

Baroque Mind-set and New Science a Dialectic of Seventeenth-Century High Culture

Jens Høyrup

Sarton Chair Lecture
13 November 2008

Abstract

The “New Science” of Galileo, Kepler, Harvey, Descartes, Boyle, Steno, etc., and the Baroque in visual arts and literature, are two conspicuous aspects of seventeenth-century European elite culture. If standard historiography of science can be relied upon, the former of the two was not affected by the latter.

The lecture asks whether this is a “fact of history” or an artefact of historiography. A delimitation of the “Baroque” going beyond the commonplaces of overloading and contortion concentrates on the acceptance of ambiguity and the appurtenance to a “representative public sphere”, contrasting with the quest for clarity and the argument-based public sphere of the new science, suggesting that Baroque and New Science were indeed incompatible currents. A close-up looks at Juan Caramuel y Lobkowitz, who was a major Baroque theoretician but also wrote much on mathematics, finding even within his mathematics love for ambiguity. The way his mathematics is spoken about in the Oldenburg correspondence shows that the mainstream of the New Science saw no interest in this.

The watershed

Modern science – this is generally agreed upon – was inaugurated in the seventeenth century by characters such as Galileo, Kepler, Harvey, Descartes, Pascal, Huygens, Boyle, Hooke, Steno and Newton. There is also broad consensus that conspicuous sixteenth-century figures like Copernicus, Tycho, Cardano, Vesalius and Bombelli (not to speak of Dee, della Porta and Paracelsus) opened the way for the breakthrough by carrying the ancient and medieval inheritance beyond the bursting point; but that they left synthesis to a future generation.

Retrospectively, Galileo etc. count as belonging within natural science – the domain which in English in more recent times became *science simpliciter*. However, we do not need to restrict our argument to this domain. The natural

law doctrines of Hobbes, Locke and Pufendorf and the *Grammaire générale* of Arnauld and Lancelot are also modern, while (say) Machiavelli forebodes modern political thinking in a way which makes his ancient models crack but does not yet reconstruct.

It is customary to categorize Paracelsus, Copernicus, Vesalius, Cardano, Dee, Brahe, Bombelli and della Porta as “Renaissance scientists”, and it is indeed not difficult to point to features of their thought that are widespread within the Renaissance movement. In contrast, there is no tradition for seeing Galileo, Kepler, Harvey, Descartes, Pascal, Huygens, Boyle, Hooke, Steno, Newton, Hobbes, Locke, Pufendorf and Arnauld as exponents of the Baroque, the indubitable general cultural importance of the Baroque for their century notwithstanding.¹

One may ask – and that is what I am going to do – whether this is a historical or a historiographical conundrum. In other words: is it true that the New Science (or “new philosophy” as it was rather called at the time) and the Baroque represent contemporary but unconnected or perhaps even conflicting cultural currents? Or, have historians of science simply been blind to the relation between the two? Is the Baroque a context without (scientific) texts, or is it simply so much in disrepute among historians of science that they do not wish to associate it with their heroes?

The question dawned to me during teaching of the history of the humanities. First I wondered that the Spanish *siglo de oro*, in spite of its importance in the general cultural landscape, seemed not to have left traces calling for the attention of historians of science; then I got the idea that at least the “etymological current” in linguistics might have to be understood within the Baroque framework. In Sweden and Denmark this current is best known through Olaus Rudbeck’s *Atlantica* [1] – famous in Sweden, notorious in Denmark: charming in Sweden and shocking in Denmark, indeed, the idea that precisely *Swedish* should be the language of Paradise! My starting point was thus not too far removed from that

¹ The recent “Baroque Science” project of Sydney University should be mentioned as an exception – see <http://www.usyd.edu.au/baroquescience>. It formulates the contrast in these terms:

‘Baroque’ refers to the preoccupation with paradox and contrast, with asymmetry and distortion, with imagery and sensual detail. ‘Science’ is the search for simple, universal structures, eschewing rhetorical embellishment for logical rigor and sense qualities for the austerity of matter in motion

which then allows the project to allow harmony between the two by looking *differently* at seventeenth-century science.

of Gunnar Eriksson's in *The Atlantic Vision: Olaus Rudbeck and Baroque Science* [2].

Delimitation of the Baroque

This starting point was a mere intuition, and it is not strange that Eriksson and I took different directions when leaving it, Eriksson making a complete portrait of Rudbeck's science, I myself returning to the initial question about the relation between the Baroque and the New Science.² In order to make this return fruitful we have to go beyond the everyday understanding of the Baroque as mere "baroque", as mere contrast to the classicist ideal of *edle Einfalt und stille Größe*. Is it possible to define the Baroque, to delimit it, or at least to characterize it?

A first strategy is the chronological approach. It is familiar from the commonsense historiography of music, where everything between Monteverdi and Bach is "baroque music" simply because of its date. This approach is that of Reijer Hooykaas and J. E. Hofmann, among the few historians of science who do mention the Baroque. Hooykaas [5: 161] speaks of modern science as produced by "scientists of the Renaissance and Baroque periods", whereas Hofmann's ultra-concise *Geschichte der Mathematik* [6] has the chapter headings "Übergang zum Barock (1450–1580)" (vol. I, p. 100), "Frühbarock (etwa 1550 bis 1650 n. Chr.)" (vol. I, p. 116), "Hochbarock (etwa 1625 bis 1665)" (vol. II, p. 4) and "Spätbarock (etwa 1665 bis 1730)" (vol. II, p. 50).

With this definition, everything is easy. Arnauld is neither more nor less Baroque than Rudbeck. The problem is neither historical nor historiographical but linguistic: the concept is empty, and we may calmly leave it to Occam's razor to dispose of it.

However, according to the same line of thought, Racine is neither more nor less Baroque than Calderón. If we insist that there *is* a difference and do not accept this elimination of the concept of the Baroque from the history of art and literature, then our problem returns. If the Baroque exists as a *particular* current of seventeenth-century elite culture within which Calderón belongs but to which Racine is in opposition, then it is still legitimate and meaningful to ask whether *this* particular current imprinted the New Science of the seventeenth century.

This approach corresponds to René Wellek's reflections on "Baroque in Literature" [7]:

² My earlier work on the topic is contained in [3] and [4].

The term baroque seems [...] most acceptable if we have in mind a general European movement whose conventions and literary style can be fixed narrowly, as from the last decades of the sixteenth century to the middle of the eighteenth century in a few countries.

Obviously, a “current” or “movement” cannot be strictly defined. Even a delimitation – the original meaning of the word we translate as “definition” in Euclid’s *Elements* – cannot be exact. Yet we may strive to dig out central characteristics, features which distinguish the core of the current but only in weakened form or not all together when we look at its periphery.

In its origin, the Baroque is linked to the Counter-Reformation and the Jesuit order – the latter to such an extent that *Il grande dizionario Garzanti* [8] explains “stile gesuitico” as “il barocco, in architettura e in letteratura”.³ In 1563, the Council of Trent issued a decree stating among many other things that ecclesiastical art was to serve the propagation and consolidation of orthodox faith:⁴

And if any abuses have crept in amongst these holy and salutary observances, the holy Synod ardently desires that they be utterly abolished; in such wise that no images, (suggestive) of false doctrine, and furnishing occasion of dangerous error to the uneducated, be set up. And if at times, when expedient for the unlettered people; it happen that the facts and narratives of sacred Scripture are portrayed and represented; the people shall be taught, that not thereby is the Divinity represented, as though it could be seen by the eyes of the body, or be portrayed by colours or figures.

