

The Roots of Modern Reason

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I.

The sciences in seventeenth-century Europe were integral parts of the high culture of the period. That high culture is often described as “baroque.” So we must be able to talk about “baroque science.” I take it that this is, in some form, the fundamental moving theme in this workshop. At the same time, we all know that art-history speak can be of problematic value in other areas of history, including the history of science: “styles” in science can always be identified, after the fact, as it were, but using them as analytical, or else explanatory, elements seems to many of us a case of mistaking the explanandum for the explanans. If the term “baroque” is to mean anything that we can use, it must surely be identifiable as a catch-all label for various cultural practices that we will then want to explain as outcomes of social processes, not as an explanatory template by reference to which we account for those particular practices in a self-vindicating, essentializing representation of an historical period.

Maravall’s Culture of the Baroque¹ is one such attempt, in the tradition of grand theorizing in history, and in its way looks rather dated. Precisely by rejecting the use of the label “baroque” as a stylistic tag that implicitly refers to a suprahistorical idealist entity that can serve to organize in a meaningful way an entire period and society, Maravall required himself to use the term as the designation of an outcome of socially identifiable processes, with their economic corollaries. His is a persuasive and admirable attempt, which is meant to embrace, to one degree or another, all of western Europe and all levels of society. That favourite of the early-modern cultural historian of the 1980s, absolutism, finds its place as just one manifestation of this entire structure (as Maravall calls it).

My own historical sensibilities also derive in large measure from another intellectual project that flourished in the 1980s, namely the science-studies version of constructivism. Those sensibilities approve of social practices and social conventions as ways of making sense of the performance of culture, and they purport to disdain idealism – although in the very specific sense of denying to ideas causal efficacy in explaining the advent of other ideas. In its strict sense, this project never really worked in the way it claimed, but it did bring to prominence sets of questions in addressing cultural practices that vied with the importation of cultural-historical approaches in the history of science, and always insisted on raising social interactions as crucial elements of any satisfactory understanding of a passage of activity. Those social interactions did not need always to be fully explicit, but neither could they be taken as fully unproblematic. It was a research program in science studies that has not yet entirely run its course; its principal sensibilities have quietly become taken for granted in much good work.

¹ . José Antonio Maravall, Culture of the Baroque: Analysis of a Historical Structure (Minneapolis: University of Minnesota Press, 1986).

In this light, Maravall's project was valuable but not radical enough. He rejected "the baroque" as an explanatory entity, but still talked about "culture" and "mentalities" as essential components of what he called "the baroque." They too make trouble. Anthropologists in particular are scared of "culture" nowadays, and "mentalities" always only sounded good in French (or French usage: compare habitus).² And, perfectly reasonably, he was a realist about society – social structure, classes and so on (something a Latourian might complain about, however). So where does that leave the historian interested in saying something about "the baroque"? One step might be to outlaw talk of "the baroque" at all; never a noun, only an adjective. But to the extent that we know them when we see them, cultural practices and artifacts that are "baroque" mean something to us, and, by transference to our historical actors, we want to understand those meanings in their lives. In the senses of a Norbert Elias or a Michel Foucault, we want to get at the internalization of behaviours and sensibilities in individuals, and at the same time to make sense of those internalizations as part of much larger socio-cultural structures, or régimes, or forms of life.

I attempted a few years ago to do something of the sort in relation to the category of absolutism as a cultural form.³ There the idea was to relate the legitimacy of a particular political arrangement to the expertise of the new experimental philosopher, and to argue that each worked according to the same concessions of ineffable authority. In a related endeavour, I have also tried to make sense of the intelligibility of Cartesian mechanical explanation in relation to early-modern court culture, similarly related to absolutist régimes.⁴ The present paper is an attempt to understand another prominent theme in seventeenth-century philosophy in ways that will also prove to link back to recognizable cultural elements, in this case ones with relation to the "baroque." This theme is "reason."

II.

Reason has been a central value in the sciences, mathematics, natural history and various other knowledge enterprises for many centuries; at the same time, it would obviously be ahistorical to imagine that "reason" has always referred to the same thing. The eighteenth century is the "age of reason," of course, but what did that mean, and how did the theme develop? In the preceding century, reason as a category or a discourse was sometimes subjected to uses and even explicit discussions that exposed it to different kinds of scrutiny than became the norm in the eighteenth, and some of those discussions indicate important issues that subsequently became hidden beneath the overlay of shifting questions; but they were still there.

² . E.g. G. E. R. Lloyd, Demystifying Mentalities (Cambridge: Cambridge University Press, 1990).

³ . Peter Dear, "Mysteries of State, Mysteries of Nature: Authority, Knowledge and Expertise in the Seventeenth Century," in Sheila Jasanoff (ed.), States of Knowledge: The Co-Production of Science and Social Order (London: Routledge, 2004), pp.206-24.

