depend on the activity of nerve fibers, he postulated that the strength or liveliness of the sensation will vary with the force produced by the vibrating nerve fiber. This force in turn will vary with the force of the external object. One might then suppose that the liveliness of the sensation will vary directly with the force of the external object, and this in fact is what Wolff had proposed, based on his own assumption about the vibratory nature of nerve activity.[89] Krüger, however, went beyond Wolff in the depth of his theoretical analysis (articulated most fully in his Naturlehre). Appealing to the physics of vibrations, he contended that the action of external bodies on individual

87. Krüger, Experimental-Seelenlehre, 2-3.
88. Krüger, De sensatione, 15-18; idem, Naturlehre, part 2, ##308-9, 2:551-8.
89. Wolff, Psychologia rationalis, ##136-41, pp. 109-12.

nerve fibers will depend on the "tension" (tensione, Spannung) of those fibers. The liveliness of the sensation will therefore depend on both the force of the external object and the tension of the nerve. He formulated the relation as a mathematical proportion: allowing S and s to represent the liveliness of two sensations, V and v the action of the external object, and T and t the tension of each nerve fiber, then, in Krüger's formulation, S:s=VT:vt. Thus, if V is three times v and T is twice t, S will be six times livelier than s. Individual differences in T-values might be found in the sensory apparatus of a single perceiver or in comparisons between or among perceivers. While he had clear conceptions of how V might be determined (based on the physics of light and sound), he gave no indication of how S was to be measured or how sensations were to be compared to establish one as "six times" livelier than another, other than through the determination of V and assumptions about T.[90]

As Krüger acknowledged in the preface of his Experimental-Seelenlehre, it did not contain much that was new.[91] Most of the experimental results he reported were extant in the literature: his real contribution was to introduce medical observations and mathematical formulations to psychology. He did not, however, accept the mathematical formulations of others uncritically: he used experience to evaluate extant theoretical claims. In his treatment of vision in the Naturlehre, Krüger initially followed a tradition in the optical literature--rendered with mathematical rigor by Wolff--according to which the apparent sizes, horizontal distances, and motions of objects vary directly with visual angle or angular velocity.[92] Although this definition of

90. Krüger, Naturlehre, part 2, ##314-22, 2:567-60; discussed qualitatively, idem, Experimental-Seelenlehre, 101-4.
91. Krüger, Experimental-Seelenlehre, iii-v.
92. Krüger, Naturlehre, part 2, ##369-79, 2:667-75. Wolff, Elementa matheseos, "Elementa opticae," chaps. 5, 6, 8.

"apparent" magnitudes was found in many technical works in optics, those writers with a keen sense of visual experience--including Descartes, George Berkeley, and Krüger's French contemporary, Claude Nicolas Le Cat--observed that objects often do not seem to have the sizes, horizontal distances, and velocities assigned by this theoretical formulation, and so they introduced additional psychological considerations, including unnoticed judgments or associative connections, to explain the character of perceptual phenomena.[93] Krüger knew at least the portion of this literature that discussed the horizon moon (the so-called "moon illusion"), and he added, almost as an afterthought to his mathematical treament of "apparent" size, the observation that sometimes apparent size does not follow visual angle but is influenced by apparent distance, such that of two objects falling under the same angle, that judged to be further away is judged to be and appears larger than the other.[94]

Krüger often made good use of the extant natural philosophical, physiological, and clinical literature in discussing the relation between nerve activity and sensations or the role of experience in the development of perceptual abilities. He presented the experiment of the natural philosopher Edmé Mariotte, who used two white dots on a black wall to demonstrate the existence of a "blind spot" at the point where the optic nerve enters the eye. Mariotte had interpreted his results as showing that the choroid, rather than the retina, is the seat of optical sensation, on the grounds that the retina, but not the choroid, is present in the blind spot. Krüger appealed to his own

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93. Descartes, Dioptrique, part 6; George Berkeley, An Essay towards a New Theory of Vision (Dublin, 1709), sections 53-60; Claude Nicolas Le Cat (1700-68; M.D.), Traité des sensations et des passions, 2 vols. (Paris, 1767), 2:441-84. On early modern theories of size and distance perception, see Gary Hatfield and William Epstein, "The Sensory Core and the Medieval Foundations of Early Modern Perceptual Theory," Isis, 70 (1979): 363-84.
94. Krüger, Naturlehre, part 2, #380, 2:675-7; also, idem, Experimental-Seelenlehre, 95-101.

previous arguments that the outer membrane and not the medulla (or marrow) of the nerve is the sensitive portion, in order to argue that the retina is not truly present in the blind spot, which, he argued, contains nerve marrow but not nerve membranes.[95] However, although Krüger adopted a vibratory conception of the effect of objects on the nerves, he did not believe that such vibrations would be carried by delicate nerve membranes along the circuitous path to the brain. Moreover, he held that the nerve fluid or animal spirits are necessary for sensations. He thus concluded that sensations arise at the locus of the vibrations, when the latter set the animal spirits in motion.[96] In support of this conclusion, he cited the observations of John Woodward on decorticized, decapitated, decardate, or otherwise vivisectioned pigeons, chickens, eels, snakes, frogs, flies, wasps, and spiders. He used Woodward to support his conclusion that "sensibility" is found in the parts of animals themselves, even if separated from the brain, and that this sensibility is lost when the nerves dry out (and hence could not depend on vibrations of membranes alone, but requires the presence of nerve fluid). At the same time, he held that in ordinary circumstances perception depends on the conveyance of motion to the brain via the animal sprits in the medulla of each nerve, while also contending that that the speed of transmission, which he thought likely to be equal to the speed of sound, was too rapid for investigators to be able to detect any noticeable difference between reports of sensations originating in the foot and in the head.[97] Krüger also reported the famous Cheselden case, to support the point that if