Moreover, in the invocation of saints, the veneration of relics, and the sacred use of images, every superstition shall be removed, all filthy lucre be abolished; finally, all lasciviousness be avoided; in such wise that figures shall not be painted or adorned with a beauty exciting to lust [...].

In fine, let so great care and diligence be used herein by bishops, as that there be nothing seen that is disorderly, or that is unbecomingly or confusedly arranged, nothing that is profane, nothing indecorous, seeing that holiness becometh the house of God.

And that these things may be the more faithfully observed, the holy Synod ordains, that no one be allowed to place, or cause to be placed, any unusual image, in any place, or church, howsoever exempted, except that image have been approved of by the bishop”.

That could not and did not determine how and what art should *be*, at most what it should *not* be – the loincloth painted over Michelangelo’s naked Christ in the

³ See for instance Arnold Hauser’s [9: 69–72] and Rudolf Wittkower’s [10] discussions.

⁴ Translation from [11: 235f].

Sistine Chapel is an almost parodic example.

In so far, the emergence of the Baroque can be seen in the perspective of an observation made by Carlo Ginzburg [12: 146, my translation], regarding

a problem the significance of which is only now beginning to be recognized: that of the popular roots of a considerable part of high European culture, both medieval and postmedieval. Such figures as Rabelais and Brueghel probably weren't unusual exceptions. At the same time, they closed an era characterized by hidden but fruitful exchanges, moving in both directions between high and popular cultures. The subsequent period was marked, instead, by an increasingly rigid distinction between the culture of the dominant classes and artisan and peasant cultures, as well as by the indoctrination of the masses from above. We can place the break between these two periods in the second half of the sixteenth century, basically coinciding with the intensification of social differentiation under the impulse of the price revolution. But the decisive crisis had occurred a few decades before, with the Peasants' War and the reign of the Anabaptists in Münster. At that time, while maintaining and even emphasizing the distance between the classes, the necessity of reconquering, ideologically as well as physically, the masses threatening to break loose from every sort of control from above was dramatically brought home to the dominant classes.

This renewed effort to achieve hegemony took various forms in different parts of Europe, but the evangelization of the countryside by the Jesuits and the capillary religious organization based on the family, achieved by the Protestant churches, can be traced to a single current. In terms of repression, the intensification of witchcraft trials and the rigid control of such marginal groups as vagabonds and gypsies corresponded to it.

However, the implementation of the Trent programme was made, and could hardly avoid to be made, on the foundation of existing art, that is, the Mannerist trend, and (since Jesuits were main responsible) with strong regard for Ignazio de Loyola's insight in the importance of the active emotional involvement of the recipient: as explained in §2 of his *Esercizi spirituali*, the religious message must never be so explicit and direct that the spiritual commitment of the recipient is barred:⁵

[...] if the person who is making the contemplation, takes the true groundwork of the narrative, and, discussing and considering for himself, finds something which makes the events a little clearer or brings them a little more home to him [...] he will get more spiritual relish and fruit, than if he who is giving the Exercises had much explained and amplified the meaning of the events. For it is not knowing much, but realizing and relishing things interiorly, that contents and satisfies the soul.

This advice not to tell too explicitly is already in potential conflict with the Trent request that "the people shall be taught, that not [by religious images] is the

⁵ I follow Elder Mullan's translation [13], after collating with the edition in [14: 11].

Divinity represented, as though it could be seen by the eyes of the body, or be portrayed by colours or figures”.

The essential point in Loyola’s method is not presentation of the religious motif by itself but the motif embedded in a totality of tension, colour and movement. Loyola prescribes thus how to get an “interior sense of the pain which the condemned suffer” (§§65–70, after [13], cf. [14: 27f]):

The first Point will be to see with the sight of the imagination the great fires, and the souls as in bodies of fire. The second, to hear with the ears wailings, howlings, cries, blasphemies against Christ our Lord and against all His Saints. The third, to smell with the smell smoke, sulphur, dregs and putrid things. The fourth, to taste with the taste bitter things, like tears, sadness and the worm of conscience. The fifth, to touch with the touch; that is to say, how the fires touch and burn the souls.

Transferring this principle to the realm of art, Gabriele Paleotti, cardinal and bishop of Bologna, declares in his *Discorso intorno alle imagini sacre e profane* (I, xxv, from 1594; my translation from [9: 71f]):

Telling the martyrdom of a saint, the zeal and constancy of a virgin, the passion of Christ himself, are things that touch the true; but when they are present in live colours, here in front of the eyes the martyred saint, there the virgin assaulted, and on the other side the nailed Christ, this truly increases the devotion and wrings the bowels, so that he who does not feel it is made of timber or marble.

This reveals another aspect of the Baroque: the Baroque work of art is a *Gesamtkunstwerk*, a planned totality where all elements are to fit together – in good agreement also with the connection between the Baroque and court culture. In the terminology of the young Habermas, the Baroque is a “representative public sphere” (*Repräsentative Öffentlichkeit*), the exhibition of “truth” *ad oculos*, beyond possible doubt or debate (though certainly not beyond idiosyncratic personal interpretation).

A strong emotional involvement of the flock impedes criticism and rational doubt and is thus fundamental for the functioning of a representative public sphere; but the clerical insight in its necessity prevented the degeneration of art into one-dimensional didactic, however much the bishops from Trent had aimed at exactly that. The Jesuit Antonio Possevino (1534–1611), friend of Clavius, thus writes in his *Tractatio de Poësi et Pictura ethnica, humana et fabulosa collata cum vera, honesta et sacra* (1595)⁶ that

the painter should take advantage of the whole of philosophy, in particular of moral philosophy, since the depiction of the soul and the expression of all its sentiments,

⁶ Translated after Paola Barocchi’s edition [15: II, 458].

agitations and other commotions makes the art of painting deserve the highest praise. The soul, indeed, being various, irascible, just, inconstant, and abominable, clement, sweet, compassionate, sublime, vainglorious, humble, proud, and frivolous, he who is able to do that is certainly not lacking in acuteness of mind.

This quotation allows several supplementary observations touching at our topic.

Firstly, we may return to the quotation from Ginzburg and take note of the contrast between Possevino's outlook (which he shared with many Jesuits and with much Jesuit practice) and the one-way moralizing of Puritanism and Lutheran orthodoxy: none of these could accept a similar inextricable conglomerate of good and evil. It may be no accident that witch burning was less common in regions where Jesuit Baroque culture was strong than in Lutheran areas (although, as has been observed, the Spanish inquisition may simply have been too busy burning heretics to bother much about witches).

Secondly, we may notice that erudite Baroque poetry – say, that of Góngora, Donne and Gryphius – is not at all fit to serve “the indoctrination of the masses from above”, and in so far not easily related to the Trent decree and its definition of the tasks of (church) art. This kind of poetry can be understood, however, exactly in the context of the way Paleotti, Possevino and others filled out the programme. We may think of this passage from John Donne [16: 178]:

I throw myself down in my chamber, and I call in and invite God and his angels thither, and when they are there I neglect God and his angels for the noise of a fly, for the rattling of a coach, for the whining of a door. I talk on, in the same posture of praying, eyes lifted up, knees bowed down, as though I prayed to God; and if God or his angels should ask me when I thought last of God in that prayer, I cannot tell. [...] A memory of yesterday's pleasure, a fear of tomorrow's dangers, a straw under my knee, a noise in mine ear, a light in mine eye, an anything, a nothing, a fancy, a chimera in my brain, troubles me in my prayer.

