Disciplinary Distinctions before the "Two Cultures"

Ann Blair, for "The Languages of the Sciences and the Languages of the Humanities"

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C.P. Snow's notion of "two cultures" as separate and in tension with one another grew out of his particular experiences--notably as a fellow at a Cambridge College starting in 1930, as a novelist, and as a senior official in various positions in the English government through the mid-1960s. But the expression Snow coined in his 1959 Rede lecture resonated rapidly beyond his immediate milieux and continues to circulate in academic and common parlance among English-speakers, especially in the British Isles and the United States, even as the grounds for conceiving tensions between the "two cultures" have changed.[1] Despite its broad resonance today and its potential usefulness for analyzing current and past interactions between the disciplines, especially starting in the 19th century, the distinction between the "two cultures" does not apply universally across space or time. Snow's lecture was translated into a number of European languages within a decade, but the expression has not become widespread in languages other than English.[2] Indeed there are often no exact equivalents in other languages for the “sciences” and the “humanities” as Snow used the terms.[3] Even within the modern West different political, educational and cultural circumstances have spawned different emphases within and interactions between the disciplines.

The culturally contingent nature of our Anglo-American notion of "two cultures" is made more evident by looking back to pre- and early modern European contexts, when neither the "sciences" nor the "humanities" were extant as categories. Even without the categories that seem to channel our interactions today, in those presumably “simpler,” less specialized times disciplinary distinctions fostered tensions too, but along different faultlines. In presenting briefly two examples of the dynamics between the disciplines in medieval and early modern Europe I argue that distinctions between the disciplines bring with them crucial benefits along with the tensions and obstacles to interdisciplinarity of which we are often more aware. Intellectual and institutional

distinctions between different approaches and areas of knowledge allow for more than one perspective on a problem to develop. The existence of multiple disciplines fosters what one might call “cognitive pluralism” or an awareness of the possibility of approaching a question from multiple points of view. Both this awareness and the availability of different approaches are generally considered assets in problem-solving.[4] The cultural standing of a discipline may wax and wane over time for a variety of reasons both internal and external. Disciplinary distinctions are valuable in protecting disciplines considered to be of lower status in a given context from encroachment and control by disciplines of higher status. They help to preserve cognitive pluralism even through periods of strong cultural bias toward one particular topic or approach.

Most of the distinctions we make today between the sciences and humanities developed some time between the 17th and the early 19th century. These include the notion that a scientific method is different from a literary or hermeneutic one, that the sciences study an objective law-bound world in a progressive way while the humanities seek subjective self-understanding, and that one person cannot function professionally as both a scientist and a humanist at the same time. Before the 17th century the principal method of studying nature was through the careful analysis of ancient texts (by Aristotle, Dioscorides or Euclid, for example) and the principal justification of intellectual inquiry of any kind was that it enhanced the understanding and admiration of God. Many scholars moved back and forth in their writing and teaching between human history and natural history.[5] Similarly they moved freely among the four branches of philosophy taught at university--logic, physics, ethics and metaphysics--which spanned what we now call the "two cultures."

The most significant division among the disciplines in the pre-modern periods was instead that between "divine" and "secular" learning, to use the Latin terms of Cassiodorus in the 6th century, or between "divinity" and "humanity" in the terms of one English writer in 1483 (in a passage noted as the earliest use of "humanity" to designate a field of learning).[6] This distinction,

first institutionalized in medieval universities, made possible the separate development of philosophy and theology but also occasioned clashes over authority that resulted from that separation. In examining some of the early interactions between philosophy and theology I will argue in a first section that disciplinary distinctions have offered salutary protection for less prestigious fields to develop relatively freely from dominant ones. But disciplinary distinctions have also hampered the movement of ideas and methods between different disciplines, as I will show in a second section from the example of interactions between mathematical astronomy and natural philosophy in the 16th and 17th centuries.