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95. Krüger, De sensatione, 20-2; Naturlehre, part 2, #312, 2:559-63.
96. Krüger, De sensatione, 23-4 (where he quotes from Newton's Query), 29-31; Naturlehre, part 2, #331, 2:607-8.
97. Krüger, Naturlehre, 2d ed., 3 vols. (Halle, 1744-1755), part 2, ##330-32, 2:625-42 (on p. 641 he favorably cites Hermann Boerhaave on the elasticity of the animal spirits). Krüger added several clinical reports to the second edition.

newborns saw things inverted because of the inverted retinal image, they could soon learn through experience to see things upright.[98] Finally, in discussing the imagination, he reported as a generally accepted "law of imagination" the regularity with which, in imagining one thing, we come to imagine things that we previously experienced simultaneously with that thing, or things that are similar to that thing. As an example, he offered the case of a microscopist who formed an aversion to cheese through the action of this law: having studied cheese mites under the microscope, he could not help but imagine those mites when eating cheese, an image that spoiled his appetite.[99]

Not long after Krüger had completed his dissertation on the senses at Halle, Guillaume-Lambert Godart submitted a medical dissertation at Reims entitled Specimen animasticae medicae (1745), which he later developed under the title La physique de l'ame (1755).[100] The framework of Godart's thought was largely Aristotelian: he attributed to humans a "rational soul" that is a "vivifying principle" that accounts both for the life functions of the body and for its power of thought;[101] after considering the nature and seat of the soul (in part 1), he successively treated (in part 2) the "vital functions" (section 1), including nutrition and generation, and the "animal" and "intellectual" functions (section 2), including sensation, perception, imagination, judgment, the passions, memory, sleep, dreams, and the "metapmorphosis" of man through his terrestrial, spiritual, and eternal stages of life. But he approached this subject matter with the empirical attitude and metaphysical chagrin characteristic of many eighteenth-century natural philosophers and natural historians: he abandoned any attempt to know the

98. Ibid., part 2, ##386, 2:718-24.
99. Krüger, Naturlehre, 1st ed., part 2, #430, 2:729-30.
100. Guillaume-Lambert Godart (ca. 1717-1794; M.D.), Specimen animasticae medicae (Reims, 1745); idem, La physique de l'ame (Berlin, 1755).
101. Godart, Physique de l'ame, 21.

nature of the soul, admitting that we have no more conception of its nature than we have of that of matter.[102] Further, he devoted special attention to his use of the word "physical" in the title of his book: "although the word physics comes from physis which signifies nature and nothing more, a book that treats of the nature of the soul may receive the name of physics." Indeed, he allowed, etymologically the word suggests the treatment of corruptible things, but natural philosophers treat of incorruptible atoms, so he may be allowed to consider the incorruptible soul under the same title. In any event:

> that which seems to me principally to authorize that name, is the manner in which I consider my object: my treatise is neither pneumatological nor moral, but physical. It concerns, it is true, a spirit, but this spirit is not considered according to its substance, but in the physical relation it has with the body, and when it comes to its actions, that which concerns merit and demerit is left to the moralists.[103]

His chief "physical" contribution was his dicussion of the seat of the soul, which, relying on observations made by François de la Peyronie, he located in the corpus collosum.[104]

The Swiss naturalist Charles Bonnet was more prolific and more influential than either Krüger or Godart. Although his early years were devoted to the natural history of insects, during which time he had little patience with metaphysics, around 1750 he came to see the interest in turning the techniques of natural history to the principal object of study for human beings, human beings themselves; his first psychological work, the Essai de psychologie, appeared anonymously in 1754, followed by the Essai analytique

102. Ibid., v-vi, 8.
103. Ibid., iii-iv, v-vi.
104. Ibid., pt. 1, chs. 3-4.

sur les facultés de l'ame in 1760.[105] As he said in the latter work, "I consecrated my first years of reason to the study of natural history; I am consecrating those of its maturity to more important study, that of our being. I have tried to study Man as I have studied insects and plants. The spirit of observation is not limited to a single genre." Although he often referred to psychology as a "metaphysical" discipline by contrast with physics, he also averred that he had put in his book "much physics and little of metaphysics," a decision he defended by suggesting that very little can be known of the soul "considered in itself." Like Godart, he intended to apply the method of physics (in the wide sense) to the study of the soul. He found two points of methodological analogy. First, he assigned two parts to psychology, one "historical" and one "systematic": "the first contains the exposition of facts; the second, their explanation" (similar to Wolff's "empirical" and "rational" psychology). Second, the only method he found viable for the purposes of investigating a new subject matter (rather than providing instruction in a well-known one) was the "method of analysis." This method consisted in "anatomizing each fact, decomposing it down to its smallest parts, and examining separately all of these parts"; then "seeking the connections that tie these things to one another and to analogous things, and to find results that can turn into principles."[106] Starting from facts of consciousness and behavior, Bonnet sought to establish the general principles

105. Charles Bonnet (1720-93; gentleman naturalist, psychologist, and religious thinker), Essai de psychologie; ou, Considerations sur les operations de l'ame, sur l'habitude et sur l'education (London, 1755 [1754]; translated into German, Lemgo, 1773); idem, Essai analytique sur les facultés de l'ame, 2 vols. (Copenhagen, 1760; 2d ed., Copenhagen and Geneva, 1769; translated into German, Bremen, 1770; Dutch, Utrecht and Rotterdam, 1771). New psychological material, along with a summary of the old, appeared in his masterpiece, La palingénésie philosophique ou idées sur l'état passé & l'état futur des etres vivans, 2 vols. (Geneva, 1769; translated into German, Zurich, 1769-70).
106. Bonnet, Essai analytique, 2d ed., vii, xxiv, ix-x.

that govern the flow of ideas and the formation of motor habits, as governed by principles of association that direct the formation of habits in accordance with the laws of pleasure and pain.[107]