Loyola had also known about such disturbances (*Ejercicios Espirituales* §§346–351 [13] [14: 84f]); but ultimately he ascribed them to “the enemy”. The champion of the Counter-Reformation thus could still provide dichotomic simplicity by means of projection and reification; the Baroque poet, like the theoretician Possevino, had come to acknowledge the inherent quiet disorder of the human mind.

On the other hand, and finally, there is a striking contrast between Possevino's words and much of what we find with central representatives of the New Science – Bacon's belief that nature can be reduced to a finite number

of forms; Descartes' clear and self-evident truths;⁷ the certainty of the geometric method; the conviction of Boyle and others that the *experiment* can establish solid facts; the faith of Descartes, Boyle, Leibniz and others that the mechanized thought of algebra may serve as a general model for the scientific and philosophical method.

General explanations

This latter contrast suggests a first general explanation of the absence of Baroque inspiration in the New Science: the two cultural currents have radically different programmes. We may think of Galileo's vicious remarks about Sarsi alias Orazio Grassi in *Il saggiatore* – the Collegio-Romano mathematician who had dared to suppose a comet to be farther away than the moon (and to point out that Galileo could not have performed his experiments too carefully):⁸

It seems to me that I discern in Sarsi a firm belief that in philosophy it is essential to support oneself on the opinion of some celebrated author, as if when our minds are not wedded to the reasoning of some other person they ought to remain completely barren and sterile. Possibly he thinks that philosophy is a book of fiction created by some man, like the *Iliad* or *Orlando furioso* – books in which the least important thing is whether what is written in them is true.

At first we may believe that Galileo just postulates the incompetence of his opponent – Benjamin Farrington's words from 1938 [18: 437] come to mind:

There is a phrase that has been much on people's lips in recent times to the effect that science is ethically neutral. It is, no doubt, possible to attach a meaning to this. But it is also surely true that with regard to one, at least, of the cardinal virtues science is not neutral: Science must be true.

However, certain turns in Galileo's assault hint at a more precise aim. Firstly, in the treatise which Galileo attacks, Grassi plays with Baroque rhetoric and metaphors, albeit showing that these *are* metaphors by explaining them; secondly, he permits himself to refer to the testimony of ancient philosophers and even to such poets who – like Ovid and Lucrece – were familiar with mathematics and natural philosophy

⁷ We may also observe that Descartes reproduces Loyola's dichotomy by other means when he separates "the passions of the soul" from the soul itself (which is essentially *thought*).

⁸ Translation from [17: 183].

For one reason as well as the other, Galileo can insinuate an identification of Grassi with *probabilism* [19: 23f], a doctrine according to which “in matters of faith and morality, it suffices for the assurance of tranquillity of conscience to follow a plausible opinion” ([20: A3] – where “plausible”, that is, *probabilis*, means that an opinion is shared by one of several (possibly discordant) recognized authorities. As observed by the horrified Pascal, the consequence is that most humans will be innocent.⁹ That horror may be one of the reasons Pascal and Arnauld created the concept of quantified probability: without quantification, the opposite *probabiliorist* doctrine – that the *most* plausible opinion must be followed – is ultimately meaningless.

Beyond the Baroque acceptance of ambiguity and the tie between Baroque culture and probabilism, we find another global conflict between the Baroque and the New Science as the latter developed in the course of the seventeenth century. As mentioned, the Baroque was a “representative public sphere” – maybe the most striking deliberate construction of this type of public sphere before the advent of modern advertising. In this respect there is no fundamental conflict with the roots of Modern science in courtly culture, as discussed by William Eamon [22]. However, from around 1615 the barycentre moved toward circles of peers, from the meetings in Mersenne’s cell over Gresham College to the creation of the scientific academies (to mention but the emblematic names). Thereby, the ambience of the New Science became an exemplification of the other main type of “public sphere” understood as locus for the creation of collective conviction: the one where “truth” is not displayed but results from discussion based on more or less well-defined shared principles between culturally qualified participants who, with respect to the discussion, are in principle peers¹⁰ – the type of public sphere which the young and still neo-liberalist Habermas believed

⁹ *Les Provinciales* VI [21: 719].

¹⁰ This point could evidently be elaborated and modulated. On one hand, the integration of the *Académie des Sciences* in Colbert’s state system had as one consequence the introduction of a hierarchy of *pensionnaires*, *associés* and *élèves*; on the other, printing gave new opportunities for the development of a *republic of letters* encompassing all of those who had received adequate education (in whatever way they had received it). Indeed, the norm that knowledge should be made public (as knowledge that can be *understood*) is already expressed in the sixteenth century in as unanticipated places as John Dee’s *Monas hieroglyphica* from 1564 [23] and della Porta’s *Magia naturalis* from 1591 [24], cf. [25: 349f, 342f – cf. also Pamela Long’s discussion [26] of the norm of openness as expressed in sixteenth-century writings on mining and metallurgy]. Since this is not my present theme, I shall restrict myself to these hints.

to have emerged only with (petty) bourgeois society.¹¹ It is characteristic that striking *displays* of the new truth like those of Otto von Guericke were performed for the Emperor and for the Berlin court [28: 168] [29: 575]. More representative than the display of the Magdeburg hemispheres is what Lorenzo Magalotti, secretary of the Accademia del Cimento, wrote about Leopold, Medici prince and protector of the Academy.¹² Leopold liked

to act as an Academician, and not as a Prince. He is content to play the second role only on occasions when there is a question of expense, generously supplying the needs of the Academy.

Close-up

Birds eye views are useful. The contrast between the quest for simplicity and clear-cut answers on one hand and the acceptance of and even infatuation with ambiguity on the other is probably a valid contribution to our understanding of why a Baroque influence on the New Science is difficult to discern; the reference to the foundation of the two currents in public spheres of discordant types is also likely to make a cogent point. However, it may be useful to look at these general explanations through the lens of a particular example: a character who was deeply rooted in the Baroque mind-set and at the same time participated in the unfolding of the New Science, or at least tried to do so – at best participating in its mathematical and natural-science main current.

Two formidable characters propose themselves. One is Athanasius Kircher, the other is Juan Caramuel. Kircher's activity ranges more widely in the natural-scientific field than Caramuel's; Caramuel, on the other hand, is more explicit as a theoretician of the Baroque. I shall concentrate on Caramuel, returning briefly to Kircher, and mention Rudbeck in an aside.

Even though all three are polymaths, we should not necessarily take all polymathy as a characteristic Baroque value: much of it, for instance Alsted's encyclopaediae, comes in the wake of Ramism, which in its love for dichotomic simplicity is at least as far removed from the Baroque as the New Science.

¹¹ This expansion of Habermas' conceptual framework is presented in Danish in my [27], together with a discussion of pre-bourgeois instances of an "argument-based public sphere".

¹² Quoted from [30: 56f]. Even though the claim may not be fully true (it seems not to be) it illustrates the ideal with which the secretary found it fitting to measure him as an academy member.

Caramuel's Baroque

Caramuel was born in Madrid in 1606. He studied theology and entered the Cistercian Order at an early age, and died in 1682 after having been bishop, first of Campania¹³ and afterwards of Vigevano close to Milan. Many among his more than 70 volumes can be linked to the theory of the Baroque.

One of them is his *Defence of the age-old and universal doctrine, about probabilism. Against D. Prospero Fagnani's new, singular and implausible opinion* [20]. The above maxim used to explain "probabilism" was borrowed from the introductory résumé of this work. Further on in the same résumé Caramuel states (exactly one hundred years after the Trent council!) that

if the theologians will be allowed for another hundred years to constrain consciences with the same force as they have done these last hundred years, then the conversion of the infidels will be made very difficult, and also for the orthodox very great difficulties will most certainly have to be feared.¹⁴

No wonder that Pascal, convinced of the sinfulness of all men, protests time and again against Caramuel's tolerance in his *Lettres provinciales* (cf. note 9).

