

## I.2 The Natural Sciences and the Humanities in the Seventeenth Century *Not Separate Yet Unequal?*

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When scientists in our day meddle with the humanities, the outcomes are not always uplifting. Sometimes they are, as when art historians and chemists supplement each other's expertise quite nicely in establishing or disproving the authenticity of some famous painting. In my own discipline, the history of science, the contributions scientists make are rarely so productive, unless (as, for instance, with Thomas Kuhn) they turn themselves into professional historians. Professional scientists with a layman's interest in history certainly tend to display a deep-seated emotional involvement in past manifestations of their own present-day concerns. But the flip side of their praiseworthy engagement is most often a rather upsetting naiveté. Armed with a few facts of questionable reliability, even the most history-conscious scientists tend to lack even the most elementary idea of how historians are for good, long-established reasons wont to deal with past facts. Clearly, to them the sciences and the humanities are quite distinct, or even insuperably different, areas of scholarship.

So much for science/humanities interactions in my professional experience. The remainder of the present chapter is about similar interactions in the past, or, more precisely, during the founding period of modern science some three to four centuries ago. I shall examine a few cases where certain subjects that were later to be reckoned among the humanities were taken up at some depth by scholars who at a later age were to count unambiguously as scientists. In examining four selected crossover cases, my primary concern is with the rigorous distinction between the sciences and the humanities that we are used to maintain at present. Rens Bod, Eric Jorink, and others have taught us that, with due reservations even for the present day, it is certainly pointless to make such a distinction for any period prior to the late nineteenth century.<sup>1</sup> My question is: Do my four chosen authors (in chronological order, Johannes Kepler, René Descartes, Blaise Pascal, and Isaac Newton) agree with Rens and Eric? Or do they perhaps prove these learned gentlemen wrong, in that they do make pre-

cisely such a distinction, either in principle or, if not that, then at least in their actual practice?

What, indeed, about the performance of these four great men of the Scientific Revolution in (to them) foreign territory? Do we find Kepler or Newton operating differently when pursuing their chronological than their astronomical studies, or not? And what about the quality of their performance? Do they operate with the disdain of professional standards on display with those history-minded scientists of today? Or did the more humanities-focused participants in then current debates perceive these apparent intruders as (by and large) their equals? Also, how do we, in looking back, judge the quality of their performance? Was Newton as great a chronologist as he was in the domains for which we still rightly celebrate him?

A clear-cut instance of a positive answer to my first question, about whether or not a principal distinction was being made at the time between science-like and humanities-like pursuits in the period of the Scientific Revolution, is provided by Blaise Pascal. In a programmatic fragment dating from c. 1647 and posthumously entitled 'Préface pour le Traité du Vide' ('Preface for the Treatise on the Void') he lists on the one hand the disciplines of history, geography, law, languages, and theology. On the other hand you have geometry, arithmetic, music, physics, medicine, and architecture. His enumeration is not meant to be exhaustive in either case, yet I am not omitting any of those he does list. Now by what criterion does Pascal distinguish the one category from the other? Knowledge in domains of the former kind, so he argues, can be attained only by consulting books, whereas the latter 'fall under the senses or under reasoning'.<sup>2</sup> If, so he continues, you want to know who was the first king of France, or where geographers place the first meridian, you are necessarily bound by authority, in that you must look up writings by authors, whereas if you want to find out about, for instance, void spaces you cannot fall back upon available writings on the subject – you must make experiments and then reason upon the outcomes thereof.