Bonnet's psychology shared many features characteristic of the new psychological naturalism: he accepted dualism and the immateriality of the soul, without claiming to achieve an analysis of the substance of the soul; his arguments for the soul's immateriality sprang from the unity of consiousness as contrasted with the conglomerate nature of material mechanisms; like Krüger, he approached the activity of the mind through its connection with vibrations of nerve fibers and motions set up in nerve fluid; and he assigned the origin of all our ideas to sense.[108] Some aspects of his thought are more particular: he developed the "mechanics" (brain fiber physiology) of each sense with special thoroughness; he developed the theory of association extensively, using it as a key to understanding the course of thought, and dwelling on the "mechanics" of association with an intensity similar to that of Hartley's slightly earlier treatment; he analyzed the role of attention in strengthening certain ideas by "reacting" on nerve fibers in the brain; he held that the formation of intellectual ideas depend on language, and that exposure of language results in the formation of "intellectual fibers" that are the bodily counterpart to abstract notions; and he explored the implications of his psychology with respect to the power of education in the cognitive development of each person.[109] Because of his heavy emphasis on the role of brain fibers in all thought processes, Bonnet's

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107. Ibid., chaps. 7, 9-11; Essai de psychologie, chap. 64.
108. Bonnet, Essai de psychologie, introduction, especially pp. 1-3; chaps. 1-6, 35.
109. Ibid., chaps. 21-26; 27-31, 61-4; 7; 8-20; 66-70. Many of the topics in the Essai de psychologie recur in the Essai analytique (which often quoted the former work); some, such as freedom, received more extended analysis, while some, such as the discussion of education, were omitted.

work raised a suspicion of materialism; he was by no means a materialist, having devoted considerable effort to showing that the mind must be immaterial. At the same time, he placed questions about the the substantial nature of the mind and its ideas, and about the mode of interaction between mind and body, beyond the pale of human reason.[110]

The newly sounded call for a "physical" science of the mind, or for the application of the methods of natural history and natural philosophy to the subject mattter of mind, was not lost on generations subsequent to Krüger, Godart, and Bonnet. Especially in Germany, their work was incorporated as part of the founding literature of the Ehrfahrungsseelenlehre and empirical anthropology that developed in the second half of the century and continued through the following century, conditioning and being continued by philosophical and natural-scientific psychology and the self-proclaimed "new" experimental psychology of Wundt and others.[111] We will return to these developments in Germany after examining the Scottish scene, which itself strongly influenced nineteenth-century developments in psychology in both Britain and Germany.

Scottish Sciences of Man and Mind

In the Scottish Universities of the first half of the eighteenth century the mind was studied in three areas of the revised Aristotelian curriculum: logic, metaphysics, and moral philosophy (which discussed appetite). By mid

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110. Bonnet, Essai de psychologie, chaps. 34-7. On Bonnet, see Lorin Anderson, Charles Bonnet and the Order of the Known (Dordrecht, Boston, and London: D. Reidel, 1982), and Raymond Savioz, Philosophie de Charles Bonnet de Genève (Paris: J. Vrin, 1948).

111. The works of Krüger, Godart, and Bonnet were regularly mentioned in overviews of the psychological literature: Karl C. E. Schmid, (1745-1799; professor of philosophy at Jena), Empirische Psychologie, 2d ed. (Jena, 1796), 143, 149; Carus, Geschichte der Psychologie, 598, 642 (Krüger and Bonnet only); Carl Hermann Scheidler (1795-1866; professor of philosophy at Jena), Handbuch der Psychology, 2d ed., 2 vols. (Darmstadt, 1833), 1:295.

century, a peculiarly Scottish phenomenon had occurred: within the university arts curriculum, the study of the mind in general became the special preserve of moral philosophy (as might be expected of the "moral sense" school). Thomas Reid, professor of moral philosophy at Glasgow, transformed moral philosophy into the examination of the "powers" of the mind. At Edinburgh, the connection between mind and morals had been forged even earlier: from 1708, the University had reserved a chair for the professor of moral philosophy and pneumatics; while the motivation may have been the relation between morals and the study of spiritual beings, when Adam Ferguson filled this chair in 1764 he answered to his title by making the "theory of mind" a proper part of his basic textbook, the Institutes of Moral Philosophy.[112]

The fact that the study of the mind fell largely under moral philosophy in the Scottish arts curriculum does not imply that the mind was considered to be distinct from nature or from natural scientific methods of study and modes of explanation. Indeed, it was characteristic of Scottish philosophers to adopt a naturalistic attitude toward the mind and its powers. Hutcheson compared the moral sense, and the internal senses more generally, to other natural human capacities, and sought to investigate them by appeal to experience.[113] Hume signaled his naturalistic intentions in the subtitle to his Treatise of Human Nature: Being an Attempt to Introduce the Experimental Method of Reasoning into Moral Subjects; in the introduction to the work, he explicitly compared his methods and modes of explanation to those of Newton. By the "experimental method" he meant no more and no less than an appeal to

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112. Thomas Reid (1710-96), On the Active Powers of Man (Edinburgh, 1788). Adam Ferguson (1723-1816), Institutes of Moral Philosophy, 2d ed. (Edinburgh, 1773), part 2; the original version was entitled Analysis of Pneumatics and Moral Philosophy.

113. Francis Hutcheson, De naturali hominum socialitate, oratio inauguralis (Glasgow, 1730); Philosophiae moralis (Galsgow, 1745), book 1, chap. 1.

experience in support of his claims; by "moral subjects" he included not only the study of the passions and of morals proper (virtue and vice) but also, and fundamentally, the "science of human nature."[114] Hume portrayed his analysis of perceptions into impressions and ideas, simple and complex, and his appeal to the laws of association in explaining their interactions, as having revealed the basic elements and laws of the human mind.