Already in 1635 Caramuel had published an *Easy and Clear Explanation of Steganography, or of the Key of the German Solomon, Ioannes Trithemius* [31]. Since Trithemius had introduced it in the early sixteenth century, "steganography" (the art of concealed writing) was in odour of cabbala and black magic (for which reason Trithemius's book was only printed a hundred years later; cf. [32] [33: 169]); Caramuel exonerated it of all dependency on demonic pact or superstition, understanding the cryptographic technique instead as a way to uncover the secrets of the mind through connotations.¹⁵

Caramuel's *Metametrika* from 1663 [35] is an extensive treatment of poetical techniques. Here (p. 1 of the treatise "Apollo analexicus") he phrases the

¹³ Thus in that same depressing area which Christ never reached because he "stopped at Eboli", as Carlo Levi's local interlocutors claimed. For Caramuel no less than Levi, writing was a way to survive mentally .

¹⁴ *Demonstratur tandem Theologos, ita centum annis ultimis constrinxisse Conscientias, ut si aliis centum eodem impetu pergere permittantur, reddetur difficillissima Infidelium conversio, et apud ipsos Orthodoxos inconvenientia maxima certissimè timeri poterunt.*

Here and everywhere in the following, translations from Caramuel's Latin are mine.

¹⁵ Actually, in a treatise *Cabala, hoc est, secretior interpretatio Sacrae Paginae* (apparently never published but referred to in the initial unpaginated list of Caramuel's publications in [34]) he did the same to cabala itself, using it to find hidden meanings in the Scripture. In the same place he tells that his *Metametrika* (on which imminently) was nothing but a reinterpretation of cabala, given this new name because of the notoriety of the old one.

programme that

The whole machine of the world is full of Proteus. Wherefore let us grasp a Proteic pen, that we may be able to praise Proteus

and he praises ("Apollo logogriphicus" p. 215) the logogriph as an

enigmatic song, which digs many significations from the same name, reading backwards, taking away letters or adding others.

If anybody, Caramuel is thus an exponent for Baroque ambiguity, for the use of connotative appeals rather than explicit messages. The word "audacious" (*audax*) recurs in several of his titles – a *Grammatica audax* is the "praecursor logicus" to his *Theologia rationalis* (1554–55), and there is even a *Mathesis audax* from 1644.¹⁶ Even Caramuel's understanding of etymology is, as we shall see, "audacious": It is not necessarily meant to reveal the true historical origin of words but rather, like the logogriph, to reveal concealed possible meanings.¹⁷

¹⁶ The full title is nothing less than *Mathesis audax rationalem, naturalem, supernaturalem, divinamque sapientiam arithmetica, geometrica, catoptrica, statica, dioptrica, astronomica, musica, chronica, et architectonica fundamentis substruens exponensque*. I have not been able to see it, but according to the secondary literature it deals with combinatorics (that is, we may observe, the mathematics of the anagram), meant to replace and outdo Aristotle's *organon* as a universal key to all sciences – see [36: 128] [37: 118] [38: 282–284].

¹⁷ On this point, reading of Caramuel may elucidate Rudbeck's programme. In *The Atlantic Vision*, Eriksson [2: 134] states that for Rudbeck the etymologies of the *Atlantica* have "a rather small degree of credibility", because Rudbeck compares them to "ornaments and paintings" on a building, whose walls and roof are constituted by the ancient written sources, whereas Swedish nature itself makes up the fundament. However, the text which Eriksson quotes continues in a way which shows that something different than mere low credibility is at stake (I quote from Eriksson's translation, repairing an omission):

Ornaments and paintings do not please all in like measure, for as one person wants green the other wants grey, when the one likes Doric the other likes Ionic. With this I mean the style and the origin of words, for maybe one is more pleased if Neptune has his origin from bathe or depict rather than from ruling the sea, and Hercules rather from being the Honour of Juno (the weather) or etc., than from being a warrior chief.

The walls and the roof are what I call the writings of the ancients with which the building is put together. If they do not tell the truth, neither could I. For I did not live in the time of Troy or before.

The foundation is what I call the country of Sweden, its lakes, mountains and streams and other such things through which the ancients have described Sweden's certain position, all of which features remain undisturbed until the stone, mentioned by Daniel, who himself planted it, falls from heaven crushing everything.

The ancient written sources thus have a lower credibility, compared to the arguments

Caramuel the mathematician

After 1663, the Jansenists and the Dominican probabiliorists got the better of Caramuel, and he was no longer allowed to persist in moral and theological tolerance. Instead he published two huge volumes in 1670 about one of his other interests, namely mathematics. His *Mathesis biceps* [34], divided into “old mathematics” and “new mathematics”, runs over more than 1800 folio pages.

About this work – the only one he mentions in his short “scientific biography” – Juan Vernet [39] tells that

although it contains no sensational discovery, [it] presents some original contributions to the field of mathematics. In it is expounded the general principle of the numbering systems of base n (illustrated by the values 2, 3, ..., 10, 12, and 60), pointing out that some of these might be of greater use than the decimal. He also proposed a new approximation (although he did not say so) for trisecting an angle. Caramuel developed a system of logarithms of which the base is 10^9 , the logarithm of 10^{10} is 0, and the logarithm of 1 is 10. Thus, his logarithms are the complements of the Briggsian logarithms to the base 10 and therefore do not have to use negative characteristics in trigonometric calculations. In these particulars Caramuel's logarithms prefigure cologarithms, but he was not understood by his contemporaries; some, such as P. Zaragoza, raised strenuous objections.

This could make us believe that Caramuel's mathematics is as easily separable from his Baroque poetics as Newton's *Principia* from his “chronology of ancient kingdoms” [38]. This, however, turns out to be yet another confirmation of Léon Rodet's principle [41: 205] that “when studying the history of a science, exactly as when one wants to obtain something, one should «rather ask God himself than his saints»”.¹⁸

At first we may look at what Vernet sees as a presentation of “the general principle of the numbering systems of base n ”. It turns up as a *meditatio prooemialis* before the treatment of arithmetic (proper), and is an answer to the question (p. xliii)

whether arithmetic be one, or several? If several, which they may be? And how do they differ from each other? Are they practical, or speculative? And are they necessary?

from geographical facts. Etymologies, on the other hand, are a domain which allows audacious subjective choice and where “the least important thing is whether what is written [...] is true”.

¹⁸ “Pour étudier l'histoire d'une science, tout comme pour obtenir quelque chose, «il vaut mieux avoir affaire au bon Dieu qu'à ses saints»”.

Caramuel's intention is not to produce a "general principle" but exactly the opposite. After having described place value systems with base 2, 3, 4, 5, 6, 7, 8, 9, 10, 12 and 60 (explaining where each may be useful) and shown how to calculate in base 2, 3 and 4 he concludes (p. lxvi; italics from the original) that

Firstly, it is thus established *that several arithmetics are possible, which differ from each other*: indeed, as there are various languages in the world, so they can be dissimilar, and varied with respect to the first return of the unit. I intend, 2, 3, 4, etc.,¹⁹ as we have shown above.

Secondly, it is established that *all these arithmetics are analogous*: indeed, as all languages agree analogically in their flow, similarly, or certainly even more strictly, the arithmetics agree. [...].