⁴ . Peter Dear, "A Mechanical Microcosm: Bodily Passions, Good Manners, and Cartesian Mechanism," in Christopher Lawrence and Steven Shapin (eds.), Science Incarnate: Historical Embodiments of Natural Knowledge (Chicago: University of Chicago Press, 1998), pp.51-82.

For about three centuries, it has been usual to speak of philosophical approaches in the seventeenth century as falling into two main camps, the “empiricist” and the “rationalist.” At the same time, it has become quite common to notice the lack of clarity in that dichotomy, and the ways in which the two alternatives tend to bleed into one another; so Locke, an exemplar of empiricism, can be represented as being much like Descartes, the exemplar of rationalism, when it comes to the innate endowments of the mind; whether these endowments are called “innate ideas” or not becomes the only real point at issue. But attempts in the seventeenth century to draw sharp battle-lines were often quite vigorous nonetheless, and the principal movers in doing that drawing tended to be the people we think of as empiricists, classically the English empiricists Locke and Boyle. These disputes nonetheless avoided contesting “reason” itself as a central component of knowledge-generation, even in attacking “rationalism.” For an “empiricist” philosopher in the seventeenth century, “experience” meant going and looking, as well as thinking about what you saw in some appropriate way; but in addition, “reason” was an essential part of that appropriate way of thinking. Empiricism could not dispense with reason any more than rationalism ignored the lessons of the senses. Most practical uses of the term “reason,” or else “rational,” failed to interrogate it very much, any more than now; usually people talked as though everyone knew perfectly well what such terms meant, and as though these self-evident terms always represented something good.

Usefully-pedantic explications of “reason” and the “rational,” according to different disciplinary contexts, appear in philosophical lexicons of the seventeenth century, and they largely confirm what one might guess from noticing the miscellany of contemporary uses. The Latin word ratio needed to be defined as it was used in mathematics (more or less the same as the modern English mathematical word “ratio”); in metaphysical and physical contexts it was often used as a synonym for the Aristotelian concept of “form,” or forma, and more generally as “cause.”⁵ In the sense in which we tend to think of “reason” in modern English, the appropriate context was that of logic, where reason could be explicated in terms of deductive, inductive, analogical, probable, or demonstrative kinds, in various combinations; ratio meant something like “ratio in action,” where ratio was in this case an intellectual faculty. However, in regard to actual uses of these terms by philosophers, writers tended in general not to tell the reader which relevant sense of the term “reason” they were appealing to; it was presumably supposed to be evident from context, or else functionally ambiguous, as with most language.

One celebrated locus in which the word ratio appears is a comparatively unpublicized one in modern scholarship, insofar as it is usually rendered into modern languages as something other than “reason”: this is Francis Bacon’s talk about method. Rather notoriously in Baconian scholarship, Bacon eschewed the perfectly contemporary word methodus to label what’s usually referred to as his “method”; instead, Bacon’s term in the “Great Instauration” and the New Organon is via et ratio, which is often translated as “method.” That is, Bacon’s famous method is a via, a way of going about things, and in this phrase via et ratio we can see that same sense incorporated into Bacon’s sonorous

⁵ . Goclenius, Micraelius, etc.

periods, using the word ratio itself. And this suggests that “reason” is here for Bacon a way of going along, intellectually.

The particular aspect of reason in this period that seems the most crucial, however, is one that seems on the face of it the most uninteresting. No mention is made of it, for example, in the chapter on “Reason” in Geoffrey Lloyd’s recent considerations in comparative anthropology, Cognitive Variations.⁶ For Lloyd, cultural variations in “reason” are about the differential plausibility of various sorts of informal inference: persuasive metaphors, contextualized versus decontextualized inferences about specific subject-matters, and so on. As with most examinations of active “reasoning,” Lloyd (ironically, for him) ignores questions concerning the sorts of inferences that Aristotle was concerned to formalize: the domain of deductive logic and its mathematical analogues.

In seventeenth-century mathematics, deductive proofs were still the gold standard. They required, in good Euclidean style, the step-wise movement from one set of statements to a new statement that the previous ones were held to imply. But there were some people who found those sorts of movements as worthy of comment. There was no difficulties, in principle, in actually performing them, but understanding how they were done was another matter. Rather than “reason,” the relevant category is perhaps better rendered as “reasoning.”

Descartes addresses the issue of human reasoning head-on in his early text from the 1620s, the Rules for the Direction of the Mind. Here he, in effect, analyzes reasoning down to its fundamentals. In Rule 10, Descartes addresses the procedures of syllogistic logic as a model for disciplined reasoning, and criticizes them for being too rote; so automatic that the mind needs to pay but little attention. The logicians prescribe precepts that supposedly govern human reason, “in which,” he says, “the conclusions follow with such irresistible necessity that if our reason relies on them, even though it takes, as it were, a rest from considering a particular inference clearly and attentively, it can nevertheless draw a conclusion which is certain simply in virtue of the form.”⁷ However, a great danger lies in the use of these procedures: one can easily become trapped in the formal structure, and be misled by sophisms. By contrast, “the cleverest sophisms hardly ever deceive anyone who makes use of his untrammelled reason.”⁸ So natural reason is something that escapes from, or underlies, formal argumentation; the precepts of formal argumentation do not themselves capture it or sum it up. Instead, the operations of reason depend on something that Descartes calls “intuition.”