Hume was not unique in claiming to be the Newton of the mind; he shared invocation of Newton with David Hartley, Reid, and Ferguson.[115] Hartley, like Hume, was not a university professor; like Krüger and Godart, he was a physician. He shared with the other Scottish naturalists the division of phenomena pertaining to human beings into two realms: bodily and mental. His major work, Observations on Man, was an attempt to ground the operation of the mind in association, and to explain association as the result of sympathetic vibrations among nerve fibers the brain.[116] Reid, who was a physician as well as professor of moral philosophy, divided all of the objects of human knowledge into two realms, material and intellectual, and grouped the sciences that study the first under the heading of natural philosophy, while reporting that the branch of philosophy "which treats of the nature and operations of mind has by some been called Pneumatology."[117] He allowed that the study of mind was less advanced than that of natural philosophy (aided as the latter had been by Galileo, Evangelista Torricelli, Johannes Kepler, Bacon, and Newton) and commended the hope that "human genius" would, in time, "produce a

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114. Hume, Treatise of Human Nature (see note 21 above).
115. Gladys Bryson, Man and Society: The Scottish Inquiry of the Eighteenth Century (Princeton, N.J.: Princeton University Press, 1945), 18-21, 138-139, 145.
116. Hartley, Observations on Man, 1:5, credited Locke and Newton for drawing attention to the importance of association and the theory of vibrations, respectively.
117. Thomas Reid, Essays on the Powers of the Human Mind (London, 1827), vi.

system of the powers and operations of the human mind, no less certain than those of optics or astronomy."[118] Reid portrayed the "philosophy of the human mind" as awaiting its Newton, but hinted that the time might well be nigh.[119] Adam Ferguson, in his telegraphic Institutes of Moral Philosophy, formulated natural laws of both matter and mind, distinguishing the latter from properly moral laws. He defined moral philosophy as "the knowledge of what ought to be" and declared that "pneumatics, or the physical history of mind, is the foundation of moral philosophy." The term "physical" is not used here to announce a physicalist or reductionist theory of mind; rather, it is used to mean "any general expression of a natural operation, as exemplified in a number of cases." The natural laws of mind were named "physical" by Ferguson in order to contrast them with the moral laws that serve to guide conduct: the physical laws of mind are the natural laws of its operations. Under this usage, pneumatics "treats physically of mind or spirit"; the branch of pneumatics pertaining to human minds is designated simply as the "theory of mind." It is equated with "the knowledge of physical laws collected from fact, and applicable to explain appearances."[120] Examples of the laws of mind include the facts that we are conscious of our "existence, operation, and will" and that perception takes place via media that do not resemble the object of perception.[121]

To these Scottish theorists of mind must be added Erasmus Darwin, whose Zoonomia; or, the Laws of Organic Life of 1794-96 was dedicated, among others,

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118. Ibid., vii.
119. Ibid., 31: This philosophy "has received great accessions from the labours of several modern authors; and perhaps wants little more to entitle it to the name of a science, but to be purged of certain hypotheses, which have imposed on some of the most acute writers on this subject, and led them into downright scepticism." This "hypothesis" is the theory of ideas and mediate perception (ibid., Essay II, chaps. 8-12).
120. Ferguson, Institutes, introduction, section 7; section 3.
121. Ibid., part 2, chap. 2, section 1.

to those who "study the Operations of the Mind as a Science."[122] In this work, Darwin presented a sophisticated version of the associationist theory, replete with novel empirical observations, including some famous ones on afterimages. Darwin stands out among the Scottish authors noted thus far for his materialistic theory of mind. He allowed that the whole of nature may be "supposed" to consist of "two essences or substances," namely, "spirit" and "matter." Spirit "possesses the power to commence or produce motion," matter "to receive and communicate it." Living and sentient things possess a "spirit of animation," which is a vital principle residing in the brain and nerves, and subject to "general or partial diminution or accumulation" (and hence material).[123] Darwin's treatment of sensory perception and associative learning were particularly astute. His works were translated into German and republished often, helping to introduce a sophisticated associationism into German psychological writings. He is virtually singular as an eighteenth-century materialist (even if vitalist) who actually contributed to the development of psychological theory.

Although the theory of the mind, or psychology, was pursued vigorously by Scottish philosophers and physicians, Scottish writers came regularly to denominate this branch of knowledge "psychology"--as opposed to pneumatics, theory of mind, science of mind, or philosophy of mind--only in the nineteenth century. Dugald Stewart, who undertook an introductory textbook on the subject, chose the title Elements of the Philosophy of the Human Mind.[124] He dedicated his work to Reid, and drew upon the mainstream Scottish tradition. He placed himself in opposition to Erasmus Darwin and Joseph Priestley, whom

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122. Darwin, Zoonomia, 1:iii.
123. Ibid., 1:1; 41; 37.
124. Dugald Stewart (1753-1828; professor of moral philosophy at Edinburgh), Elements of the Philosophy of the Human Mind (Philadelphia, 1793).

he classified as materialists. Priestley himself did not contribute to psychology, but brought out an abridgement of Hartley's Observations.

Ehrfahrungsseelenlehre

While in the Scottish context investigators sought to make the mind an object of empirical investigation and to discover its "physical laws" as a prolegomena to morals, in Germany the science of the soul (or mind) was treated as an autonomous discipline--or as a subdiscipline of the science of Man--within the theoretical (as opposed to moral) sciences. The framers of "Seelenlehre," "Ehrfahrungsseelenlehre," and "empirische Psychologie" aspired to such an empirical approach to the soul or mind. Developed instances are found in the work J. F. Abel and K. C. E. Schmid. Abel and Schmid placed empirical psychology within natural science proper, distinct from metaphysics; they considered psychology to be the branch of anthropology or Menschenlehre that searches for the general laws of the mind and its relation to the body.[125]

Abel's book exhibits a typical psychological textbook organization, with roots in the De anima tradition. After brief preliminary methodological remarks, it considers first the nature of the mind, its basic powers and organs, and especially its relation to the brain, and then it systematically surveys the chief faculties of mind: sense, imagination, attention, thought,