Thirdly, it is established *that before the operation of the mind there is neither number nor arithmetic. Truly, numbers are entities produced by the intellect*:²⁰ and that the return of the same numbers depends on human free will; and that these go back to the beginning at so many, and neither by more nor fewer units is because it pleased those who first fashioned arithmetic thus and not otherwise. [...].

We may find the level rather elementary, but Caramuel was none the less the first to publish about different place value systems and describe algorithms for calculating with them.²¹ The metamathematical stance is even more original, too original indeed to the taste of mathematicians: only the non-Euclidean geometries of the nineteenth century led some mathematicians to accept this kind of pluralism; most, even then, only accepted the non-Euclidean variants when Felix Klein had reduced even this pluralism to a single "general principle". It was never the prevalent habit of mathematicians to stress the free subjective choice.

In the *Mathesis biceps*, on the contrary, subjective choice turns up even in places where we would expect Caramuel's choice to be anything but free. Time and again he returns to the choice between the Copernican, the Tychonic and

¹⁹ The meaning is that in the dyadic system, the unit "returns" as 2 (which will be written 10), etc.

²⁰ In the next paragraph, Caramuel emphasizes that numbers are not chimerical figments of the mind but *formed* by the mind, and that *after* the operation of the mind they truly exist in things. His "relativism" is Einsteinian, allowing translation, not postmodern in Feyerabend-Latour style.

²¹ Harriot had done as much before, but in an unpublished note [42]. In the early thirteenth century, Jordanus de Nemore had explained the possibility of place value *fractions* with different bases, speaking of them as "consimilar fractions", and confronting with "dissimilar fractions", ascending continued fractions with changing divisors.

the Ptolemaic world system, and as we should expect from a Catholic bishop in 1670 he rejects the Copernican option. His formulations, however, are not as we would expect. He does not say that this system is contrary to Sacred Scripture but (p. 1392b) that “the cardinals have declared it to be contrary to Sacred Scripture” (which indeed they had; the statement is preceded by a list of “famous mathematicians” – Galileo, Kepler and others – who support the Copernican system).²² Caramuel’s own opinion is stated in phrases like “for me, the earth stands still” (p. 1581a) or (p. 1400b)

We have no need for that which the Church has condemned. When hence the Copernican system has been rejected, the two others remain in court. The Ptolemaic system is implausible [*improbabile*]: Nobody can indeed deny that Venus and Mercury move around the sun. Thus the Tychonic system stands.

Algebra!

Caramuel wrote long after Cardano, Bombelli, Viète and Descartes, and it therefore seems adequate that algebra is treated on 108 folio pages. What is immediately striking is that these pages belong to the first volume, “ancient mathematics”. However, this location turns to be well-founded. Nothing of what these four authors had done has indeed left the least trace in Caramuel’s algebra.

This does not mean that Caramuel just explains or repeats what can be found in algebraic writings from the earlier Renaissance or the Middle Ages. As far as I know, *no* precursor ever dealt with the material as does Caramuel. His basic idea – a *free choice* if any – is that algebra or “abstract proportion” is an extension of the “false position” and the rule of three.²³ For this reason, his algebra never

²² Elsewhere (p. 105) he declares the stance of the cardinals to be *prudent*, because nothing in the Sacred Scripture suggests the earth to move, but much that it rests.

²³ Both terms may be in need of explanation.

First the “false position”, which may be “simple” or “double”. A number, to which $\frac{1}{7}$ of itself is added, gives 19. In the “simple” variant we make a convenient but probably false guess – for instance, that the number is 7. Adding its $\frac{1}{7}$ gives us 8 – but we should have $\frac{19}{8}$ as much. Therefore, our guess should also be multiplied by $\frac{19}{8}$. In the “double” variant we make two guesses (for instance, 7 and 21), and find the result as a mean, weighed in inverse proportion to the two resulting errors (the principle of alligation).

Next the “rule of three”. 3 sacks of flower cost 17 shillings, what is the price of 4 sacks? The rule, as it is formulated in late medieval abacus books, prescribes that we multiply [the counterpart of] the things we want to find (that is, 4, namely 4 pounds) but the magnitude which is not of the same kind (17, namely shillings) and divide by the third magnitude (3, pounds).

goes beyond the first degree, even though his presentation of algebraic symbolic notations suggests a notation for higher powers which in principle is related to that of Bombelli (but so different in its concrete shape that borrowing can be excluded).

I shall take up only a few aspects of Caramuel's idiosyncratic algebra. At first (pp. 99–110) comes a philosophical deliberation whether it is possible to derive true conclusions with necessity from false premises. This deliberation is necessary precisely because of the identification of algebra with the "false position". Caramuel rambles widely. He moves through the schemes of Aristotelian logic (not least of course *modus tollens*, the "indirect proof" whose schematic figure called *barocco* may indeed have given rise to the nickname which the Enlightenment gave to seventeenth-century art²⁴); the fictions of legal thought; *theorica planetarum* with its falsely assumed epicycles and crystal spheres; logarithms; the indirect proofs of mathematics; and finally the false position. The conclusion is a denial of the possibility – Caramuel, like Farrington, thinks that "science must be true", his steganography and logogriphs should not be seen as a rejection of the demand for truth; but as Paleotti's way towards piety, the path toward truth may be indirect, poetical rather than through explicitly argued discourse.

This is clearly exemplified in what follows on pp. 117–119: an etymological investigation of the origin of the names of algebra: *algebra*, *cossa* and *almucabala*.

First comes a philological discussion of the proposal to derive *algebra* from the name Geber, a discussion which is at the level of seventeenth-century standard philology at its best. Caramuel objects that Geber Hispanus (Jābir ibn Aflah) must have lived around the twelfth century, which is too late. But then Caramuel goes on, at first with a borrowing from Alsted's *Encyclopaedia* [43: III, 844a]:

Algebra is an arabic word, which means the doctrine of the excellent man: AL, indeed, is the article: GEBER means Man: and it is often a title of honour, as with us Master, or Doctor. Today this book is much venerated among the erudite nations of the Orient, and by the Indians who are very fond of this art it is called Aliabra, or Alboret, since they do

Both methods, we see, are rather *alternatives* to algebra as we know it from the medieval treatises than *fundaments* for it.

²⁴ The other standard etymology derives the word from Portuguese *barroco*, an imperfect pearl. As far as metaphorical value is concerned, one explanation is as plausible as the other (which certainly would have pleased Caramuel if the word in its current meaning had existed in his times).

not know the proper name of its creator.²⁵ Certainly גבאר, GABAR, in Arabic is restored. And as the article is אל, AL, prefixed, the restoration of arithmetic was אלגברה, ALGABRA.

But why do we call the same science *cossic*, and the special numbers which it makes use of, *cossic numbers*? In Tome 2, book 14, chapter 4, § 1 in Alsted: Moreover, Algebra was called the art of res, and census by certain Latin writers; as with Regiomontanus; by the Italians (read, by the Spaniards)²⁶ Arte de la cosa, from which Cossa. Christoph Rudolph, excellent master of this art, considers that the rule is called Cossic, as Art of things, because it serves to solve questions about hidden things: after the manner in which arithmetic books usually express themselves in all problems, We lay down a thing. Further, by certain Greeks Algebra was called Analytica. They also, etc.²⁷ [...] And there are in Europe two current names, Regula di tre [the rule of three], and Arte de la Cosa, the former Italian, the latter Spanish, which clearly indicates how much these two nations have promoted, adorned and made illustrious arithmetic.