Medieval and early modern disciplinary distinctions are rooted in the earliest texts of Greek philosophy. Plato classified the sciences according to their level of abstraction, with special attention to the mathematical disciplines. Aristotle wrote separate treatises in a wide range of areas and was associated with the principle that each field should proceed according to its own method as appropriate to its subject matter and level of abstraction.[7] Their writings spawned a tradition of discussion of the classification of sciences, even if neither author devoted as much attention to the question as later commentators made it seem. Aristotle became known especially for a bipartite division of philosophy into theoretical or speculative disciplines (metaphysics, physics and mathematics) and practical ones (ethics, politics and economics). A tripartite division with an additional third branch for "poesis" or productive knowledge can also be found in Aristotle, but was generally associated with Plato.[8] Medieval and early modern commentators added multiple variations to the lists of disciplines and their placement in categories, but all the classifications shared the assumption that the disciplines formed a hierarchy.[9] The theoretical disciplines generally ranked above the practical, for example; in ancient culture practical and mechanical activities were generally considered degrading and were associated with un-free or slave labor. Greater levels of abstraction also often conferred superiority--to metaphysics over physics for example. But not always: mathematics was recognized as more abstract, but Aristotelian classifications often ranked

it below and as a propedeutic to physics because of its presumed inability to account for real phenomena.[10]

Medieval and Renaissance discussions of the classifications of knowledge in treatises or prefatory remarks made contributions to philosophy but generally had little impact on teaching or institutional structures. Much more consequential were the distinctions institutionalized in the universities which spread to the major centers of learning throughout Europe starting ca. 1200.[11] The faculty of arts offered instruction in various parts of philosophy as preparation to the higher faculties of medicine, law and theology. Particularly as writings of Aristotle became widely available for the first time through translations from Greek and from Arabic, teaching in the faculty of arts focused on the explication of Aristotelian philosophy, from logic (already known through Latin summaries like Boethius') to the newly available texts in ethics, physics and metaphysics. Masters of arts trained students in these areas, who could after five years of study receive a master's degree licensing them to teach in the arts faculty in turn. The faculty of arts was primarily designed as a way station where a master could teach before or while pursuing study in one of the higher faculties. But once it was institutionalized, the faculty of arts also enabled masters to spend their entire careers there, devoted to teaching and commenting on Aristotelian philosophy.

The separate incorporation of each faculty ensured that masters of arts set their own curricula and regulations independently of other faculties. At Paris and elsewhere masters of arts opted for a curriculum based on the Aristotelian texts which had recently become available in Latin translation during the 12th and 13th centuries.[12] They quickly came upon passages in Aristotle which posed difficulty for Christians, notably arguments for the eternity of the world, the mortality of the soul or the necessity of natural law, and they offered various interpretations designed to emphasize the compatibility of Aristotle with Christian doctrines. But some of these interpretations and the teaching of Aristotelian philosophy in general provoked negative reactions from theologians (notably at Oxford and Paris) and a spate of condemnations of various propositions, including most

famously the 219 propositions condemned in 1277 by the bishop of Paris, Etienne Tempier. Although the condemnations of 1277 were likely compiled in haste and do not name any specific teachers of the condemned views, they generally forbad teaching propositions which seemed to challenge the Christian notions of divine omnipotence, creation *ex nihilo* and the immortality of the soul. Most interestingly Tempier attacked those who "say that things are true according to philosophy but not according to the Catholic faith; as if there could be two contrary truths."[13] Citing the Bible, Tempier insisted that there could only be one truth, to be found in the divine word as interpreted by the Church and its institutions, notably the faculty of theology. This condemnation warranted the claim by later historians (starting with Ernest Renan) that some philosophers in 13th-century Paris (perhaps Siger of Brabant or Boethius of Dacia) espoused a doctrine of "double truth" which allowed for philosophical truths to differ from theological ones. Recent scholarship has concluded that no philosopher explicitly taught such a position in 13th-century Paris, but acknowledges that some masters of arts defended their independence from theology in the 13th century and a few later philosophers, like Pietro Pomponazzi in the early 16th century, came close to articulating a form of double truth.[14]

The condemnations of 1277 did not dislodge Aristotelian philosophy from its central place in the university curriculum. But the masters of arts at Paris henceforth steered clear of positions that might be interpreted as leading to a double truth and adopted other strategies for reconciling philosophy and theology. Many followed Thomas Aquinas in arguing that Aristotelian philosophy properly understood offered truths, but only partial truths ("preambles of the faith") which had to be complemented by "articles of faith." The latter lay beyond the grasp of philosophy and were supplied by revelation and religious authority.[15] This strategy followed that of Moses Maimonides who, in his Guide to the Perplexed, argued for example that Aristotle supported the eternity of the world not as a demonstrated truth, but only to refute less plausible alternative positions. According to both Maimonides and Aquinas, Aristotle acknowledged that reason could not decide for or

against the eternity of the world; hence the need for revelation to establish creation as an article of faith.[16] With this and other ingenious maneuvers Aristotle's philosophy was Christianized so it was not perceived as a threat to Christian doctrine; theologians and philosophers alike invoked Aristotle as a most respected source.