Thus in Rule 3: “The self-evidence and certainty of intuition is required not only for apprehending single propositions, but also for any discourse whatever.” So, Descartes continues: “Take, for example, the inference that 2 plus 2 equals 3 plus one: not only must we intuitively perceive that 2 plus two make four, and that 3 plus one make four,

⁶ . G. E. R. Lloyd, Cognitive Variations: Reflections on the Unity and Diversity of the Human Mind (Oxford: Clarendon Press, 2007).

⁷ . AT X, pp.405-406; trans. Cott. I p.36, my emphasis. See on this text especially the edition by Jean-Luc Marion: René Descartes, Règles utiles et claires pour la direction de l’esprit en la recherche de la vérité, trans. Jean-Luc Marion (La Haye: Martinus Nijhoff, 1977).

⁸ . AT X, p.406, trans. Cott. I p.36.

but also that the original proposition follows necessarily from the other two.”⁹ The certainty of lengthy deductions is a more difficult problem, however, because, as Descartes explains, a long string of intuitively-linked propositions only confirms the eventual conclusion with the additional support of the memory. Nonetheless, the fundamental units from which the string or chain is constructed are still those of intuitively-recognized true propositions and their intuitively-perceived individual relations each to the next.

In effect, Descartes represents this kind of intuition, whereby one makes an inference from one set of statements to the next, as a kind of seeing: you just see that the conclusion follows, in the same way as Aristotle knew that you cannot prove foundational statements; axioms must simply be accepted. In Rule 9, Descartes explicitly analogizes mental intuition with ordinary vision.

Both here and elsewhere, Descartes also describes how the best kind of deductive demonstration, of the sort that consists of a large number of primitive intuitive steps, will be one where you have trained yourself to run over the stages of the proof so smoothly that your mind can move from the beginning to the end without any longer needing to break down the deduction into its discrete steps. Thus in Rule 7, referring to such separate inferential steps, he says:

I shall run through them several times in a continuous movement of the imagination, simultaneously intuiting one relation and passing on to the next, until I have learnt to pass from the first to the last so swiftly that memory is left with practically no role to play, and I seem to intuit the whole thing at once.... In addition, this movement must nowhere be interrupted. Frequently those who attempt to deduce something too swiftly and from remote initial premises do not go over the entire chain of intermediate conclusions very carefully, but pass over many of the steps without due consideration. But, whenever even the smallest link is overlooked the chain is immediately broken, and the certainty of the conclusion entirely collapses.¹⁰

Thus deductive reasoning reduces, for Descartes, to brute (or, perhaps, angelic) intuition -- in its most primitive form, to the irreducible leaps from one statement to the next that you just have to see; and in a more capacious sense, to a trained capacity to encompass an entire deductive sequence as a single intuitive perception. In that sense, the core of deductive reasoning is anything but mechanical: even deduction was not simple deduction.

A particular feature of Descartes’s ideas is worth noting: historians have sometimes remarked that Descartes’s notion of res cogitans, the immortal thinking stuff that constitutes the mind, comes dangerously close to medieval Averroïst doctrine.¹¹ Averroës made a distinction between the active and the passive intellect: the passive

⁹ . Ibid., p.369; modified from Cott., I pp.14-15. Interestingly, the translation in Cottingham (I, p.14) of Descartes’s word discursus is “train of reasoning.”

¹⁰ . AT X, p.388; Cott.I p.25; see also Marion, p.128.

¹¹ . E.g. Gaukroger, Descartes***

intellect registers an individual's experiences, and dies with that individual, and the active intellect is shared by everyone and is, in that shared sense, immortal. The basic idea behind the identity of this immortal active intellect seems to be that reason is taken to be the same for everyone; there is no individuality, in effect, in the correct use of reason, in the sense that two plus two equals four for me in exactly the same way as it supposedly does for everyone else. Extending this point to Descartes's analysis -- for which that commonality is also clearly assumed -- we have the intuitions that knit together each step of a deductive sequence themselves being necessarily shared and identical -- in turn, again, suggesting a common origin for the validity of those intuitions.

This point in turn relates to a major area of discussion in modern Cartesian scholarship to do with the status for Descartes of the eternal truths: axiomatic logical and mathematical statements of the sort that provide the foundations for solid deductions. Descartes famously argued in writing to Mersenne that the eternal truths -- things like the Euclidean axioms -- are themselves radically dependent on God's will; their truth is not separate or autonomous from God, and these statements are only true because God wills them to be true. This assertion alarmed Mersenne, not surprisingly, as a more extreme position than Thomas Aquinas's view that these true statements are "co-eternal" with God; God is not Himself the cause of their truth.¹² But more immediately important than these metaphysical finesses is the issue of how we ourselves know these eternal truths, regardless of their exact relationship to God's will. This brings us into territory more familiar to seventeenth-century theological orthodoxy, albeit territory that was itself something of a battleground.