Consequently (so Pascal keeps arguing) innovation is quite possible and, indeed, indispensable in fields of the latter kind, whereas with the former their very point is to stick to what we have. Consequently, the Jesuits (Pascal's arch-enemies) have it doubly wrong. In theology, they introduce all kinds of innovations where these do not belong, in that they go way beyond the sole repository of religious truth, Scripture and the Church Fathers. But these self-same Jesuits oppose new, experimental findings about (for instance) the void, as contradicting the received wisdom of the ancients. By way of another consequence that Pascal draws from his distinction, the perfection of disciplines of the former, humanities-oriented kind lies in the past, whereas the latter can only attain perfection in an as yet unknown future. In short, the humanities are unlike the

sciences in that only the latter, guided by experimental reasoning, are capable of attaining progress.<sup>3</sup>

It may look surprising that, in his listing of sciences capable of such progress, Pascal takes up 'music'. In this connection he meant not so much the practice of music as, rather, the mathematical-physical theorizing that underlies it. Indeed, my next case of a humanities/sciences distinction being made during the Scientific Revolution concerns thoughts about musical theory of a thinker Pascal abhorred only slightly less than he did the Jesuits, to wit, his older acquaintance René Descartes. The grounds for Pascal's abhorrence (scholarly, not personal) reside in what he diagnosed as Descartes' know-all pretensions, his claim to have hit once and for all upon the one indubitably true system of all knowledge that we can possibly attain of the natural world and how it operates. Take a typical line from Descartes like the following, near the end of *Discours de la méthode*:

Making my mind pass once again over all objects which at any time have presented themselves to my senses, I venture to say that I have never come across any thing which I could not explain adequately enough by means of the Principles I had found.<sup>4</sup>

'Explain', for sure! Descartes (I am addressing him here in his philosopher's role, not as a highly innovative mathematical scientist) was not out to discover any new phenomena.<sup>5</sup> His concern was rather to give these their rightful place in his grand scheme of things, necessarily true because he had derived it from indubitably secure first principles. Whenever his faithful correspondent back in Paris, Marin Mersenne, who was in the business of making empirical discoveries, confronted Descartes with his latest, Descartes' preponderant, nay, his sole concern was to make the new phenomenon fit in with his natural philosophy of particles in motion. However, in one exceptional case Descartes did not go along.<sup>6</sup> The subject, part of the contemporary science of music, was degrees of consonance – a concern, not only of Mersenne, but of Galileo, Kepler, Beeckman, and other pioneers, too. Most agreed that the phenomenon of consonance (that is, the sweet, near-blending quality of certain musical notes sounding together) is due to how often the notes that make up a musical interval coincide. Musical sound, so they came to realize, is produced by the vibrations of a string put in motion, and each musical interval is marked by a specific ratio of vibrational frequency, as 1:2 for the octave, 2:3 for the fifth, etc. (in modern terms, standard A is 440 Hertz, hence, the A one octave higher is 880 Hertz). In Mersenne's view it followed that, the more often two strings co-vibrate, the more consonant are the intervals thus produced. With the octave, vibrations coincide every  $1 \times 2 =$  second time, with the fifth every  $2 \times 3 =$  sixth time, and so on. This yields a neat scale of degrees of

consonance, from the unison 1:1 to the minor sixth 5:8. How, then, could it be that musical practice fails in several regards to conform to this mathematical-physical rule of descending consonance?

Confronted by Mersenne with the scale and with the question, Descartes felt comfortable only with one portion thereof – the portion that we would nowadays call ‘scientific’. The scale of degrees of consonance that seems to follow inexorably from Mersenne’s coincidence account of consonance, so Descartes retorted, is indeed right as far as it goes. Only, it does not go very far:

Concerning the sweetness of the consonances two things should be distinguished: namely, what renders them simpler and more accordant, and what renders them more agreeable to the ear. Now, as to what renders them more agreeable, that depends on the places where they are employed; and there are places where even diminished fifths and other dissonances are more agreeable than consonances, so that one could not determine absolutely that one consonance is more agreeable than another. [...] One can say absolutely which consonances are the most simple and the most accordant ones; for that depends only on how often their sounds unite, and how closely they approach the nature of the unison; so that one can say absolutely that the fourth is more accordant than the major third, while ordinarily it is not so agreeable, just as the cassia is definitely sweeter than olives, but not so agreeable to our taste.<sup>7</sup>

What we appear to have here, then, is (once again) a clear-cut sciences/humanities dichotomy. Descartes perceptively distinguishes between the ‘science’ aspect of musical consonance, which is a matter of ratios of vibrational frequencies, and the aspect of artistic analysis, concerned with the actual context of an actual musical piece in which musical intervals are bound to serve in multiple ways that, at the very least, do not correspond in a one-to-one manner with what mathematical-physical analysis leads us to predict.