Religious authority certainly played a role in shaping philosophy teaching, especially at Paris (through explicit censorship and by fostering self-censorship), but the intellectual and institutional distinction between philosophy and theology in the medieval universities created a context in which philosophy developed with significant independence from theology, despite (or perhaps thanks to) its lesser status. Intellectual independence was the unintentional result of a separate incorporation of the faculties which relieved theologians from the burdens of teaching introductory courses and rarely occasioned anxiety among them. After all, theologians were all trained in Aristotelian philosophy; and though they had no training in theology, masters of arts were all clerics and acknowledged the supreme dignity of theology. As a result philosophers were free to develop areas of unique expertise—including cosmology, astronomy, optics, the sciences of weights and of motion, and "the intension and remission of forms," which recorded and explained variations in the intensity of qualities of all kinds—from heat to charity.[17] The distinctions between philosophy and theology triggered an early episode of "conflict" at Paris in the condemnations of philosophical positions by religious authorities in the 13th century, but those same distinctions had made it possible in the first place for philosophers to formulate propositions which theologians could find condemnable. From their beginnings ca 1200 European universities fostered intellectually and institutionally distinct contexts for the development of philosophy and theology, as well as law and medicine, which served as a source of cognitive pluralism even within a unified religious context.[18]

Opportunities for cognitive pluralism increased substantially during the early modern period, as both elements of the medieval synthesis of Aristotle and Christianity came under attack. Universities lost their position as the sole or even the principal site for intellectual activity, given the

employment of intellectuals and the formation of academies under princely or royal patronage. Aristotle was attacked on many different grounds by philosophers within and especially outside the universities and new alternatives were proposed, from Christianized versions of Platonism, Epicureanism, Stoicism and other ancient philosophies to the new philosophies of Descartes, Newton and Locke among others.[19] At the same time the unity of the medieval church was broken by Protestantism in its multiple forms, principally Anglicanism, Lutheranism and Calvinism, each of which in turn harbored a range of positions. Religious condemnations were henceforth limited in their geographical scope. The Catholic condemnations of heliocentrism in 1616, of Galileo in 1633 or of Descartes' mechanical philosophy in 1671 had no impact on Protestant areas and were not honored equally in all Catholic countries either, since the French emphasized in the 16th and 17th centuries their Gallican privileges. Protestant churches issued condemnations too, but these were even more geographically limited since each church was dependent on a local temporal authority. In the 17th century the number of possible combinations of different philosophical and religious positions and the multiple institutional contexts for intellectual work prevented any single synthesis from prevailing. By the 18th century the dynamic between philosophy and theology was no longer the dominant intellectual issue. Some *philosophes* pared religion down to a deistic minimum so that it had virtually no place in their philosophy; other thinkers engaged in theological reflection and writing independently of religious authorities, often to unorthodox results.[20] Debates among theologians were increasingly limited to small, specialized circles or even forbidden by papal decree for fear of damage to the Church. Instead many new fields in the sciences and the humanities were successful in commanding a broad readership and increasingly theoretical discussion, including the belles-lettres (a category formed in the 18th century), aesthetics, ethics and a number of scientific fields which acquired in the early 19th century names and definitions that are still recognizable today (e.g. biology, geology, paleontology, chemistry, physics, etc).[21] With the development of separate educational tracks for scientific and literary fields during the 19th century the preconditions were in

place for the formation of a new faultline between Snow's two cultures, in place of the earlier constellation of theology vs philosophy.