The widely-accepted Thomistic position, adopted by most Jesuit theologians and in general a conventional Catholic position in this period, was that we recognize the truth of such statements through what Aquinas calls the "natural light" of our minds. This is an inborn human endowment that God has put there, not just another feature of the human intellect, and this "natural light" has considerable theological significance: Aquinas calls it the "image of God" in man, regarding it as what was meant by the assertion that man was made in God's image.

There was also another Latin theological tradition, and a culturally significant one, that represented similar issues in a rather different, and in practice less optimistic, way. St. Augustine's neo-Platonic Christian theology, which was quite central to Lutheran and especially Calvinist theologies, assigned a role for divine assistance in the acquisition of knowledge and the operations of reason that was analogous to the more Aristotelian one put together by Aquinas: instead of God giving man a natural light by which to perceive truth on his own, Augustine has God illuminate the human mind whenever it directly perceives truth -- this is the operation of the so-called divine light rather than natural light, and in that sense it makes man more directly dependent on God. It is therefore inferior, in a sense, to Thomistic natural light, because on Augustine's view "original sin" (which Augustine, after all, invented), attendant on the expulsion from Eden, had severely compromised human intellectual capacities. Peter Harrison has recently argued for the importance of the role of the Fall in seventeenth-century philosophical and natural-philosophical projects; certainly the matter is sufficiently ubiquitous to be worth taking seriously as a structural element of contemporary

¹² . Latterly, Menn.

philosophical discourse.¹³ The Fall is also an element that correlates closely with confessional allegiances. Within Catholic, typically Thomistic, theology, the Fall tended not to be seen as quite so catastrophic as in Protestant, typically Augustinian, theology: for Augustine, the Fall had resulted in the profound darkening of human intellectual perceptions, and made certainty considerably harder to attain, whereas the Thomistic, and typical Catholic, view restricted the damage done by the Fall largely to the loss of guaranteed salvation rather than to the loss of intellectual capacities -- the image of God in man is still alive and well from that perspective, and hence the natural light of reason remains intact.¹⁴ Harrison shows that this theological question played a significant role in seventeenth-century English Puritan critiques of university learning, as in the Webster-Ward debate, with the pretensions of Aristotelian philosophy to access the essences of things being equated with Papist superstition.¹⁵

From this perspective, Descartes had no real difficulty: his attempts to square himself with Catholic orthodoxy were no kind of stretch. The crucial role of God in his metaphysical system accommodated itself pretty well to a Thomistic notion of “natural light”; he says in the Discourse that “all our ideas or notions must have some foundation of truth, for otherwise it would not be possible that God, who is all-perfect and all-truthful, should have placed them in us.”¹⁶ And in Principles of Philosophy, in talking about knowledge of efficient causes, he says, “we shall see, with the aid of our [God-given] natural light, what conclusions should be drawn concerning those effects which are apparent to our senses.” After which he adds the safety-clause: “we should remember... that the natural light is to be trusted only to the extent that it is compatible with divine revelation.”¹⁷

The invocation of large assumptions and historiographical categories are tempting here: first of all, our sensibilities regarding what makes some cultural style “baroque” are very much tied up with hallmarks of the Counter-Reformation. Roman Jesuits like Kircher, not English Puritans, are the prize exhibits. Although it can be tiresome to draw, once again, contrasts between Protestant and Catholic in the seventeenth century, the tiresomeness attaches only to the purely taxonomic approach; when the cultural practices display internal consistencies maintained by concrete arguments, something worthwhile has been learned. If, following Maravall’s ambitious approach, we characterize “the baroque” as being concerned with such themes as social hierarchy and the notion of honour, the adaptability of Thomistic “natural light” to Counter-Reformation theology

¹³ . Peter Harrison, “Original Sin and the Problem of Knowledge in Early Modern Europe,” Journal of the History of Ideas 63 (2002), pp.239-59; idem, The Fall of Man and the Foundations of Science (Cambridge: Cambridge University Press, 2008).

¹⁴ . Cf. William B. Ashworth, Jr., “Light of Reason, Light of Nature--Catholic and Protestant Metaphors of Scientific Knowledge,” Science in Context 3 (1989), pp.89-107.

¹⁵ . Webster/Ward, ed. Debus.

¹⁶ . AT VI, p.40; trans. Cott. I, p.131.

¹⁷ . AT VIII, p.16; trans. Cott., I, pp.202-203. “God-given” is used in Cottingham et al.; it is a contextually justifiable interpolation.

and culture may be made clearer. Unlike the enthusiastic overtones of intellectual perception triggered by the immediate gift of divine light, natural light gives everyone at all times the potential for true perception through reason -- but “only to the extent that it is compatible with divine revelation.” Natural light unites all human beings together, but its correct use (which Descartes wanted to teach) separated the gentlemen from the boys: honour, or its specific seventeenth-century French version, honnêteté, underlay such intellectual facility.¹⁸

III.