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125. Jacob F. Abel, (1751-1829; professor of psychology and morals at the Karlsschule), Einleitung in die Seelenlehre (Stuttgart, 1786), Einleitung; Karl C. E. Schmid, (1761-1812; professor of philosophy at Jena), Empirische Psychologie, 2d ed. (Jena, 1796), p. 8, 11-12. Earlier works included Dietrich Tiedemann (1748-1803; professor of ancient languages at the Karlsschule), Untersuchungen über den Menschen, 3 vols. (Leipzig, 1777-78); Johann Nicolas Tetens (1736-1807; professor of philosophy at Kiel), Philosophische Versuche über die menschliche Natur und ihre Entwickelung, 2 vols. (Leipzig, 1777), which, while applying the "psychological method" of observation (the method of the natural philosopher), did so to a restricted set of topics, namely, understanding, will, the nature of humankind, freedom, the nature of the soul, and the development of the soul.

feeling, and bodily motion. Throughout, Abel attempts to show how all of the various powers and capacities of the mind can be reduced to one basic power, the power of representation, and how the materials on which the power of representation operates must all derive from sensory ideas aroused through stimulation of the sense organs. As had become common in the eighteenth century, he showed an interest in quantitative measures where these were available; indeed, he gave quantitative values for the "briefest still perceivable duration" of an impression on the sense organs. But the primary theoretical interest of the work was the discovery of "laws" governing the various faculties, including laws of association and attention.[126] The laws of attention assumed an all-or-none "conquest" (siegen) of attention by one or another representation. Originally, the currently liveliest or most pleasant representation wins out, but through experience it may happen that a less lively or pleasant representation that has in the past been followed by more pleasant representations will win out; the attentional faculty then comes to be guided by means-ends considerations in choosing which representations to enhance through its own power.

Many of the topics in Abel's textbook, such as the perception of size, shape, location, and distance, and attentional "conquest," can be found in nineteenth- and in early- and late-twentieth-century textbooks. But one set of questions would no longer be found after circa 1930: those pertaining to the existence and nature of the soul. The framers of Seelenlehre typically argued that the soul is a separate substance from the body, and they did so on philosophical as opposed to religious grounds. Abel repeated the widely used argument that the unity of consciousness requires a unified substance as its vehicle; but body is essentially conglomerate; hence, the simple substance

126. Abel, Seelenlehre, ##148-163, 194-206.

that is mind must be distinct from body. He took this argument to be an example of empirical investigation. He divorced his investigation from "metaphysical" considerations that transcend experience, for example, about mind-body interaction. Historians of psychology typically lump together talk of a separate thinking substance and of mind-body interaction as "metaphysics." Here, an eighteenth-century author asserts a different dividing point. He holds that empirical considerations can be brought to bear on the existence and nature of the soul. He does not mean that one can simply introspect and discover the simple substance of the soul. An argument is required: a theoretical structure must be fit to the "data" of inner sense. But he considered these questions on the soul to be empirically tractable, by contrast with the problem of mind-body interaction, which admits of multiple hypotheses that "save" the phenomena without differing empirically. He excluded the latter, empirically undecidable problem from his Seelenlehre.[127]

Schmid's Empirische Psychologie is a more advanced textbook than Abel's, and in particular it is filled with rich and detailed methodological discussions that are informed by previous writings, including those of Wolff and Kant. These discussions include a precise delimitation of the disciplinary boundaries and relations of empirical psychology to anthropology more generally, a discussion of the empirical object and form of explanation of psychology, and a division of psychology itself into distinct sub areas. Schmid observed that some would limit the subject matter of psychology to the data of inner sense alone (as in fact Kant had done), but he argued that it should be defined more broadly, to include those "outwardly" observable phenomena of body that have a lawful relation with inner sense. He thus included not only the introspective data of inner sense but observations of

127. Ibid., ##4-20.

the behavior of other humans and indeed the historical record of human behavior within the subject matter of psychology. Again, he acknowledged that some would limit a science "in the strict sense" to those fields that could derive their main conclusions a priori (as Kant had maintained), but he chose to employ a concept of science "in the wide sense," as a "systematic body of knowledge, that is, one ordered according to principles"; when the concept of science is so understood, Seelenlehre can be a science. It seeks empirical generalizations (Regeln) and universal laws (Gesetze) of mental life, which, Schmid is careful to observe, are to be regarded as theoretical laws of nature governing the operation of the mind, and not as the moral laws by which we seek to guide our behavior.[128]

Schmid drew the boundaries of the empirical more narrowly than had Abel. He followed Kant in removing questions pertaining to the substantiality and simplicity of the soul from the domain of empirical investigation and relegating them to "dogmatic" metaphysics--for which he reserved the names "transcendental" or "pure" psychology, or "pneumatology," thereby deviating from Kant's terminology. Included here were questions pertaining to the independence, simplicity, personhood, spirituality, immutability, and immortality of the soul, as well as those pertaining to its real causal relation to body. He used the terms "empirical" and "rational" psychology as Wolff had, to denote disciplines that are based directly on experience (or are a posteriori) and those that are based on the analysis of concepts that themselves are drawn from experience (and hence are "comparatively a priori").[129] The rational part of psychology constructs explanations for the empirical generalizations and other data collected in the empirical part.

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128. Schmid, Empirische Psychologie, 11-17.
129. Ibid., 18-26.

Having relegated the problem of the substantial nature of the mind to the domain of dogmatic metaphysics, Schmid adopted a position of "empirical dualism."[130] Empirical dualism distinguishes soul and body on the grounds that the properties and phenomena revealed through outer and inner sense cannot be united under a single set of concepts. Experience shows that the phenomena of each are lawfully related. Empirical psychology charts lawful relations within the domain of soul, spirit, or mind, and between that domain and bodily processes. Schmid's work is particularly impressive for its detailed analytical treatment of psychological concepts informed by a thorough acquaintance with the psychological, anthropological, and medical literatures.