Further, if you do not want to favour the Spaniards, you shall say that the term Cossa comes from the Hebrews or the Arabs to the Greeks and the Latins. Indeed קסר, Casar, with the Saracens is to Break [Frangere], and therefore should mean the science which considers broken numbers [i.e., fractions]. Add to this that one may derive an etymology from the roots קזז QAZA, Judged, and קזר QAZAR, was Brief: indeed, this science is a kind of arithmetic which is fit for judging, and most sure in matters concerned with numbers. An indication that it solves with utmost security and concision difficulties which ordinary arithmetic is hardly able to solve when moved in roundabout ways and labyrinths.

Johannes Geysius²⁸ explains the word differently. In Book 1 on the Coß, chapter 1, he says, COSSA comes from קסר, CASA, that is, Weaved; it teaches indeed to find a number which has been hidden. Etc. This indeed I do not understand, since “to weave” [texere] is not “to reveal” [detexere]. Say thus that this ability was named from weaving because it disentangles numbers which have been woven together and intertwined; so that the denomination refers not to the science but to the object.

In Greek it can also be called ΚΟΣΙΚΗ, since ΚΟΣΙΜΒΟΣ is a Knot.²⁹ And actually, all problems which are treated by this science are knots which you cannot

²⁵ Here the first borrowing from Alsted ends.

²⁶ This correction is inserted by Caramuel, who has not forgotten his Spanish origin even though he is a bishop in southern Italy. According to my work on the beginnings and background of Italian abacus algebra Caramuel may indeed be right in as far as the first algebraic use of the word is concerned.

²⁷ Alsted goes on “They also called normal arithmetic synthetic”, and explains that with reference to other works from the Ramist tradition.

²⁸ A parson [44: 220] and, as we see, amateur mathematician at the *Rechenmeister* level, who wrote 10 pages (vol. III, pp. 865–874) on algebra in Alsted’s encyclopedia. Alsted refers to him as *cossista*.

²⁹ The spelling ought to be κοσύμβος, which actually is something made from knots (a hair-net etc.); but Caramuel’s translation agrees with that of dictionaries from his century.

solve if not by breaking (dividing unity). And also, if anybody is audacious, from *Cos*, a Latin word, *Cossica* is almost as saying *Cotica*. The mind actually needs a whetstone [*cos*] in order to be sharpened, and this science sharpens the mind, which is often dulled by badly digested methods. But even the small worms which bore through the hardest tablets are called *Cossi* by the writers on natural history. Also, if anybody is audacious, the name may be drawn from here. Indeed, if the multiplication table is easy and can be penetrated by any mind, others are hard, and cannot be penetrated if not by learning the *Cossic* art.

Further, it follows from Johannes Geysius's *Book 1 on the Coß*, chapter 4 No. 4 that *Coß* and *Algebra* are the same thing. There he says, *It is also called ALMUCABALA, that is, Hidden tradition; and also ALGEBRA, that is, Magisterial Art. Etc.* And Alsted, who in *Tome 2 book 14 § 1* says, *It is told that there was one remarkable Mathematician, who wrote down his art in Syriac language and sent it to Alexander the Great, and called it ALMUCABALA, that is, book on hidden things (this Art, indeed, teaches how to find a hidden number), the doctrine of which others preferred to call ALGEBRA.* None of them expresses the precise meaning of the word. Indeed, ܐܠܡܘܩܒܠܐ is *Tradition*, from the root ܩܒܠܐ QABAL, *to transmit*. Since they would not divulge it, they did not transmit it in writing but orally to disciples. ܡܩܒܠܐ MAQABALIM are *Cabalists*, and when the article is added it could be called AL-MUCABALA, not in Syriac but in Arabic.

ΕΝΑΠΙΘΜΟΣ is said about the one who is appreciated, a distinguished and extraordinary man: from which ΕΝΑΠΙΘΜΙΚΗ, some noble and distinguished kind of arithmetic, which is appreciated by learned men.

But one may also call this thing ΜΕΤΑΠΙΘΜΙΚΗ which has gone beyond the measure of common arithmetic and traverses the fields that lay beyond it.

It should be obvious that Caramuel does not believe that the etymologies from *Casar* onwards are historical truth. They are propounded for the case “you do not want to favour the Spaniards”; some are “audacious”, and repeatedly two alternative explanations are combined into one figure (as *qaza* and *qazar*). As the steganography and the logogriph, these etymologies are meant through poetical play to dig out – or rather display – aspects of the nature of algebra. That these aspects are indeed prior to the etymologies can be seen for instance from the example ΚΟΣΙΚΗ/κοσύμβος: only the one who already knows that he wants to get to broken numbers (that is, to transcend the Greek concept of number as a plurality of units) will find it in *knot*.

The Reception

As we see, Caramuel's *Mathesis biceps* is soaked with ambiguous and poetical Baroque subjectivity – so far removed from the Counter-reformation “constraint of consciences” that only familiarity with the mediating process allows us to discern the connection. Caramuel's Baroque is no external aspect, no mere decoration, as Grassi's poetical references in the treatise about the comets: it

inspires the investigation of the “plurality of arithmetics” and allows the understanding of algebra as an abstract version of the false position. Even when writing about mathematics, Caramuel remains a Baroque mind.

Was he a mathematician all the same? The creators of the New Science appear to have nourished some doubts – as Vernet points out, they did not understand the new mathematical ideas contained in the *mathesis biceps* (Leibniz had to reinvent the place-value system), and the rest did not interest them. If we look for references to Caramuel in Oldenburg’s correspondence³⁰ we do not find much. In 1668 John Collins (vol. V, p. 213) lists his *Solis et artis adulteria* as one of those books in a catalogue “which I doe not much desire unless cheape”; in 1669 (vol. VI, p. 228) he asks Oldenburg “how he approoves the treatises of John Caramuel Lobkowitz Intituled Ingeniorum crux et Mathesis audax”. Oldenburg (vol. VI p. 234) forwards the question to René-François de Sluse, who answers (vol. VI, p. 525) that “I saw the *Mathesis audax* and *Sublimium ingeniorum crux* very many years ago, but saw them only, nor does any memory of them remain”. In 1670 Sluse offers (vol. VII, p. 256) to get hold of the *Mathesis biceps* when it becomes available. In the meantime, Oldenburg has received a letter from François Vernon (vol. VII, p. 273), which refers to

a great Vast Bulke of Caramuel, Able to fill a Library. His Mathesis biceps, speculative & Practicall [*sic*] 2 vol in Folio. His Calamus 2 volumes more [i.e., *Metametrical*] & whc is worse hee is [not] contented with the loade hee hath laid on the world already. but he promiseth to Plague it wth I doe no know how many volumes more.

In consequence, Oldenburg answers (vol. VII, p. 368) that

As for the two ample volumes of Caramuel Lobkowitz, we understand them to be damned with faint praise, which has cooled our desire to see them.

Sluse, on his part, concludes (vol. VII, p. 484) after getting hold of the volumes that

I have looked through Caramuel’s farrago, and indeed, to speak kindly, its utility does not seem proportionate to its bulk.

This was all – neither much nor very positive.

³⁰ [45]. Where the letters are in Latin I quote from the stylistically faithful English translation of the editors.

Historical or historiographical problem?

An examination of Kircher's works and their reception would lead to similar results. Most of his works about nature deal with issues and objects for which it was less easy to judge the validity of new results and proposals than in the case of mathematics – magnetism, the subterranean world, applied acoustics – so the rejection is less absolute. Yet the difference is not significant – when Kircher approached nature as a *Gesamtkunstwerk* or *theatrum* it was difficult to find a perspective which was theoretically fruitful or seen as such by the representatives of the New Science.