One immediate association with deductive reasoning that we might tend to make nowadays is computation carried out by a machine -- artificial intelligence, as it were. Questions of causation in machines set up a useful counterpoint to early-modern ideas of “natural light,” the piquancy of which has in effect been observed in the 1982 essay “Relativism, Rationalism and the Sociology of Knowledge,” by Barry Barnes and David Bloor. Barnes and Bloor at one point criticized philosophers, including Gilbert Ryle, for saying that, in psychology, causal accounts are only appropriate for pathological phenomena, not for normal or “correct” ones. They then ridicule that view:

Perhaps one day the dualist account... will be developed into its ultimate form, and we will be told that the operations of adding machines are causally determined only when erroneous results are produced, and that at other times such machines operate rationally in ways which require no explanation.¹⁹

Barnes and Bloor make a crucial assumption here, that what’s at stake is indeed a “causal” account of an outcome, and, like their philosophical opponents, they are imprecise about what that word “causal” means. A seventeenth-century Aristotelian philosopher -- or a Galenic physiologist -- could have replied that a normal perception would be economically explained by making reference to the proper functioning of the sensory apparatus: what would amount to a formal cause explanation. Why bother with providing an efficient cause for something normal? As for adding machines, if they work properly it’s because they are correctly designed according to sound principles -- they work properly because they’ve been built in such a way as to do so. Such a machine that does not work properly is then anomalous; something must have gone wrong, or a mistake made in the design, and that error would be the feature in need of explanation.

But what, in fact, did seventeenth-century philosophers have to say about such machines? One such was Pascal’s famous adding machine, which he invented and had built in the 1640s. The sets of wheels displayed base-10 digits, and were designed to add

¹⁸ . On honnêteté in relation to mathematics, see Matthew L. Jones, The Good Life in the Scientific Revolution: Descartes, Pascal, Leibniz, and the Cultivation of Virtue (Chicago: University of Chicago Press, 2006); also Peter Dear, “A Mechanical Microcosm: Bodily Passions, Good Manners, and Cartesian Mechanism,” in Christopher Lawrence and Steven Shapin (eds.), Science Incarnate: Historical Embodiments of Natural Knowledge (Chicago: University of Chicago Press, 1998), pp.51-82.

¹⁹ . Barry Barnes, and David Bloor, “Relativism, Rationalism and the Sociology of Knowledge,” in Martin Hollis and Steven Lukes (eds.), Rationality and Relativism (Cambridge, MA: MIT Press, 1982), pp.21-47, on p.33n.

and subtract, the chief trick being the technical means of carrying numbers. Pascal described the machine as allowing the performance of arithmetical operations “without any work of the mind”; he makes no claim that there is “artificial intelligence” embodied in it. Further, Pascal does not attempt to compare its operations to a person doing mental arithmetic; instead, the only things to which he compares it are other means of performing calculations. He speaks of the

ease there is in working with this machine... if you take the trouble to compare it with the methods of working with counters and with the pen. You know how, in working with counters, the calculator (especially when he’s not used to it) is often obliged, for fear of falling into error, to make a long sequence and extension of counters, and as necessity constrains him afterwards to abridge and remove those which prove to be uselessly laid out; in which you see two useless troubles, with the waste of two periods of time.... You know, similarly, how, in working with the pen, one is constantly obliged to carry or borrow the necessary numbers, and how many errors slip in, in these carryings and borrowings -- from long routine and without profound attention, anyway -- and how the mind quickly tires. This machine relieves whoever operates it from this vexation: it’s enough that the operator have judgment; [the machine] relieves him from weakness of memory.²⁰

Pascal understands his arithmetical machine as an alternative technique for performing computations, on a par with working on paper or using the common system of counters (a kind of abacus on a table). His machine chiefly serves to relieve the memory, as well as being quick. He also mentions that the machine performs the desired operations without its operator even having to think about it (sans même qu’il y pense).

Recall at this point Descartes’s remarks about the intellectual virtues of being able to pass in a single movement of thought from premises to conclusion in deduction: he spoke of learning “to pass from the first to the last so swiftly that memory is left with practically no role to play, and I seem to intuit the whole thing at once.” Pascal here attributing a similar virtue to his machine: no need to rely on one’s own memory, because the machine manages those operations itself. But there is a central and crucial difference: the outcome of the process in the case of Pascal’s machine is the result; whereas the virtue of Descartes’s procedure was that it created an “intuition” of the correctness of that result. And Pascal’s version, as he stresses, dispenses with the troublesome need for thought...