To be sure, Descartes was enabled to making the distinction in the first place, not out of some *a priori* urge to distinguish the sciences from the humanities so much as, rather, due to the extraordinary feature of his natural philosophy just discussed – his emphatic claim to indubitable certainty. The consequence of his highly staked claim (of his all-or-nothing style of philosophizing, really), was that all those matters he did *not* feel certain about ought to be banished to the outer darkness reserved for topics at the other side of the certainty/uncertainty divide. As in another context he acknowledged himself, he was barely able, when listening to a piece of music, to distinguish a fifth from an octave, or judge whether someone had correctly sung *ut re mi fa sol la*, let alone do it himself. In

sum, then, Descartes' urge to distinguish between the sciences and the humanities side of scholarly life coincided with what he felt subjectively certain of, and what not.

My final topic concerns the discipline of chronology. What I have picked up on the subject I owe (of course) to Anthony Grafton,<sup>8</sup> further to Franz Hammer, co-editor of Johannes Kepler's *Gesammelte Werke*,<sup>9</sup> and to Isaac Newton's biographer Richard S. Westfall.<sup>10</sup> The subject of greatest fascination to Kepler, second only to his all-time favorite, the science of the heavens, was the year of nativity – How many years before Christ was Jesus actually born? The seemingly obvious answer – 'Well, none at all, of course' – was by the early seventeenth century greatly in doubt, as many students of the matter had already questioned the accuracy of the sixth-century monk who created our Christian 'Anno Domini' calendar. But by how many years had this learned monk been wrong?

At the time when Kepler was drawn into the question by a patron who sought his help in fixing dates of Roman history by means of heavenly events like lunar and solar eclipses or planetary conjunctions, Joseph Just Scaliger was busily turning himself into the great authority on this and all other topics that come up in what in his hands became the academic discipline of chronology. Kepler quickly threw himself into the Europe-wide debates that followed upon the appearance of Scaliger's two big books on the subject. Kepler's first publication came as an appendix to his treatise on the New Star, the *nova*, of 1604, and it took shape as an argument to antedate Jesus' birth by one more year than Scaliger had established for it, to wit, the year 6 rather than 5 BC. Two astronomical considerations guided Kepler's determination. One was a lunar eclipse mentioned by Flavius Josephus as occurring on the eve of the death of King Herod (the year of Herod's demise was one important tidbit in the stew of Bible passages, ancient calendar rules, passing remarks by the yes or no reliable historian Flavius Josephus, and other contemporary facts and factoids that together made up the riddle of the nativity). Kepler realized, as Scaliger had, too, that in years around 1 BC not one but two lunar eclipses qualified, but on astronomical grounds not considered by Scaliger he settled on the one that led to 4 BC for Herod's death and, hence, to 6 BC for Jesus' birth. Kepler thus left the Magi some 10 months for making up their minds upon spotting the Star of Bethlehem finally to set out on their voyage to the crib of God's Son.

Actually, the Star of Bethlehem provided the other piece of evidence for Jesus' birth in 6 BC that Kepler dropped into the current debate. He connected the Star to the 1604 *nova* he was writing about, by means of a series of Saturn-Jupiter conjunctions that happened to accompany both these spectacular heavenly events. It is a very technical argument, such as only an expert astronomer could produce, and together with the lunar eclipse just ahead of King Herod's death it made

Kepler settle for good on 6 BC, the year (by the way) still accepted today partly on other grounds.