As adherence to religious doctrine has become a matter of personal choice rather than an obligation in the modern period, the protection that disciplinary specialization afforded to philosophy in the 13th century now helps to protect theology as an academic discipline. Disciplinary autonomy has in the past formed a crucial protective device for disciplines of lower status; philosophy would not have developed as independently as it did without such protection in pre-modern Europe. Today too the less powerful disciplines (e.g. theology or the humanities) benefit from the autonomy that comes with respect for disciplinary distinctions. The gap between the "two cultures," for all its negative side-effects, is also worth respecting lest we try to reduce all truths to one as the condemnations of 1277 called for. Renewed calls for a single truth stem these days for example from religious groups who offer the Bible as the answer to all questions, but also from some scientists who promise an explanation of all human phenomena through the mechanisms in which their field specializes. In announcing the "coming together" of the sciences and the humanities E.O. Wilson's Consilience proposed a reduction of the various disciplines to the perspective of biology.[22] The ideal of the unification of knowledge may still seem appealing today and certainly has a long history. But given the complexity of human experience as we perceive it now, after centuries of disciplinary pluralism in the Western intellectual tradition, no single explanatory scheme will likely win the assent of a broad cross-section of academics or the general public. To strive for a single truth involves eliminating more or less self-consciously alternative perspectives, including the very notion that complexity is a central feature of persuasive knowledge claims. Although the fissiparous tendencies of modern cultures can be lamented and may invite various remedies, we need some disciplinary distinctions. They aided the beginnings of rational philosophy in the medieval universities, when theology was the dominant discipline. Today they allow for the cultivation of disciplines (e.g. in the humanities and social sciences) which have

qualities to complement trends dominant in the natural sciences, by emphasizing (among other themes) the co-existence of a multiplicity of perspectives, complexity of explanation, and the instability of current, and past, cultural trends.

At the same time as we need disciplinary distinctions, we also benefit from encouraging exchange across disciplines between and within these institutional-cultural boundaries. Pre- and early modern disciplinary interactions support the conclusion that disciplinary distinctions, while salutary in some respects, have also slowed the growth of new approaches, notably "interdisciplinary" ones. The status of mathematical disciplines within natural philosophy in the pre-modern periods offers a good case in point. The mathematical disciplines formed a distinct group already in antiquity,[23] comprising principally arithmetic, geometry, harmonics (music), astronomy and optics, and required a distinctive expertise in mathematics. Although mathematics was acknowledged to produce a high level of certainty, Aristotle and most Aristotelians considered mathematics inferior to physics because it did not adequately account for the complexity of physical reality; instead Aristotelian physics offered a qualitative analysis of such topics as time, motion and causation. Most scholastics shared this conception of physics, but some medieval philosophers cultivated disciplines which were considered mixed or intermediate between physics and mathematics because partaking of both—notably astronomy, optics and harmonics. The transmission to European universities of Arabic treatises alongside ancient texts in the 13th century renewed interest in these fields; in addition new "mixed sciences" emerged in the 14th century, such as the science of weights and the measurement of bodies (stereometry) and mathematical approaches to the study of motion. The Merton school in 14th-century Oxford is especially noted for its development of these *scientiae mediae*, but its impact remained fairly limited in time and place.[24]

Of more decisive consequence was the confrontation between mathematical methods and

those of Aristotelian physics which unfolded in astronomy and physics between the 15th and the 17th centuries. Two separate disciplines had developed since antiquity: mathematical astronomers like Ptolemy developed models carefully matched to observations and which made accurate predictions, while natural philosophers ignored these models as irrelevant to the physics of planetary motion which they derived instead from commentary on Aristotelian texts. Recent research has emphasized that the mathematical astronomers viewed their work as relevant to a physical understanding of the heavens in the 14th and 15th centuries, long before natural philosophers, from their position of greater intellectual and institutional prestige, were willing to do so (mostly in the 17th).[25] Copernicus had addressed his presentation of the heliocentric model in De revolutionibus (1543) quite pointedly to "those trained in mathematics" like himself and at the same time offered heliocentrism as a realist description of planetary movements. Copernicus thus meant to use mathematical astronomy as a basis for physical astronomy, but Andreas Osiander who saw the book through the press added an anonymous preface without the permission of Copernicus. This preface was designed to smooth the reception of the work by portraying heliocentrism as a convenient fiction with no claim to physical reality. Osiander's fictionalism was interpreted at the time and for a long time afterward as Copernicus' own position. Indeed all but a handful of natural philosophers in the 16th century ignored heliocentrism as a potential description of reality.[26]