Psychology in the Anthropological, Medical, and Optical Literatures

This is not the place to survey the diverse set of works in anthropology, or the "Science of Man," that appeared in the eighteenth century. However, two general points will help place the natural scientific approach to psychology with respect to the anthropological tradition. First, anthropology was considered by many to be a more encompassing discipline than psychology: whereas the latter pertained to mind, anthropology considered the whole human: mind, body, and their union. (Of course, anthropology was also narrower than psychology, in that the latter might treat of animal as well as human souls.) Consequently, one trend in anthropological treatises, so denominated, was to focus on problems of mind-body union, giving only a summary treatment of bodily functions (which were discussed in medical physiology) and mental functions (which were discussed in psychology), a description that fits Johann Karl Wezel's Versuch über die Kenntnis des Menschen (1784-85).[131] Secondly,

130. Ibid., 189-90.
131. Johann Karl Wezel (1747-1819), Versuch über die Kenntnis des Menschen, 2 vols. (Leipzig, 1784-85).

even those, such as Kant and Blumenbach, who took the science of man to pertain to human kind in its full empirical diversity--to include various individual, national, and racial types--began their anthropologies with an overview of what is common to all humans, or at least to all human minds.[132] Kant placed anthropology among the empirically based investigations of nature. He considered its evidence to come from self-observation, observation of others, and reports of others' behavior, as found in fiction, travel literature, and history. Yet the most extensive portion of his anthropological lectures concerns the properties and operations of the cognitive faculties in diverse empirical circumstances, including a discussion of the roles of vision and touch in the perception of three-dimensional solid shapes.

Medical physiology had long included examination of the mental powers of humans and the physiological structure of the sense organs, nerves, and brain that serve them.[133] This practice continued through the eighteenth century, and into the nineteenth and twentieth. Albrecht von Haller's physiological lectures are noteworthy for the extensive discussion and wealth of the citation in the six books (filling one large volume) devoted to the external and internal senses.[134] These discussions referred to a great deal of literature, but were of mixed quality from a psychological perspective. Thus, like Wolff, Haller simply equated apparent size with the visual angle subtended by an object in the field of view, whereas many of the authors he cited, including Berkeley and Le Cat, recognized that perceived size may take

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132. Immanuel Kant, Anthropologie in pragmatischer Hinsicht (Frankfurt and Leipzig, 1799); Johann F. Blumenbach, De generis humani varietate nativa (Göttingen, 1775).
133. Jean Fernel (1497-1558; physician and philosopher), Opera medicinalia (Venice, 1566), "Physiologiae," book 1, chaps. 9-10, and book 5.
134. Albrecht von Haller (1708-77), Elementa physiologiae corporis humanae, 8 vols. (Lausanne, 1757-66), vol. 5, books 12-17.

into account the perceived distance of an object.[135] Beyond the five external senses, Haller discussed the "internal senses," under which he grouped intellect, will, and sleep. In the section on intellect, he also discussed the faculties of memory and imagination, the cognitive acts of judgment, wit, and abstraction, and the conditions leading to truth and error, delirium, and foolishness. His discussion of the intellect focused especially on the status of mental representations. In particular, he advised that four different things must be kept distinct in discussing mental representations such as perceptions: (1) the external object, (2) its impressions on the sense organs, (3) the effects of these impressions as transmitted to the cerebrum, and (4) the representation of this effect in the mind.[136]

Finally, the optical literature, which had long included psychological topics as part of a complete theory of vision, flourished under this description in the eighteenth century, even if some authors adopted the narrower Newtonian conception of optics. The theory of vision addressed the act of seeing itself, especially the perception of size, shape, distance, motion, and color. Berkeley's New Theory of Vision, for instance, was widely known and often admired in the eighteenth century. It introduced a new psychological theory into the theory of vision, by accounting for the connection among visual and tactual ideas via the mechanism of "suggestion" (association), which Berkeley opposed to the posited unnoticed judgments of previous optical writers, including Descartes. Berkeley's theory that touch educates vision through a process of learning was widely discussed in the eighteenth century; Berkeley and others claimed empirical support for his position from observations on the newly-sighted blind.[137]

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135. Ibid., book 16, section 4, #29, 5:520-2. Berkeley, New Theory of Vision, sections 53-60; Le Cat, Traité des sensations, 2:441-84.
136. Haller, Elementa physiologiae, vol. 5, bk. 17.
137. On Berkeley, see Margaret Atherton, Berkeley's Revolution in Vision

Beyond these theoretical disputes, many authors engaged in geometrical modeling and empirical investigation of the phenomena of size, shape, and distance perception. Because it was descended from optics, a mixed mathematical science, the theory of vision inherited geometrical modeling, and as the other mixed mathematical sciences appealed ever more to experiment, optics and theory of vision became experimental disciplines. It is in optics and theory of vision, before and during the eighteenth century, that the first significant body of mathematical constructions and quantitative measurements were applied to mental phenomena. It is here that we should look for the first success in quantitative, experimental psychology, though this work in sensory psychology was not credited to the name of "psychology" until the nineteenth century.

Empirically and Theoretically Progressive Research Programs

According to the usual sociological measure of progressiveness, psychology was a progressive discipline during the eighteenth century: academic appointments in psychology were made, courses were taught, the number of textbooks published per decade increased, and, near the end of the century, journals were founded (even if they failed within a decade).[138]

In Britain the "theory of mind," conceived as a branch of natural science, was firmly entrenched by the end of the century, and it continued into the next. In Germany, "psychology" so called was even more firmly entrenched as a discipline, and it continued to be taught throughout the next

(Ithaca: Cornell University Press, 1990).