Kepler did more than just drop 6 BC and his arguments for it into an ongoing debate – he actually joined it. Expert chronologists of both Catholic and Protestant denominations, some of whom he knew personally, challenged his conclusions, and he met their not so much astronomical as, rather, historical arguments on their own ground. For instance, he argued at length for the reliability of Flavius Josephus's book on Jewish history in view of its consistency both with the text itself and with other contemporary Roman authors. In short, Kepler turned himself into an expert historian, taking part in the chronological debate with the research methods and the criteria for authenticity then current in the field. Thus he gained the respect of many among those who, together with Kepler, took the late Scaliger's vast scholarship to heart.

Can we say the same thing about Isaac Newton's concerns with chronology? No, we cannot, as hardly a word of his even more extensive writings on the subject was published during his lifetime. Nor is this by accident – Newton kept quite deliberately silent about the vast scholarship he, too, had amassed in chronology. He came to the subject due to the theological studies he engaged in as a consequence of the obligation that rested upon every Fellow of Trinity College at Cambridge to be ordained within seven years of appointment to the fellowship. A few years ahead of that deadline, so as to acquaint himself with the theological background to the solemn oath he would in due time have to swear, Newton threw himself with his customary methodical thoroughness into the writings of the church fathers – not only Augustine or Eusebius but just about all of them. In those hefty tomes he made an unsettling discovery. In course of the debates over Christian dogma that had raged all over the fourth to sixth centuries, people had been deceived, words had been twisted, texts had been corrupted, so as to peddle and eventually get turned into dogma a pernicious, wholly unbiblical notion – that of the Trinity. The two Bible verse which proclaim the consubstantial unity of God the Father, God the Son, and God the Holy Spirit appeared to Newton to be fourth-century forgeries, produced by Athanasius, Bishop of Alexandria, in his ongoing battle with Arius, priest in the same city. Newton relived these millennium-old ecclesiastical battles as if he took part in them, himself. In a sense he did. In short order he took the part of Arius, rejected for good the Holy and Undivided Trinity on which he was presently to swear an oath in the very college of that name. He knew well that if he made his heretical views known he would be kicked out of Cambridge University forthwith. He chose not to take the mantle of another prophet out to combat corruption, but to keep silent, all his life. Somehow he managed to wriggle out of ordination, and he kept pursuing his theological studies in private for the rest of his life.

Chronology was definitely part of those studies. The only books he wrote that appeared during his lifetime are, of course, *Principia* and *Opticks*, but within a year of his death a third, his *Chronology of Ancient Kingdoms Amended* saw the light of day. As Westfall has shown, one should not take this work at face value, as Newton had deliberately robbed his entire chronology of its own thrust. The true point of this book, which he took great care to keep out of it, is rather to be found in a much earlier manuscript of fully heretical, part late-Arian part early deist tenor, known after its incipit as 'Theologiae gentilis origines philosophicae' ('The Philosophical Origins of Gentile Theology').<sup>11</sup> There is an original, wholly rational religion, with at its center celebration of God's absolute predominance over the cosmos by means of a fire that represents the sun with the planets orbiting it. This religion, 'then which nothing can be more rational', was instituted after the Flood by Noah, and spread over the length and breadth of the ancient world by Noah's three sons. Due to the depravities of the human heart, this rational religion has found itself corrupted time and again. Ever so often God sends a prophet, Abraham, Moses, Jesus, to bring religion back to its pristine purity, but then corruption sets in all over again, as in the fourth century with Athanasius.

Religion just rational, Christ just a prophet – all this did not just smack of heresy, it constituted heresy in Newton's own time, and he knew it. His private time-reckoning in the 'Origines' testifies to it, too – in view of the role accorded Noah and his sons Newton acquired an interest in curtailing time as much as he possibly could. That is why he availed himself, among many other tricks of the trade, of a subterfuge that was already around for some time. Facing as Scaliger had the inconveniently lengthy chain of pharaohs in Manetho's authoritative listing, Gerard Vossius departed from Scaliger in shortening the chain by declaring without a shred of evidence several early Egyptian dynasties to be not consecutive but parallel. Why Newton followed Vossius in this regard, then, becomes clear, not from his orthodox-looking book on chronology itself but from his far earlier, profoundly heretical 'Origines'.