The status gained by the mixed mathematical sciences in the 14th century was mostly ignored by natural philosophers in the 15th and 16th century as they pursued the humanist program of rejecting medieval innovations and focusing on Aristotle's texts alone. Thus during the Renaissance natural philosophy as taught at universities rarely included any mathematical approaches, The creation of new educational institutions in the late 16th century, such as the Jesuit Collegio Romano, allowed for a renewed study and teaching of the mixed mathematical disciplines which could then spread elsewhere. Galileo's training at the University of Pisa for example included elements derived from teaching at the Collegio Romano.[27] Galileo was one of a handful of near-

contemporaries who took Copernicus' work seriously as physical, not just mathematical astronomy. He saw the importance of developing a physics that could accompany heliocentrism (for example by explaining inertial and projectile motion). Galileo angered his fellow natural philosophers by mocking them and their Aristotelianism; he wrote most of his works after he had ceased teaching at university and was receiving patronage from the Medici. The efforts of Galileo and others culminated in Newton's Principia, which articulated mathematical laws of motions that accounted for everyday phenomena as well as the motions of the planets according to a heliocentric model. As a result, "natural philosophy" (as Newton still called his field) was visibly changed from a hermeneutic activity – which had been characteristic of philosophy of all kinds until then – to an activity which required mathematical expertise and was thus differentiated from the other branches of philosophy. But the formation of this new mathematical physics and its subsequent diffusion through print, academic societies and university teaching had taken over a century because it required breaking down traditional and long institutionalized disciplinary boundaries and hierarchies.[28]

Copernicus' presentation of his work as written by a mathematician for mathematicians not only claimed for mathematics an expanded purview into statements about physical reality, but also claimed independence for his work and his field from the criticism and meddling of "babblers," who might invoke biblical passages to attack heliocentrism without understanding the mathematical and astronomical arguments which supported it.[29] This attempt to forestall religious criticism was successful to the extent that little attention was paid to heliocentrism as a realist model before 1600. But arguments against heliocentrism on biblical grounds were frequently raised and considered significant by both Protestants and Catholics. They led the Lutheran Tycho Brahe to develop a geo-heliocentric system which combined some of the mathematical elegance of heliocentrism with a stationary earth. On the Catholic side a new insistence on abiding by traditional interpretations of the Bible (as defined principally by the Church Fathers) resulted in the condemnation of

heliocentrism as absurd in philosophy and heretical in religion in 1616 and the condemnation of Galileo in 1633 for taking such a public stance in support of heliocentrism in his Dialogue Concerning the Two Chief World Systems. This condemnation was ineffective in stemming the acceptance of Cartesian and Newtonian cosmologies, both of them heliocentric, and a movement within the Church to overturn it began in the mid-18th century, though Copernicus' book was removed from the Index only in 1833.[30] After the condemnation of Descartes in 1671, which did not prevent the adoption of Cartesianism in French universities by the 1690s, the Catholic Church generally avoided taking stands on new scientific ideas. The faultline between theology and philosophy which had dominated disciplinary interactions since the Middle Ages faded as other disciplinary constellations took shape.

During the 17th century the gap between mathematical sciences and natural philosophy gradually closed and a gap between the "two cultures" began to emerge. The conversion of natural philosophers from commentary on Aristotle to the study of mathematical laws of nature was an early and significant phase of this process. The mathematized Newtonian synthesis was rapidly hailed in its time as conclusively demonstrated, universally true and clearly superior to any alternatives (even in France where Newtonianism prevailed by the 1730s). Natural history and the life sciences did not change as radically during the 17th century, but these disciplines too became less reliant on ancient authority and increasingly grounded in direct observation. Even without a mathematical barrier to entry, these fields developed specialist requirements of their own--including for example protocols for the use of instruments, for description and comparative analysis of specimens.[31] Most importantly Francis Bacon created an aura of authority for the non-mathematical, empirical sciences on the promise that they would soon deliver practical improvements and new knowledge.[32]

The new admiration for the natural sciences, both mathematical and "Baconian," was an important backdrop for the debates known as the "quarrel of the ancients and the moderns" in