In so far we may say that the absence of a Baroque impact on the New Science is a fact of history, no historiographical blind spot. Works which were too close to the Baroque current with its emphasis on ambiguity and poetico-connotative understanding were too far removed from the sensibility of the New Science to gain much influence. When they offered new answer, these were to questions which seemed outdated or irrelevant, or they concerned matters that were too complex to allow the answers to be convincing.

However, once work with the Baroque prototypes (not “ideal types”, since Caramuel and Kircher were quite real!) has opened our eyes to characteristic Baroque features, we may find such features elsewhere though as a rule not together. I shall not go into details but just suggest three sketchy examples.

First we may think of Scott Mandelbrote's distinction between two kinds of natural theology in seventeenth-century England [46]: on one hand the “Wilkins-Boyle” type which

stressed the importance of the providential ordering of nature and the consequent lawful operation of the universe as a proof of divine superintendence and of the power of the divine will

on the other that of the Cambridge Platonists, which based its argument on

appeal to the wondrous activity found in nature, of which regularity was only ever a part, and which required the constant, creative involvement of a hierarchy of spiritual agents

and which

was ultimately weakened by its association with credulity and with discredited attempts to prove that spiritual agents could be observed at work in the world.

The spiritual agreement of the latter group with the Kircher we know for instance from the *Musurgia universalis* is not perfect, nor is it however totally absent. The reasons for rejection are also fairly alike.

Next, we may turn our attention to the title pages and frontispieces of scientific printed works of the epoch. The point is not that these look very much like other visual art from the epoch, and thus as “Baroque”; this could hardly be otherwise.³¹ Significant is that they served to carry a message by indirect, metaphorical means about the trustworthiness and legitimacy of the book under the frontispiece. As stressed by Volker Remmert [47], however, the message of the frontispiece was not only distinct from the technical argument of the book, which it would indeed be hard to translate into emblematic pictures; it was also largely directed at a different audience, an audience that was hardly able to follow the technical discourse. The text of books was thus directed at the argument-based public sphere of what was soon to be called the “republic of letters”, whereas the frontispieces – which were indeed so detached from the argument of the book for which they were produced that they might be transferred to quite different books – were directed at a distinct, representative public sphere.

We may finally ask whether the tenacious dedication of certain late-seventeenth- and early-eighteenth-century *virtuosi* to the study of insects, worms and microscopic animals irrespective of the scandalized antagonism of galant society and writers like La Bruyère and Addison [48: 29f and *passim*] can not be seen as a symptom of Baroque obsession with everything proteic.

If such suggestions of Baroque presence are taken into account, we may conclude that the total absence of the Baroque from the historiography of seventeenth-century science is also to some extent a historiographical artefact. But this is a different story which I shall not pursue.

A third story – no less important, perhaps, but which I shall not take up even sketchily – is the *modernity* of the Baroque. Not, of course, in relation to modern *science*, but as the starting point for an understanding of the nature and tasks of poetry that was to unfold in the aesthetic theory of the twentieth century (see [49] and [50]) – and (less flattering perhaps for the seventeenth century but quite to the point if we think of the initial intertwinement of the Baroque with Counter-reformation propaganda) in relation to the contemporary calculated use of emotion, ambiguity and indirect messages in the advertisement industry.

³¹ Similarly, Eriksson’s observation that “we must admit [the] striking baroque character of Newton’s monument in the Westminster Abbey” [2: 164] is irrelevant as an argument for declaring Newton a Baroque scientist.

References

- 1 Rudbeck, Olaus, *Atland Eller Manheim. Dedan Japhets afkomne, de förnemste Keyserlige och Kongelige Slechter ut til hela werlden, henne at styra, utgångne äro, så och dess efterföljande Folk utogade, nemligen Skyttar, Borbarn, Asar, Jettar, Giotar, Phryger, Trojaner, Amaizor, Traser, Lyber, Maurer, Tussar, Kaller, Kiempar, Kimrar, Saxer, Germen, Swear, Longobarder, Wandaler, Herular, Gepar, Tydskar, Anglar, Paitar, Danar, Sidkampar, och de som i werket wisas skola. Atlantica Sive Manheim. Vera Japheti posterorum sedes ac patria, ex qua non tantum Monarchae et Reges ad totum fere orbem reliquum regendum ac domandum, Stirpesque suas in eo condendas, sed etiam Scythae, Barbari, Asae, Gigantes, Gothi, Phryges, Trojani, Amazones, Thraces, Libyes, Mauri, Tusci, Galli, Cimbri, Cimmerii, Saxones, Germani, Svevi, Longobardi, Vandali, Heruli, Gepidae, Teutones, Angli, Pictones, Dani, Sicambri, aliique virtute clari et celebres populi olim exierunt.* Uppsala: Henricus Curio S.R.M. & Academiae Upsal. Bibliopola, [1679].
- 2 Eriksson, Gunnar, *The Atlantic Vision: Olaus Rudbeck and Baroque Science.* (Uppsala Studies in History of Science, 19). Canton, Mass.: Science History Publications, 1994.
- 3 Høyrup, Jens, “Barocco e scienza secentesca: un legame inesistente?” *Analecta Romana Instituti Danici* 25 (1997), 141–172.
- 4 Høyrup, Jens, “Reflections on the Baroque in the History of Science”. Essay Review of: Gunnar Eriksson, *The Atlantic Vision: Olaus Rudbeck and Baroque Science.* *Physis* 24 (1997), 675–694.
- 5 Hooykaas, R., *Humanisme, science et réforme: Pierre de la Ramée (1515–1572).* Leiden: Brill, 1958.
- 6 Hofmann, Joseph Ehrenfried, *Geschichte der Mathematik.* 3 Bände. (Sammlung Göschen 226, 875, 882). Berlin: Walter de Gruyter, 1953, 1957, 1957.
- 7 Wellek, René, “Baroque in Literature”, pp. 188–195 in *Dictionary of the History of Ideas*, vol. I. New York: Scribner, 1973.
- 8 *Grande dizionario Garzanti della lingua italiana.* Milano: Garzanti, 1987.
- 9 Hauser, Arnold, *Il Manierismo. La crisi del Rinascimento e l’origine dell’arte moderna.* (Biblioteca di storia dell’arte, 4). Torino: Einaudi, ²1965.
- 10 Wittkower, Rudolf, *Arte e architettura in Italia: 1600–1750.* (Biblioteca di storia dell’arte, 14). Torino: Einaudi, ²1972.
- 11 Waterworth, J. (ed., trans.), *The Canons and Decrees of the Sacred and Oecumenical Council of Trent.* London: Dolman, 1848. Pp. 232–289, “Twenty-fifth Session” on <http://history.hanover.edu/texts/trent/ct25.html>.
- 12 Ginzburg, Carlo, *Il formaggio e i vermi: Il cosmo di un mugnaio del ’500.* Torino: Einaudi, 1976.
- 13 Mullan, Elder (ed., trans.), *The Spiritual Exercises of St. Ignatius of Loyola*, translated from the autograph. New York: P. J. Kennedy & Sons, 1914. <http://www.ccel.ignatius/exercises/formats/exercises1.0.pdf>.
- 14 de Loyola, Ignacio, *Ejercicios espirituales.* Barcelona: Linkgua, 2007.
- 15 Barocchi, Paola (ed.), *Scritti d’arte del Cinquecento.* 9 vols. Torino: Einaudi, 1978.
- 16 John Donne, *Selected Poetry and Prose*, ed. T. W. Craik & R. J. Craik . London & New York: Methuen, 1986.