It is time to draw from the foregoing some conclusions. There are, of course, many more pertinent cases to examine than the four I have just sketched in their barest outlines, such as, for instance, Galileo's literary criticism or Bacon's *Essays* or (a vast enterprise in itself) numerous writings by the incredibly versatile Leibniz. So whatever responses I shall now give to the questions I announced at the start of the present chapter can be no more than very provisional.

Two of our protagonists made a principled distinction. Pascal did so in general terms, Descartes in one specific case only. Descartes' distinction, stemming as it did from the ideal of indubitable certainty paramount to all his philosophizing, seems to correspond by and large to his famous dualism of *res extensa* (extended



stuff) and *res cogitans* (thinking stuff). Pascal's distinction, much like the one so often maintained at present, is between disciplines that draw on authoritative, extant texts, and those that build forth upon experimental reasoning. In contrast, neither Kepler nor Newton seems to bother to make any distinction in principle, so the question is whether it may nonetheless be found back in their actual practice. To a large extent the answer is 'yes'. When doing chronology, both men are chronologists with the chronologists. Kepler took a full, well-respected part in current debates. So, but inevitably posthumously, did Newton's thoroughly self-emasculated views on the subject.

Even so, both men contributed something uniquely their own to the field as well, something that derives from their work in domains we now call scientific. Kepler's solution to the problem of nativity, albeit defended in terms of then current history writing, resulted from his pursuing in depth questions raised by lunar eclipses and past and present planetary conjunctions. Astronomy was hardly foreign to the field of chronology as Scaliger restructured it, only, Kepler was on surer ground and thought more deeply about its possible uses. With Newton the contribution of his science to his chronology, or more generally speaking to the theology which determined the entire thrust of his chronology, is more complex. Just like Kepler, he enriched his efforts in chronology with astronomical details foreign to other practitioners, such as his usage of the precession of the equinoxes for calculating the exact year of the expedition of the Argonauts as a baseline for Greek history. More importantly, Newton's conception of human history stemmed in the last resort from his personal conception of the Deity, that is, from an idea expressed as well in the second edition of his *Principia* – God's absolute dominion over nature as over human history.

No full-blown distinction between the 'humanities' and the 'science' side of things is called for, then, in either case – in the period of the Scientific Revolution the two interpenetrate to some extent. This applies *a fortiori* to both Kepler's and Newton's working habits. Kepler brought to his chronological investigation the same style of enthusiastic outbursts alternated with doggedly pursued exactitude that we encounter in his astronomical work. Newton's theological efforts are just as thoroughly and methodically undertaken, just as much built upon vast, carefully accumulated learning as is true of his work on the calculus, on orbital motion, and on light and color.

Still, interpenetration goes only so far. Kepler's unique achievement in the domain of planetary theory rests in good part on his willingness to throw the results of the most painstaking theorizing and calculating in the wastebasket when a timely empirical check showed these results to be wrong within available limits of accurate measurement – the rightly famous eight minutes of arc discrepancy between a parameter theoretically predicted and actually measured. No such will-



ingness seems to mark Kepler's work in chronology. He arrives at a well-reasoned conclusion, and he sticks to it. Not that, as a rule, the discipline of chronology left room for clear-cut empirical refutation – one could always twist the evidence to one's own, always theologically determined advantage. So it is with Newton. In *Principia*, he went out of his way to establish an exact match between abstract orbits derived geometrically and planetary orbits observed physically, not hesitating along the way to subject ideas dear to him to the strictest scrutiny and if need be reject them without more ado. In *The Chronology of Ancient Kingdoms Amended* he availed himself without apparent qualms of Vossius' gambit at the service of a fully preset conclusion – the relatively short amount of time available for Noah's sons in spreading true, rational religion before its first corruption. This conclusion in its turn followed inexorably from his highly personal, deeply felt conception of what a truly rational religion amounts to.