France and the Battle of the Books in England.[33] Charles Perrault, secretary to Louis XIV's minister Colbert, is credited with starting the French dispute with his delivery in 1687 at the Académie Française of a long poem in which he sang the praises of the age of Louis XIV. He did so principally by proclaiming the superiority of modern accomplishments over those of the ancients in fields ranging from architecture, sculpture and literature to navigation and commerce. Perrault himself remarked that modern superiority was "incontestable" in "fields whose secrets can be calculated and measured," notably "astronomy, geography, navigation, physics, chemistry and mechanics [méchaniques]."[34] In eloquence and poetry Perrault was no less adamant about modern superiority, but he noted that "the impossibility of convincing people in things of taste and imagination" prevented many from acknowledging that superiority. Indeed Perrault's enemies did not dispute claims for progress in the natural sciences, but the debates in France and in England focused on arguments about the relative merits of modern and ancient accomplishments in the arts and literature. These debates likely helped to define artistic and humanistic fields as distinct from the sciences precisely because their achievements could not be measured by practical innovations or widely shared notions of progress. Perrault himself effectively assumed a distinction between the "two cultures," observing, as if the point were unproblematic and self-evident, that scientific fields were cumulative and progressive, while in literary fields matters of taste prevailed over any more objective standard of measurement.

The disciplinary constellation we live with, with a major faultline between the sciences and the humanities (and the social sciences forming in the later 19th century), has roots in the 17th century, in the changes in scientific methods and practices, and in the decline of the tension between philosophy and theology characteristic of earlier disciplinary interactions. The gap between the "two cultures" is bridged today in a number of different ways: by educational requirements in high school and college (which have not necessarily declined despite the end of requirements in classical languages), by writings in both areas aimed at non-specialist audiences and by the curiosity of

individuals in sampling the huge range of kinds of knowledge, available in an ever-increasing range of media. The gap between the two or three (or more) cultures does not strike me as inherently detrimental to our culture—I see it rather as a sign of vitality.

The distinctions we make between disciplines are subject to change over time even though in any given context institutional structures and intellectual arguments are often used to portray those distinctions as fundamental or inherent in the nature of things. Although they are malleable, disciplinary distinctions are not arbitrary--they develop from the assumptions, practices and understandings which are part of the fabric of intellectual and social life of that time and place. Disciplinary distinctions are often decried for narrowing and restricting intellectual work that crosses or merges the disciplines. Certainly interdisciplinary work has often been of great value, for example in the development of the "mixed mathematical" fields which are at the origins of many of the modern physical sciences. Interdisciplinarity is now so well recognized as to be institutionalized in many instances. At the same time disciplinary distinctions and the institutional structures that support them have also been useful, notably in enabling less prestigious disciplines to develop with minimal from dominant ones. As the distinctions between the two cultures seem to be growing sharper than ever, I hope we can look forward to continued acknowledgement of the differences that warrant their intellectual and institutional separation, even as we promote opportunities for interacting between and beyond those distinctions.

NOTES

I am grateful to Oren Harman and Michael Shank for many helpful suggestions.

[1] Benjamin Cohen, "Science and humanities; across two cultures and into science studies," Endeavour 25 (2001), pp. 8-12.

[2] The lecture was translated into Swedish in 1961, German, Norwegian and Spanish in 1963, Italian in 1964, Catalan in 1965, French in 1968 and Russian in 1973. See Paul W. Boytinck, C.P. Snow: A Reference Guide (Boston: Hall, 1980), p. 9, to which I can add Die Zwei Kulturen: literarische und naturwissenschaftliche Intelligenz, tr. Grete and Karl-Eberhardt Felten (Stuttgart: Klett, 1963) and Le due culture, tr. Adriano Carugo (Milano: Feltrini, 1964). A partial translation appeared in China in 1984 entitled "Liang-zhong wenhua" in Zhongguo wenhua 1 (1984): 454-65, as cited in Tongqi Lin, review of Scientism and Humanism: Two Cultures in Post-Mao China (1978-89), Philosophy East and West 47, no. 4 (1997), 607-11, p. 610.

[3] German discussions of Snow's thesis have been and continue to be particularly active. While the term for the natural sciences is quite stable ("Naturwissenschaften"), those for the "humanities" range from "literarische Intelligenz" (the term used in the German translation of Snow's original and in Helmut Kreuzer ed., Literarische und naturwissenschafltiche Intelligenz, C. P. Snows These in der Diskussion, Stuttgart: Klett-Cotta, 1987) to "Bildung" (in Werner Kutschmann, Naturwissenschaft und Bildung, Der Streit der "Zwei Kulturen", Stuttgart: Klett-Cotta, 1999) and "Geisteswissenschaften" (in Jost Halfmann and Johannes Rohbeck ed., Zwei Kulturen der Wissenschaft revisited, Weilerswist: Velbrück Wissenschaft, 2007); see Die Zwei Kulturen, Forum Clausthal, Heft 12 (2000). Others use the English terms; e.g. "Zwei Kulturen" at http://science.orf.at/science/rosenstrauch/4222 (consulted 9-17-07) switches to English terms by the third section entitled "Trennlinien zwischen 'Sciences' und 'Humanities.'" For an international discussion in English, see Meeting the Challenges of the Future. A discussion between the two cultures, ed. Walter Rüegg, Balzan Symposium 2002 (Florence: Leo S. Olschki, 2003).

