Studies in History and Philosophy of Science 32

Marco Sgarbi

The Aristotelian Tradition and the Rise of British Empiricism

Logic and Epistemology in the British Isles (1570–1689)

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STUDIES IN HISTORY
AND PHILOSOPHY OF SCIENCE

VOLUME 32

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ISSN 0929-6425
ISBN 978-94-007-4950-4 ISBN 978-94-007-4951-1 (eBook)
DOI 10.1007/978-94-007-4951-1
Springer Dordrecht Heidelberg New York London

Library of Congress Control Number: 2012946205

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

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Ernst Cassirer to Aby Warburg on his Sixtieth Birthday
Individuum und Kosmos in der Philosophie der Renaissance

Notes on the Texts

All Greek and Roman authors are cited in their most familiar single-name form, both in the text and in the bibliography, e.g. Cicero (not Marcus Tullius Cicero) and Quintilian (not Marcus Fabius Quintilianus). Titles of Greek works are given in their most familiar Latin form (for example, I speak of Aristotle's *Analytica posteriora*). All other titles are given in the original language. My general rule has been to preserve original spelling and punctuation, even when erroneous, except where there are critical editions. Sometimes, when fitting quotations around the text, I have silently changed a lower case initial letter to an upper, or vice versa, as the sentence requires. When transcribing early modern Latin I have expanded all contractions, while dropping diphthongs and omitting diacritical marks. I have also modernised ':' with ';' or ',', where required for the comprehension of the sentence. The extensive use of Latin quotations in the footnotes serve the purpose of having an immediate reference to sometimes rare sources.

Acknowledgments

I gratefully acknowledge the help and support of numerous people and institutions while I was working on this book. This research has been possible thanks to a Frances A. Yates Short-Term Fellowship at The Warburg Institute, to an Assegno di ricerca at the Dipartimento di Filosofia, Psicologia e Pedagogia of the Università di Verona and to an Accademia dei Lincei-British Academy Fellowship.

While any list of reasonable length would be undoubtedly incomplete, I nonetheless want to acknowledge the great support of Constance Blackwell, Giorgio Bernardi Perini, Enrico Berti, Marco Bertozzi, Martin J. Burke, Stefano Caroti, Stephen Clucas, Paolo Cristofolini, Eva Del Soldato, Germana Ernst, Marta Fattori, Mordechai Feingold, Guido Giglioni, Lucia Girelli, Tullio Gregory, Howard Hotson, Sarah Hutton, Per Landgren, Seung-Kee Lee, Peter Mack, Laura A. Macor, Ferdinando L. Marcolungo, Ann E. Moyer, Lodi Nauta, Gianenrico Paganini, Enrico Peruzzi, Vittoria Perrone Compagni, Gregorio Piaia, Antonino Poppi, Riccardo Pozzo, Tad Schmaltz, Richard W. Serjeantson, Quentin Skinner, Maurizio Torrini and Cesare Vasoli.

A special thanks to Stephen Gaukroger and the editorial board of 'Studies in History and Philosophy of Science', who have accepted so benevolently my book in this prestigious series. I am greatly indebted to Jill Kraye, who supervised my work during my stay at the Warburg Institute, and I am particularly grateful to Anthony Ossa-Richardson for his help in revising my book and for all his valuable suggestions. Despite the invaluable assistance of many people, any and all errors or shortcomings in this book are mine, and mine alone.

To the Warburg Institute, to its library and to all those who have worked and are still working at this institution I dedicate this book.

October 2012

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Chapter 1
Introduction

1.1 Matters of Method

In his pioneering article 'The Development of Scientific Method in the School of Padua',[1] subsequently published in the book *The School of Padua and the Emergence of Modern Science*,[2] John Herman Randall suggested that Paduan Aristotelianism had a decisive impact on the making of modern science, and in particular on the philosophy of Galileo Galilei, and that this influence was attributable to the advanced theories of scientific method elaborated at the University of Padua in the Renaissance. The Paduan school had as its ancestor Pietro d'Abano (1257–1316/1317), who, in his *Conciliator differentiarum philosophorum, et praecipue medicorum*, established Aristotle's *Analytica Posteriora* as the chief point of reference for the study of natural philosophy.[3] This school would subsequently be developed by authors such as Paul of Venice (1368–1429),[4] Agostino Nifo (1473–1538),[5] Bernardino Tomitano

[1] John H. Randall, 'The Development of Scientific Method in the School of Padua', *Journal of the History of Ideas*, 1 (1940), 177–206.

[2] Cf. John H. Randall, *The School of Padua and the Emergence of Modern Science* (Padua, 1961), 13–68.

[3] Randall, 'The Development of Scientific Method in the School of Padua', 185–186.

[4] On Paul of Venice cf. Zdzislaw Kuksewicz, 'La teoria dell'anima in Paolo Veneto', in Luigi Olivieri (ed.), *Aristotelismo veneto e scienza moderna* (Padua, 1983), 325–348; Francesco Bottin, 'Paolo Veneto e il problema degli universali', in Olivieri (ed.), *Aristotelismo veneto*, 459–476; Alessandro D. Corti, 'Il problema della conoscibilità del singolare nella gnoseologia di Paolo Veneto', *Bollettino dell'Istituto Storico Italiano per il Medio Evo e Archivio Muratoriano*, 98 (1992), 323–382; Id., *Esistenza e verità. Forme e strutture del reale in Paolo Veneto e nel pensiero filosofico del tardo Medioevo* (Rome, 1996).