So a final conclusion to my preliminary investigation seems to be this. At the 'science' side of things, as distinguished along Pascal's lines from the 'humanities' side of things, impartiality in the sense of a certain readiness to subject one's dearest conclusions to rigorous testing, albeit difficult always, is easier to attain with the former than with the latter. In the humanities, notably, of course, in the theological concerns always present in all seventeenth-century thinking, values dear to the human heart could not, as they still cannot, fail to determine the overall setup and course of an investigation to a far larger extent than in the sciences of the natural world. By and large, Pascal had it right.

## Notes

- 1 Rens Bod made the point throughout his *De vergeten wetenschappen. Een geschiedenis van de humaniora*. (Amsterdam: Bert Bakker, 2010), translated since as *A New History of the Humanities* (Oxford University Press, 2013). Eric Jorink did so in his *Het Boeck der Natuere. Nederlandse geleerden en de wonderen van Gods Schepping 1575-1715* (Leiden: Primavera Pers, 2006), translated as: *Reading the Book of Nature in the Dutch Golden Age, 1575-1715* (Leiden: Brill, 2010).
- 2 Blaise Pascal, 'Préface pour le Traité du Vide', first line of the seventh paragraph: 'des sujets qui tombent sous le sens ou sous le raisonnement'.
- 3 To be sure, Pascal does not literally use the term 'progress', but the entire point of his next paragraph is the steady advance of the sciences since their inception with the Greeks.
- 4 René Descartes, *Oeuvres* 6, 64 (*Discours de la méthode*: part 6): 'repassant mon esprit sur tous les objets qui s'estoient jamais presentez a mes sens, i'ose bien dire que ie n'y ay remarqué aucune chose que ie ne puisse assez commodement expliquer par les Principes que i'avois trouvez'.
- 5 In my *How Modern Science Came into the World: Four Civilizations, One 17th-Century Breakthrough* (Amsterdam University Press, 2010), I take great pains to maintain this distinction, which was quite in keeping with the (up to mid-seventeenth-century) tradi-

tional, almost watertight separation between mathematical science and natural philosophy in the sense of a closed system of speculative thought.

- 6 I have treated the matter at some length in my *Quantifying Music: The Science of Music at the First Stage of the Scientific Revolution, 1580-1650* (Dordrecht: Reidel, 1984), 169-172.
- 7 René Descartes to Marin Mersenne, October 1631: 'Touchant la douceur des consonances, il y a deus choses a distinguer: a sçavoir, ce qui les rend plus simples et accordantes, & ce qui les rend plus agreables a l'oreille. Or, pour ce qui les rend plus agreables, cela depend des lieux ou elles sont employées; & il se trouve des lieux ou mesme les fausses quintes & autres dissonances sont plus agreables que les consonances, de sorte qu'on ne sçauroit determiner absolument qu'une consonance soit plus agreable que l'autre. [...] Mais on peut dire absolument quelles consonances sont les plus simples & plus accordantes; car cela ne depent que de ce que leurs sons s'unissent davantage l'un avec l'autre, & qu'elles approchent plus de la nature de l'unison; en sorte qu'on peut dire absolument que la quarte est plus accordante que la tierce maieur[e], encore que pour l'ordinaire elle ne soit pas si agreable, comme la casse est bien plus douce que les olives, mais non pas si agreable a nostre gout'.
- 8 Anthony Grafton, 'Joseph Scaliger and Historical Chronology: The Rise and Fall of a Discipline', *History and Theory* 14.2 (1975), 156-185.
- 9 Franz Hammer's extensive 'Nachberichte' in volumes 1 and 5 of Johannes Kepler's *Gesammelte Werke*.
- 10 Richard S. Westfall, *Never at Rest: A Biography of Isaac Newton* (Cambridge University Press, 1980).
- 11 This is the one work by Newton on which Westfall developed views that go substantially beyond *Never at Rest*. See R.S. Westfall, 'Isaac Newton's Theologiae Gentilis Origines Philosophicae', in W.W. Wagar (ed.), *The Secular Mind: Transformations of Faith in Modern Europe* (New York/London: Holmes & Meier, 1982), 15-34.