[4] Paul Feyerabend presents an extreme version of this position in Against Method (London: NLB and Atlantic Highlands: Humanities Press, 1975).

[5] See for example Nancy G. Siraisi, History, Medicine and the Traditions of Renaissance Learning (Ann Arbor: University of Michigan, Press, 2007).

[6] Oxford English Dictionary, consulted on-line 9-17-07: "Humanity" section 4a: "Caxton, Gold[en] Leg[end] 121a/2. He floured in double science ... that is to saye dyvynyte and humanyte. " The first occurrence of the plural "humanities" is dated to 1702 in section 4b.

[7] On Aristotle's separation of the disciplines see Malcolm Wilson, Aristotle's Theory of the Unity

of Science (Toronto: University of Toronto Press, 2000), pp. 8-9. For Renaissance reaffirmations of this principle see Neal Gilbert, Renaissance concepts of method (New York: Columbia University Press, 1960), e.g. p. 8; pp. 146-47.

[8] For a brief survey of classifications of knowledge see my "Organizations of Knowledge," in Cambridge Companion to Renaissance Philosophy, ed. James Hankins (Cambridge: Cambridge University Press, 2007), pp. 287-303.

[9] The question of the order in which to teach the disciplines was somewhat different and less often discussed; see Gilbert, Renaissance concepts of method, p. 30-31.

[10] See James Weisheipl, "The Nature, Scope and Classification of the Sciences," in Science in the Middle Ages, ed. David Lindberg (Chicago: University of Chicago Press, 1978), pp. 461-82, p. 467.

[11] On their development see Universities in the Middle Ages, ed. Hilde de Ridder-Symoens (Cambridge: Cambridge University Press, 1992).

[12] David Lindberg, "The Transmission of Greek and Arabic Learning to the West," in Science in the Middle Ages, pp. 52-91.

[13] A Source Book in Medieval Science, ed. Edward Grant (Cambridge, Mass: Harvard University Press, 1974), p. 47.

[14] See Richard C. Dales, "The origin of the doctrine of the double truth," Viator 15(1984), pp. 169-79; Martin Pine, "Pomponazzi and the Problem of 'Double Truth,'" Journal of the History of Ideas 29 (1968), pp. 163-76; and J.M.M.H. Thijssen, "What really happened on 7 March 1277? Bishop Tempier's condemnation and its institutional context," in Texts and contexts in ancient and medieval science, ed. Edith Sylla and Michael McVaugh (Brill: Leiden, 1997), pp. 84-114.

[15] For an introduction to this topic see John F. Wippel, Mediaeval reactions to the encounter between faith and reason (Milwaukee: Marquette University Press, 1995).

[16] See Dales, p. 173; more generally, Thomas Aquinas, Siger of Brabant, St Bonaventure, On the Eternity of the World, tr. Cyril Vollert et al. (Milwaukee: Marquette University Press, 1964).

[17] For more on the latitude of forms, see John Murdoch and Edith Sylla, "The Science of Motion," in Science in the Middle Ages, pp. 231-241.

[18] See more generally Daniel Callus, "The function of the philosopher in 13th-century Oxford," in Beiträge zum Berufsbewusstsein des mittelalterlichen Menschen, ed. Paul Wilpert (Berlin: De Gruyter, 1964), 152-62; John Marenbon, "The theoretical and practical autonomy of philosophy

as a discipline in the Middle Ages: Latin philosophy 1250-1350," in Knowledge and the sciences in medieval philosophy: proceedings of the Eighth International Congress of Medieval Philosophy Helsinki, August 1987, ed. Monika Asztalos, John Murdoch and Ilkka Niiniluoto (Helsiniki: Yliopistopaino, 1990), pp. 262-74. For a different perspective on the "two cultures" in the Middle Ages, see Lynn White Jr., "Science and the Sense of Self: The Medieval Background of a Modern Confrontation," Daedalus 107 (1978), pp. 47-59.