138. These claims are supported by Carus's Geschichte and Schmid's overview of the literature, Empirische Psychologie, p. 142-156. A reveiwer in the Allgemeine Literatur Zeitung of 1787 (supplement), while panning Christoph Meiners' Grundriss der Seelenlehre (Lemgo, 1786), could speak of the great number of "textbooks of psychology" that are available. It has been customary for writers of psychology textbooks, from Krüger and Bonnet on, to apologize for adding to such a crowded field.

century. There were competing conceptions, of course, and in the second half of the nineteenth century some entrepreneurs proclaimed the founding of a "new" psychology, meaning thereby to distinguish themselves from the extant discipline. This claim of novelty rested on a comparison with the old psychology, portraying it as "merely philosophical," which meant metaphysical and not experimental (i.e., not empirically based).

I would like to make a stronger claim for the progressiveness of various eighteenth-century research programs that took a natural scientific attitude toward the mind or mental phenomena. I propose as a working historical thesis that eighteenth-century work made a threefold contribution to the psychology of the nineteenth century. First, eighteenth-century faculty psychology yielded a conceptual framework that was more fine-grained than that of earlier centuries and that benefited nineteenth-century investigations. Second, eighteenth-century association psychology provided the theoretical framework that dominated much nineteenth-century psychology, the associationist framework. Third, eighteenth-century experimental work, especially in vision, provided a tradition of experimental practice that, although not often counted as part of "psychology" so called during the eighteenth century, was incorporated into the "new" experimental discipline of psychology during the nineteenth century. Further development of the long-standing tradition of experimental work on vision provided the primary foundation for the claims to found a new, experimental psychology.

A survey of that subset of popular late-nineteenth- and early-twentieth-century psychology textbooks that treat psychology as a natural science would reveal that the structure of these books has much in common with scholastic textbooks of the seventeenth century: the external senses, their organs and associated nervous processes, are treated first; the "internal senses"

(usually not so called) are treated further on, including memory and imagination; higher cognitive faculties, including reasoning, further on; bodily motion, somewhere along the way; and appetite and will, near the end.[139] We can discover the specifically eighteenth century contribution by finding those new chapters in these textbooks that have origins in that century. The new chapters include those on attention, conception or abstraction, and association. Attention was brought into psychology by the faculty tradition, particularly by Wolff and his followers, and was further addressed in Ehrfahrungsseelenlehre, which proposed empirically discovered constraints on the scope and direction of attention.[140] The chapters on discrimination and on conception or abstraction, though rooted in ancient Greek philosophy, were introduced into eighteenth-century psychology books by those developing the faculty approach.[141] The added chapter on association was due largely to attempts by authors such as Hume and Hartley to make the laws of association the fundamental explanatory principles of mind.[142]

Thus far my analysis of the "progressive" tenor of eighteenth-century psychology has been restricted to changes in psychological textbooks, which may or may not have claimed novel conceptual and theoretical results, and

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139. James, Psychology; Edward B. Titchener, Outline of Psychology, new ed. (New York and London, 1901); Hermann Ebbinghaus, Abriss der Psychologie, 4th ed. (Leipzig, 1912); Edward L. Thorndike, Elements of Psychology, 2d ed. (New York, 1915); Wilhelm Wundt, Grundriss der Psychologie, 13th ed. (Leipzig, 1918); Carr, Psychology.

140. Wolff, Psychologia empirica, part 1, section 3, chap. 1. Abel, Seelenlehre, ##194-268. Nicholas Malebranche previously had placed attention at the center of his discussion of method, Recherche de la vérité, book 6, part 2, in his Oeuvres, 20 vols. (Paris, 1958-1970), vol. 2.

141. Wolff, Psychologia empirica, part 1, section 3, chap. 1; Psychologia rationalis, part 1, section 1, chap. 4; Abel, Seelenlehre, ##392-436.

142. Hume, Treatise, book 1, part 1, section 4; Hartley, Observations on Man, part 1, chap. 1, propositions 10-14, and passim. Wolff described the phenomena of association and their law, Psychologia empirica, ##104, 117; his follower Baumgarten named "associatio idearum" the "lex imaginationis," Metaphysica, #561.

which only sometimes claimed to present original observations. One might concede that this older tradition contributed conceptual materials to the textbooks of the new psychology of the nineteenth century, without accepting that the eighteenth century contributed to the rise of quantitative experimental psychology. In point of fact, the strongest eighteenth-century contribution to the rise of quantitative experimentation in psychology came from the mixed-mathematical science of optics.

Optics was a "mathematical" science in virtue of its use of geometrical constructions, especially in the tracing of "visual rays." As regards vision proper, these rays were used in the analysis of the perception of size, shape, distance, and motion. Mathematical (geometrical) regularities, such as that among visual angle, apparent distance, and perceived size, were typically expressed as proportions. There were few numerical values in optics (indices of refraction being one). In the seventeenth century Descartes gave estimates of the range within which accommodation and convergence could provide accurate information for the perception of distance, though he did not say how he had arrived at the values. Berkeley, who introduced a conceptual revolution into the theory of vision with his doctrine of suggestion, did not cite quantitative observational evidence.[143] The eighteenth century was replete with novel observations of sensory phenomena, including after-images and color blindness, which were not quantitative but were nonetheless important for that.[144]

Nonetheless, there were quantitative studies of visual perception in the

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143. On Descartes and Berkeley, see Hatfield and Epstein, "Sensory Core."
144. Georges Louis Leclerc, comte de Buffon, "Dissertation sur les couleurs accidentelles," Memoires de mathématique et de physique, 60 (Paris, 1743): 147-58. John Dalton, "Extraordinary Facts Relating to the Vision of Colours: with Observations," Memoirs and Proceedings of the Literary and Philosophical Society of Manchester 5 (1798): 28-45.