- 17 Drake, Stillman, & C. D. O'Malley (eds, trans.), *The Controversy of the Comets of 1618. Galileo Galilei, Horatio Grassi, Mario Guiducci, Johann Kepler*. Philadelphia: University of Pennsylvania Press, 1960.
- 18 Farrington, Benjamin, "Prometheus Bound: Government and Science in Classical Antiquity". *Science and Society* 2 (1937–38), 435–447.
- 19 Hacking, Ian, *The Emergence of Probability*. London: Cambridge University Press, 1975.
- 20 Caramuel, Juan, *Apologema pro antiquissima et universalissima doctrina, de probabilitate. Contra novam, singularem, improbabilemque D. Prosperi Fagnani opinionem*. Lyon: Sumptibus Laurentii Anisson, 1663.
- 21 Pascal, *Oeuvres complètes*, ed. Jacques Chevalier. (Bibliothèque de la Pléiade, vol. 34). Paris: Gallimard, 1954.
- 22 Eamon, William, "Court, Academy and Printing House: Patronage and Scientific Careers in Late Renaissance Italy", pp. 25–50 in Bruce T. Moran (ed.), *Patronage and Institutions. Science, Technology and Medicine at the European Court, 1500–1750*. Rochester, New York: Boydell & Brewer, 1991.
- 23 Josten, C. H., "A Translation of John Dee's 'Monas hieroglyphica' (Antwerp, 1564), with an Introduction and Annotations [and a facsimile of the Latin text]". *Ambix* 12 (1964), 84–221.
- 24 della Porta, Giovanni Battista, *Magiae naturalis libri viginti*. Frankfurt, Wechel, 1591.
- 25 Høyrup, Jens, "From Hesiod to Saussure, from Hippocrates to Jevons. An Introduction to the History of Scientific Thought". Eighth, still preliminary version. *Lecture notes*, Roskilde Universitetscenter, Faggruppen for Filosofi og Videnskabsteori, 2004.
- 26 Long, Pamela, "The Openness of Knowledge: An Ideal and Its Context in 16th-Century Writings on Mining and Metallurgy". *Technology and Culture* 32 (1991), 318–355.
- 27 Høyrup, Jens, "Erkendelsesteoretiske, historiske og andre bemærkninger til offentlighedsbegrebet". *Filosofi og Videnskabsteori på Roskilde Universitetscenter* 4 (1984), 136–168.
- 28 Foley Ames, M. G. (ed., trans.), Otto von Guericke, *The New (so-called Magdeburg) Experiments*. [Experimenta nova, Amsterdam 1672]. (Archives Internationales d'Histoire des Idées, 137). Dordrecht etc.: Kluwer, 1994.
- 29 Krafft, Fritz, "Guericke, Otto von", pp. 574–576 in *Dictionary of Scientific Biography*, vol. V. New York: Scribner, 1972.
- 30 Middleton, W. E. Knowles, *The Experimenters: A Study of the Accademia del cimento*. Baltimore: Johns Hopkins Press, 1971.
- 31 Caramuel, Juan, *Steganographiae, nec non claviculae Salominis Germani, Ioannis Trithemii, genuina, facilis dilucidaque declaratio*. Köln: Typis Egmondanis, 1635.
- 32 Brann, Noel L., *Trithemius and Magical Theology: A Chapter in the Controversy over Occult Studies in Early Modern Europe*. Albany, NY: SUNY Press, 1999.
- 33 Coulianu, Ioan P., *Eros and Magic in the Renaissance*. Chicago: Chicago University Press, 1987.
- 34 Caramuel, Juan, *Mathesis biceps. Vetus, et nova*. 2 vols. Campania: In Officina Episcopali, 1670.
- 35 Caramuel, Juan, *Primus Calamus ob oculos ponens Metametricam*. Romae: Fabius Falconius, 1663.

- 36 Lüthy, Christoph, "Where Logical Necessity Becomes Visual Persuasion: Descartes's Clear and Distinct Illustrations", pp. 97–133 in Sachiko Kusukawa & Ian Maclean (eds), *Transmitting Knowledge: Words, Images and Instruments in Early Modern Europe*. Oxford: Oxford University Press, 2006.
- 37 Gavilán, María Dolores Martínez, "La *Grammatica audax* de Juan Caramuel y las corrientes lingüísticas del siglo XVII", pp. 107–133 in E. F. Koerner & Hans-Josef Niederehe (eds), *The History of Linguistics in Spain II*. Amsterdam: John Benjamins, 2001.
- 38 Pérez de Laborda, Alfonso, *Estudios filosóficos de historia de la ciencia*. Madrid: Encuentro, 2005.
- 39 Vernet, Juan, "Caramuel y Lobkowitz, Juan", p. 61 in *Dictionary of Scientific Biography*, vol. III. New York: Scribner, 1971.
- 40 Newton, Isaac, 1728. *La Chronologie des anciens royaumes corrigée, à laquelle on a joint une chronique abrégée, qui contient ce qui c'est passé anciennement en Europe, jusqu'à la conquête de la Perse par Alexandre le Grand*. Paris: Gabriel Martin, Jean-Baptiste Coignard, Hippolite Louis Guerin & François Montalant, 1728.
- 41 Rodet, Léon, "Les prétendus problèmes d'algèbre du manuel du calculateur égyptien (Papyrus Rhind)". *Journal asiatique*, septième série **18** (1881), 184–232, 390–559.
- 42 Ineichen, Robert, "Leibniz, Caramuel, Harriot und das Dualsystem". *Mitteilungen der Deutschen Mathematiker-Vereinigung* **16:1** (2008), 12–15.
- 43 Alsted, Johann Heinrich, *Encyclopaedia. 7 tomis distinctis*. Herbornae Nassoviorum, 1630.
- 44 Hotson, Howard, *Commonplace Learning: Ramism and its German Ramifications, 1543–1630*. Oxford: Oxford University Press, 2007.
- 45 Hall, A. Rupert, & Marie Boas Hall (eds, trans.), *The Correspondence of Henry Oldenburg*. 13 vols. Madison, Wisconsin: University of Wisconsin Press (I–IX) / London: Mansell (X–XI) / London & Philadelphia: Taylor & Francis (XII–XIII), 1965–1986.
- 46 Mandelbrote, Scott, "The Uses of Natural Theology in Seventeenth-Century England". *Science in Context* **20** (2007), 451–480.
- 47 Remmert, Volker R., "'Docet parva pictura, quod multae scripturae non dicunt.' Frontispieces, Their Functions, and Their Audiences in Seventeenth-Century Mathematical Sciences", pp. 239–270 in Sachiko Kusukawa & Ian Maclean (eds), *Transmitting Knowledge: Words, Images and Instruments in Early Modern Europe*. Oxford: Oxford University Press, 2006.
- 48 Daston, Lorraine, *Eine kurze Geschichte der wissenschaftlichen Aufmerksamkeit*. (Themen, 71). München: Carl Friedrich von Siemens Stiftung, 2002.
- 49 Koch, Ludovica, "Rime, arditezze e ragioni", pp. 169–194 in *Etimologia: Pratiche e invenzioni* (Fabrica 1. Quaderni di retorica e di euristica letteraria). Napoli: Istituto Universitario Orientale, 1983.
- 50 Koch, Ludovica, "Écho, sa raison et ses rimes", pp. 89–96 in Inge Degn, Jens Høyrup & Jan Scheel (eds), *Michelanea. Humanisme, litteratur og kommunikation*. Festschrift til Michel Olsen i anledning af hans 60-årsdag den 23. april 1994. (Sprog og kulturmøde, 7). Aalborg: Center for Sprog og Interkulturelle Studier, Aalborg Universitetscenter, 1994.