How, then, does Pascal establish that the machine, as a technique for calculating with, does indeed yield results that are correct? Certainly, the machine does not intuit their validity, in the manner of an ideal Cartesian deduction. Instead, Pascal discusses two different foundations for regarding his machine as reliable. One is the possession of a full understanding by the builder of the principles on the basis of which the machine is designed and constructed; the reliability of the calculations follows from those principles, in what one might see as a mechanically deductive fashion: if you know how the wheels work, you’ll know that they must give correct results. In mentioning this issue, however,

²⁰ . Blaise Pascal, La machine d’arithmétique, in Pascal, Oeuvres, ed. Lafuma, p.189 col.II (my trans.).

Pascal is only concerned with having the artisan manufacture the machine properly. This process, he says,

necessarily requires that art be aided by theory until use renders the rules of the theory so common that it finally reduces them to art, and that continual exercise has given to artisans the habit of following and practicing these rules with assurance.²¹

The manufacturing of the machine, which guarantees its reliability, is itself, on this view, reduced to a kind of mechanical procedure, albeit a human one.

The other basis for believing the machine's continued reliability is that Pascal has tested it. The only way that he could gain a complete assurance for himself, which could then be passed on to others, was, he says, to "make the experience, by the transport of the instrument over more than two hundred and fifty places on the road without any alteration" in the performance²² -- rather like Perier's famous stops during the ascent of the Puy-de-Dome to measure the height of the mercury.

The examples underscore the point that Pascal's understanding of what computation was all about had little to do with the mind, or with reasoning. The mechanical behaviours of the machine as its wheels were turned by the operator could perhaps be seen as analogous to the stages in a deductive argument as Descartes had described them, but for Pascal they had nothing to do with understanding a deductive demonstration. The results of calculations made with the machine were just that -- results brought about by appropriately mindless manufacture on the part of habituated workmen, and by the grinding of gears. No intuition was needed, any more than in performing sums on paper or with counters, or in using such gadgets as Napier's bones; Pascal promoted as its chief selling-point the fact that the machine dispensed with the need to use the memory. In fact, the same thing seems to apply to later elaborations of Pascal's type of machine too, including Leibniz's from the 1670s, as well as other kinds of mechanized calculators like Samuel Morland's in England.²³

The key difference between Descartes on deduction and Pascal on his arithmetical machine can be illustrated by a simple thought, reminiscent of Barnes' and Bloor's remarks: it would have been possible for Pascal to have made an arithmetical machine that reliably produced wrong answers, whereas Descartes's view of deduction presupposed that his codified mental procedure will always produce correct answers. Pascal's machine is just a gadget, like an abacus, not an example of Artificial Intelligence, and it was never intended to be anything else.²⁴

But the core of what the term "reason" means for Pascal is still fairly close to what it was for Descartes. Recall again what Descartes says in the Regulae about intuition, intuitus. It's an irreducible sense of conviction, like a "clear and distinct" mental perception, and it applies both to simple, single deductive steps and to awareness of the truth of one's fundamental, unprovable axiomatic principles. Pascal understood

²¹ . Ibid., p.190 col.II (my trans.).

²² . Ibid., p.190 col.I (my trans.).

²³ . Ratcliff BJHS

²⁴ . And cf. Collins, Artificial Experts.

matters in much the same way, which isn't too surprising given the role of these sorts of notions in Aristotle's logic. What makes Descartes, and Pascal, modern is what they add to the Aristotelian analysis -- which is God.

One of the most famous of Pascal aphorisms, from the Pensées, is itself about reason: usually, in English, "the heart has its reasons that reason knows not of."²⁵ Although it seems at first sight to be a typically paradoxical theological aphorism, it can be read as fairly straightforward when understood in terms of the variety of associated meanings that the word "reason" -- here, la raison -- had in seventeenth-century philosophical and literary parlance. Pascal is referring here to fundamental, unprovable principles at the foundations of formal "scientific" deduction. "The heart has its reasons" in the sense of "reason" that meant underlying causal principles, as with the ratio of an Aristotelian philosopher. Such reasons are those that "reason knows not of" because this second sense of reason concerns the exercise of the rational faculty, "reasoning," which is unable in itself to establish the very principles on the basis of which it builds. In effect, Pascal seems to be saying that "the heart has its cherished convictions that the reasoning intellect cannot touch." And part of his point is that this is just as true of religious faith as it is of Euclidean geometry.

Unsurprisingly, Pascal, like Descartes, sometimes discusses formal reasoning with reference to the "natural light," which enables us to obtain certainty in geometry despite the obvious impossibility of defining and proving every element of our starting principles; our "natural light" sees us through. In another passage from the Pensées, Pascal puts the matter this way:

The knowledge of first principles -- space, time, motion, and numbers -- is as firm as any of those that our reasoning gives us, and it is on this knowledge of the heart and instinct that reason must rely and must base all its discourse. The heart feels that there are three spatial dimensions and that numbers are infinite, and reason then demonstrates that there are no two square numbers of which one is double the other. Principles are felt, propositions are proved, and both with certitude, although by different ways -- and it is as useless and ridiculous for reason to demand of the heart proof of its first principles before willingly accepting them as it would be ridiculous for the heart to demand of reason a sentiment of all the propositions that it demonstrates in order to be willing to accept those. This powerlessness ought only to serve to humiliate reason... but not to undermine our certitude.²⁶

The irreducibility of this kind of intuition (or, as he sometimes called it, sentiment²⁷) is also expressed, albeit in an indirect way, in Pascal's account of his arithmetical machine. Referring to the operation of the machine -- its practical employment -- he says that his

²⁵ . Ibid., p.552 col.I (L423): "Le cœur a ses raisons que la raison ne connaît point."