eighteenth century, among which I give three examples. Patrick D'Arcy measured the persistence of visual impressions by devising an apparatus for presenting to an observer a luminous object (a live coal) with a circular motion whose diameter, velocity, and distance from the observer could be varied. By observing how rapidly the coal must turn in order to result in the perception of a closed circle under a constantly fixed gaze, he concluded that the impression lasts for "8 tierces."[145] Pierre Bouger examined the question of how lines must be rendered in perspective to yield an appearance of being parallel, which was a problem addressed by several mathematical theorists. He introduced into the problem the notion of the apparent (as opposed to real) inclination of the ground plane, and measured the latter.[146] Robert Smith undertook a thorough study of the moon illusion, which he explained in accordance with the hypothesis that for a given visual angle, perceived size varies with apparent distance. He contended that the moon appears larger at the horizon because it seems further away than when it is overhead. In support of this hypothesis, he undertook to measure the perceived curvature of the vault of the heavens, which informal observation suggested is flattened. He obtained numerical values by comparing the known position of the stars with the apparent bisections by visible stars of the angle between the horizon and straight overhead.[147]

The practice of seeking precise measurements in testing theories of perception became more common in the nineteenth century and was particularly

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145. Patrick D'Arcy, "Memoire sur la durée de la sensation de la vue," Memoires de mathématique et de physique 82 (Paris, 1765): 439-51.
146. Pierre Bouger, "Recherche sur la grandeur apparente des objets," Memoires de mathématique et de physique 72 (Paris, 1755): 99-112.
147. Robert Smith, Compleat System of Opticks, 2 vols. (Cambridge, 1738), 1:63-6. All three examples, along with others, are reported in Joseph Priestley, History and Present State of Discoveries Relating to Vision, Light, and Colours (London, 1772).

highly developed in German sensory physiology and psychology. Wundt and Hermann Helmholtz drew upon earlier work when they brought sensory psychology into a position of scientific prominence, and not solely with respect to experiment; equally or more importantly, their theoretical conceptions were inherited from the highly developed theories of spatial perception that arose in the eighteenth and early nineteenth centuries.[148]

Conclusions

Psychology or the science of the mind was conceived as a natural science in the seventeenth, eighteenth, and nineteenth centuries. The notions of psychology and natural science underwent significant change along the way. At first "psychology" was the science of the Aristotelian soul, and covered vegetative as well as sensory and intellectual powers; study of the latter, "cognitive," powers was a (dominating) subdiscipline in Aristotelian psychology. Wolffians made psychology a part of metaphysics, coordinate with cosmology. Scots placed psychology within moral philosophy, but distinguished its "physical" laws from properly moral laws (for guiding conduct). Several Germans sought to establish an autonomous empirical psychology. Meanwhile, British and French visual theorists developed sophisticated theories of spatial perception and mathematically precise theories of size and distance perception; they created instruments to test these theories, and to measure other visual phenomena, such as the duration of visual impressions. Nearly all of these investigators were dualists of one sort or another. From early to late, the trend was to bracket metaphysical questions in favor of the search for empirical regularities and empirically based systems of classification. These empirical studies were directed at mental phenomena

148. Hatfield, Natural and Normative, chaps. 2, 4, 5.

considered as distinct from material phenomena.

This being the case, psychology was not "invented" in the eigthteenth century, but remade. Subsequently, a historical narrative according to which genuinely natural scientific psychology came into existence only in the second half of the nineteenth century has been invented. It would be interesting to look into the historical coniditions that gave rise to it. Wundt, in the first edition of his Grundzüge, admitted considerable continuity between the old, empirical and observational psychology and the new experimental psychology that drew upon the methods of psychophysics, though he toned down the talk of continuity and stressed the differences in later editions.[149] My guess is that the story of the invention of the new psychology will lead well into the twenteith century, and will include the narrative of experimentalists such as Edward Sripture and the Harvard experimental psychologist turned historian (and, perhaps in fact, founder), Edwin Boring.[150]

My sketch of the early history of psychology challenges not only the usual historiography but also the usual conception of Enlightenment progress. In the standard narrative, the heroes of the Enlightenment are materialists. If psychology is to be made a science, the story goes, mind must be equated with matter and thereby rendered subject to empirical investigation.[151] The problem is that no one bothered to tell the early practitioners of natural scientific psychology that they had to be materialists in order to be natural scientific psychologists. In point of fact, of all the major eighteenth century authors who made contributions to the development of psychology, only Erasmus Darwin allowed that mind might be material; nineteenth-century

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149. Wundt, Grundzüge, 1-8; ibid., 3d ed., 2 vols. (Leipzig, 1887), 1:1-8; ibid., 5th ed., 3 vols. (Leipzig, 1902), 1:1-8.
150. Edward Wheeler Scripture, New Psychology (London, 1898); E. G. Boring, History of Experimental Psychology (New York: Century, 1929).
151. Schaffer makes this position explicit in "States of Mind," 240, 263.

founders of psychology, including Wundt, Helmholtz, R. H. Lotze, Hermann Ebbinghaus, William James, Hugo Munsterburg, and Alfred Binet, banished the very question from scientific psychology.[152] These authors conceived psychology as natural scientific without seeing the need to adopt the metaphysical position of materialism. In so doing, they would seem to be proceeding quite rationally, by studying what can be studied on its own terms and avoiding an unnecessary commitment to the unsupported claim that mental phenomena can be reduced to material processes. The old equation of Enlightenment Reason with materialism turns out to have been so much prejudice. It would be interesting to discover the historical conditions in which this version of history became entrenched. In the meantime, there is much work to be done investigating the history of psychology considered as the science of mental phenomena, a history in which faculty psychology is no joke, and in which materialism is virtually nowhere to be found.

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152. Darwin, Zoonomia, 1:108-9. On antimaterialistic and nonmaterialistic stances in eighteenth- and nineteenth-century psychology (including Wundt, Helmholtz, and Lotze), see my Natural and Normative, chaps. 6-7; James, Psychology, 6-7; Hugo Munsterberg, Psychology: General and Applied (New York and London, 1914), 39-42: Alfred Binet, Introduction à la psychologie expérimentale (Paris, 1894), 146.