[19] For a brief survey of the multiple strands of natural philosophy in the 16th and 17th century see my "Natural philosophy" in Cambridge History of Science, vol. 3: Early Modern Science, ed. Katharine Park and Lorraine Daston (Cambridge: Cambridge University Press, 2006), pp. 365-406.

[20] See Richard Westfall, "The Rise of Science and the Decline of Orthodox Christianity: a study of Kepler, Descartes and Newton," in God and Nature, ed. David Lindberg and Ronald Numbers (Berkeley: University of California Press, 1986), pp. xx

[21] On the development of the new literary and artistic fields, see Paul Oskar Kristeller, "The Modern System of the Arts: a study in the history of aesthetics," Journal of the History of Ideas 12 (1951), pp. 496-527 and 13 (1952), pp. 17-46. "Belles-lettres" does not appear in the Dictionnaire de l'Académie in 1694 and is first attested in English in The Tatler in 1710 according to the Oxford English Dictionary (both consulted on-line 9-17-07).

[22] E. O. Wilson, Consilience: the Unity of Knowledge (New York: Knopf, 1998). Among other insightful critiques see D. Graham Burnett, "A View from the Bridge: The Two Cultures Debate, Its Legacy, and the History of Science," Daedalus 128 (1999), pp. 193-218, pp.213-14.

[23] Thomas S. Kuhn, "Mathematical versus Experimental Traditions in the Development of Physical Science," in The Essential Tension. Selected Studies in Scientific Tradition and Change (Chicago: University of Chicago Press, 1977), pp. 31-65.

[24] William Laird, "The School of Merton and the middle sciences," Bulletin de philosophie médiévale 38 (1996), pp. 41-51.

[25] See for example Michael H. Shank, "Mechanical thinking in European astronomy (13th -15th centuries)," in Mechanics and Cosmology in the Medieval and Early Modern Period, ed. Massimo Bucciantini et al. (Florence: Olschki, 2007), pp. 3-27.

[26] Robert Westman, "The Melanchthon Circle, Rheticus and the Wittenberg Interpretation of the Copernican Theory," Isis 66 (1975), pp. 165-193; and Peter Barker and Bernard Goldstein, "Realism and instrumentalism in 16th astronomy: a reappraisal," Perspectives on Science: Historical, Philosophical, Social 6 (1998), pp. 232-258.

[27] William Wallace, Galileo and his sources : the heritage of the Collegio Romano in Galileo's science (Princeton: Princeton University Press, 1984).

[28] For introduction to these developments see I.B. Cohen, The Birth of A New Physics, updated ed. (New York: Norton, 1985).

[29] Nicolaus Copernicus, De revolutionibus. On the revolutions, tr. Edward Rosen (Baltimore: Johns Hopkins University Press, 1992), preface, p. 5

[30] On the reception of Galileo, see Richard Blackwell, Galileo, Bellarmine and the Bible (Notre Dame: Notre Dame University Press, 1991); on an early attempt to remove Copernicus from the Index of forbidden books see Pierre-Noël Mayaud, La condamnation des livres coperniciens et sa révocation à la lumière de documents inédits des Congrégations de l'Index et de l'Inquisition (Rome: Editrice Pontificia Università Gregoriana, 1997). More generally see John L. Heibron, The Sun in the Church: cathedrals as solar observatories (Cambridge, Mass.: Harvard University Press, 1999).

[31] Linnaeus for example made a point of creating a barrier to entry into the practice of natural history; see Lisbet Koerner, Linnaeus: Nature and Nation (Cambridge: Harvard University Press, 1999).

[32] See Antonio Pérez-Ramos, "Bacon's Legacy," in Cambridge Companion to Francis Bacon (Cambridge: Cambridge University Press, 1996), pp. 311-34.

[33] See Marc Fumaroli's long preface in La querelle des anciens et des modernes, ed. Anne-Marie Lecoq (Paris: Gallimard, 2001); and Joseph M. Levine, The Battle of the Books : history and literature in the Augustan Age (Ithaca: Cornell University Press, 1991)

[34] Charles Perrault, Parallèle des anciens et des modernes, ed. H. R. Jauss (Munich: Eidos Verlag, 1964), p. 98 (sig e iiij r-v of the 1688 edition provided in facsimile).