²⁶ . Ibid., p.512 col.II (L110; my trans.).

²⁷ . Pascal's usage of this last term has been examined in Matthew L. Jones, "Writing and Sentiment: Blaise Pascal, the Vacuum, and the Pensées," Studies in History and Philosophy of Science 32 (2001), pp.139-81; idem, The Good Life in the Scientific Revolution: Descartes, Pascal, Leibniz, and the Cultivation of Virtue (Chicago: University of Chicago Press, 2006).

reader will forgive Pascal's decision not to give a detailed account of the working of the machine:

if you take the trouble to reflect, on the one hand, on the ease of explaining orally and understanding by a brief conversation the construction and use of this machine, and, on the other hand, on the embarrassment and difficulty there would have been to explain in writing the measures, forms, proportions, situations and the other properties of so many different pieces -- then you will conclude that this doctrine is among those which can only be taught *viva voce*.²⁸

Pascal subsequently recommends the mathematician Gilles Personne de Roberval as the person to consult if his reader happens to be in Paris and wants instruction on how to use the machine.²⁹ Furthermore, this recommendation is not casual; there is for Pascal more involved in teaching the use of the machine than a formalized conveyance of information. In effect, Pascal invokes the importance of tacit knowledge: not everything can be made explicit, but there are ways around that problem; sometimes God, but in this case, Roberval.

IV.

Perhaps the most uncompromising, and, for modernist sensibilities, the clearest position on the nature of reason was presented by Thomas Hobbes in a number of his writings, most familiarly in Leviathan: he tells us what, in his view, "is meant by this word Reason, when wee reckon it among the Faculties of the mind. For REASON, in this sense, is nothing but Reckoning (that is, Adding and Subtracting) of the Consequences of generall names agreed upon, for the marking and signifying of our thoughts."³⁰ Presumably, then, Hobbes would have regarded Pascal's machine as in some sense a "reasoning engine." But even for Hobbes, this does not imply that reason was entirely straightforward, entirely "mechanical." Besides so-called "natural reason," there was also something called "right reason."

The locus classicus for "right reason" was Aristotle's Nicomachean Ethics: in Greek, orthos logos. The Stoic adoption of the term is then rendered by Cicero as recta ratio; and the overall sense of the term is something akin to "sound reason," "proper reason," "ethically proper reason"; "sound practical reasoning." The term stresses reasoning as a process rather than reason as a mental faculty. One seventeenth century discussion of these issues is by Marin Mersenne, in his first publication, from 1623, a devotional work called L'Usage de la raison. Mersenne is interested in showing how reason can aid in salvation; he explains that proper reason, in the sense of active reasoning, is the result of combining understanding with the will. Although this rather Molinist account makes no use of the term "right reason," its theme is the pursuit of

²⁸ . Ibid., p.189 col.I (my trans.).

²⁹ . Ibid., p.191 col.II.

³⁰ . Thomas Hobbes, Leviathan, ed. Richard Tuck (Cambridge: Cambridge University Press, 1996 [1651]), p.32.

salvation resulting from the will's decision to embrace what the understanding recognizes as the good; it fits very well various uses of the term in this period.³¹

Lotte Mulligan has shown in several articles³² how "right reason" was widely used in Anglican apologetics to designate reasoning in religion that was correctly aligned with accepted assumptions or premises derived from orthodox interpretations of Christian revelation, or in general that led to theologically desirable conclusions. For most users of the term, the hallmark of right reason was that it supported, and never contradicted, orthodox religious teaching. In effect, it was a form of reasoning that was uncorrupted by the Fall, or else that had been restored with the help of God's grace and the sweat of man's brow.³³ But for Hobbes this was clearly a tricky issue, because of his determination that civil authority not be threatened by an autonomous church. "Right reason" for Hobbes was still reason that had been morally purified, but for him that meant a form of reason that promoted the interests of the civil power. When Hobbes discussed even so basic a subject as arithmetic, he required that this kind of authority be central.

Hobbes held that "Reason" itself could always be reduced to a matter of adding and subtracting. Arithmetic was therefore the most fundamental of sciences, because it represented formalized "reckoning," as he put it, which was all that reason truly was. But even reckoning was not a self-sufficient, self-justifying procedure. As Hobbes says in Leviathan:

...the ablest, most attentive, and most practised men, may deceive themselves, and inferre false Conclusions; Not but that Reason it selfe is alwayes Right Reason, as well as Arithmetique is a certain and infallible Art: But no one mans Reason, nor the Reason of any one number of men, makes the certaintie; no more than an account is therefore well cast up, because a great many men have unanimously approved it. And therefore, as when there is a controversy in an account, the parties must by their own accord, set up for right Reason, the Reason of some Arbitrator, or Judge, to whose sentence they will both stand, or their controversie must either come to blowes, or be undecided, for want of a right Reason constituted by Nature; so is it also in all debates of what kind soever.³⁴

Reason, in other words, needed to be policed correctly; its virtue, represented above all in the strict procedures of mathematics, could not stand by itself. Otherwise, exactly as in the case of religious enthusiasm, the social fabric would fall apart, as Hobbes goes on to explain. He says:

³¹ . Involves crypto-Molinist arguments; and cf. Dear, Mersenne.

³² . Lotte Mulligan, "'Reason,' 'Right Reason,' and 'Revelation' in Mid-Seventeenth-Century England," in Brian Vickers (ed.), Occult and Scientific Mentalities in the Renaissance (Cambridge: Cambridge University Press, 1984), pp.375-401; idem, "Robert Boyle, Right Reason, and the Meaning of Metaphor," Journal of the History of Ideas 55 (1994), pp.235-57; idem, "Robert Boyle, the Christian Virtuoso, and the Rhetoric of 'Reason,'" in Robert Crocker (ed.), Religion, Reason, and Nature in Early Modern Europe (Dordrecht: Kluwer, 2001), pp.97-116.

³³ . Schaffer, "Occultism and Reason," with another "right reason" ref.

³⁴ . Hobbes, Leviathan, pp.32-33. Cf. p.246, where "right reason" describes one of the means whereby God promulgates his laws, which is the same as "natural reason."

And when men think themselves wiser than all others, clamor and demand right Reason for judge; yet seek no more, but that things should be determined, by no other mens reason but their own, it is as intolerable in the society of men, as it is in play after trump is turned, to use for trump on every occasion, that suite whereof they have most in their hand.³⁵

Notice, here, what the wicked Hobbes is doing. For his contemporaries, “right reason” was contrasted with so-called “natural” reason, which included no truths of revelation with which it had to accord. For Hobbes, on the other hand, sound reason, natural reason, is the same as right reason; there is no distinction between the two. The supernatural has been quietly replaced with civil authority, which provides the absolute criterion for reason. For Hobbes, notions of God could not by themselves be cashed; the brute force of civil authority necessarily played that role for Him. The king was both God’s banker and God’s trustee.

Perhaps there should be nothing surprising about finding the idea of “reason” and the “rational” being grounded in some kind of transcendental supra-human power. In a sense, seventeenth-century views about God’s role in reason may be easier to take, historiographically, than Hobbes’s equally seventeenth-century totalitarian vision. Hobbes sometimes seems to speak directly to secular modernist sensibilities, but when he asserts that our reasoning capacities depend on political power we tend not to like it, even in our more Foucauldian moments; Hobbes seems to go too far for comfort. Nonetheless, God may be our most perspicuous focus in trying to understand what’s going on even in Hobbes’s arguments: the functioning of “reason” in the seventeenth century, and perhaps, by implication, for a much longer period than that, depended on some transcendental guarantor. Hobbes saw it most clearly: someone or something is needed to tell you when you’ve got it right: reason does not shine by its own light. That was why, for most commentators on the subject, natural or divine light, thanks to God, was essential for completing the circuit -- unless you were willing to allow the king to do it for you.

V.

If such the issues circulating in the seventeenth century, clearly much had changed by the time of the famous eighteenth-century question “What is Enlightenment?”³⁶ The Age of Reason had by then established a new idol, neither illumination, exactly, nor civil authority. What the seventeenth-century discussions had shown is how “reason” itself was not free-standing, and never could be without becoming completely circular: even formal logic failed to show a way out, because, despite the connotations, there was a lot more to reason than mere logic. No doubt this is how reason, like nature, could take on such strong moral connotations in the eighteenth century.

³⁵ . Ibid., p.33.

³⁶ . Schmidt vol.

Historically, “reason” as an epistemic theme has always been a flexible resource.³⁷ In the present context, an irony of considering reason in relation to things we want to label “baroque” is that the stereotypical baroque artefact or performance is opaque, marvelous, defiant of straightforward accounting. If that is so, and the function of such display was in some way the maintenance of established social hierarchy, then the transcendence that underlay and guaranteed reason necessarily passed through the Church; otherwise it would be a threat to stability. And that is precisely what some in the eighteenth century used it for.

³⁷ . On epistemic themes, Michael Lynch, Scientific Practice and Ordinary Action: Ethnomethodological and Social Studies of Science (Cambridge: Cambridge University Press, 1993).*** John Spurr, JHI 1988 (“reasonable religion” to combat enthusiasts)...