[5] On Tomitano cf. Enzo Riondato, 'Per uno studio di Bernardino Tomitano filosofo', in *Aristotelismo padovano e filosofia aristotelica* (Florence, 1960), 221–229; Id., 'Momento accademico e filosofico nella prefazione di G. Breznicio alla logica aristotelica di Bernardino Tomitano', in *Relazioni tra Padova e la Polonia* (Padua, 1964), 67–74; Giovanni Papuli, 'La teoria del regressus come metodo scientifico negli autori della Scuola di Padova', in Olivieri (ed.), *Aristotelismo veneto e scienza*

M. Sgarbi, *The Aristotelian Tradition and the Rise of British Empiricism*,
Studies in History and Philosophy of Science 32, DOI 10.1007/978-94-007-4951-1_1,

(1517–1576),[6] and finally its most important exponent, Jacopo Zabarella (1533–1589), who improved scientific method to the point that his theories were influential on the first experimental philosophers and on early scientists. Randall began his studies from a well-defined intellectual background. Few previous scholars had dealt with Paduan Aristotelianism, and historians such as Ernst Rénan,[7] Francesco Fiorentino,[8] Pietro Ragnisco,[9] and Erminio Troilo[10] were concerned mainly with the problem of the immortality of the soul and with the presence of Averroistic traces, rather than with the methodology of science.

Randall merely suggested the possibility that the Paduan school influenced the genesis of modern science, a suggestion immediately understood by historians of philosophy as an attempt to reconstruct the genealogy of modern science from Paduan Aristotelianism.[11] For instance, Neal W. Gilbert vehemently attacked Randall's hypothesis for its 'uncongenial task' of demonstrating Galileo's debt to Zabarella. According to Gilbert, we must first ask 'why there is so little tangible evidence of Zabarella's influence on Galileo'.[12] Second, 'anyone who has ever read a page of

moderna, 221–277; Maria R. Davi, *Bernardino Tomitano, filosofo, medico e letterato (1517–1576)* (Trieste, 1995); Maria T. Girardi, *Il sapere e le lettere in Bernardino Tomitano* (Milan, 1995).

[6] On Nifo cf. Ennio De Bellis, *Il pensiero logico di Agostino Nifo* (Lecce, 1998); Edward P. Mahoney, *Two Aristotelians of the Italian Renaissance. Nicoletto Vernia and Agostino Nifo* (Aldershot, 2000); Ennio De Bellis, *Nicoletto Vernia e Agostino Nifo. Aspetti storiografici e metodologici* (Lecce, 2003).

[7] Cf. Ernest Renan, *Averroës et l'Averroïsme. Essai historique* (Paris, 1852).

[8] Cf. Francesco Fiorentino, *Pietro Pomponazzi: studi storici su la scuola bolognese e padovana del secolo XVI* (Florence, 1868).

[9] Pietro Ragnisco, 'Una polemica di logica nell'Università di Padova nelle scuole di Bernardino Petrella e di Giacomo Zabarella', *Atti del Reale Istituto Veneto di Scienze, Lettere e Arti*, 4 (1885/1886), 463–502; Id., 'La polemica tra Francesco Piccolomini e Giacomo Zabarella nella Università di Padova', *Atti del Reale Istituto Veneto di Scienze, Lettere e Arti*, 4 (1885/1886), 1217–1252; Id., 'Carattere della filosofia patavina', *Atti del Reale Istituto Veneto di Scienze, Lettere e Arti*, 5 (1886/1887), 271–308; Id., 'Pietro Pomponazzi e Giacomo Zabarella nella questione dell'anima', *Atti del Reale Istituto Veneto di Scienze, Lettere e Arti*, 6 (1886/1887), 949–996; Id., 'Da Giacomo Zabarella a Claudio Berigardo, ossia prima e dopo Galileo nell'Università di Padova', *Atti del Reale Istituto Veneto di Scienze, Lettere e Arti*, 7 (1893/1894), 474–518.

[10] Erminio Troilo, 'L'averroismo padovano', *Atti della XXVI riunione della Società Italiana per il Progresso delle Scienze*, 3 (1938), 255–286; Id., *Averroismo e aristotelismo padovano* (Padua, 1939).

[11] Against Randall's general interpretation or one of its aspects cf. Neal W. Gilbert, *Renaissance Concepts of Method* (New York-London, 1960), XIII–XVI; Eugenio Garin, 'Gli umanisti e la scienza', *Rivista di filosofia*, 52 (1961), 259–278; Neal W. Gilbert, 'Galileo and the School of Padua', *Journal of the History of Philosophy*, 1–2 (1963), 223–231; Eugenio Garin, *Scienza e vita civile nel Rinascimento italiano* (Rome-Bari, 1965); Paola Zambelli, 'Rinnovamento umanistico, progresso tecnologico e teorie filosofiche alle origini della rivoluzione scientifica', *Studi storici*, 6 (1965), 507–546; Neal W. Gilbert, 'Renaissance Aristotelianism and Its Fate: Some Observations and Problems', in John P. Anton (ed.), *Naturalism and Historical Understanding. Essays on the Philosophy of John Hermann Randall* (Albany, 1967), 42–52; Charles B. Schmitt, *A Critical Survey and Bibliography of Studies on Renaissance Aristotelianism 1958–1969* (Padua, 1971), 38–46; Id., 'Aristotelianism in the Veneto and the Origins of Modern Science: Some considerations on the Problem of Continuity', in Olivieri (ed.), *Aristotelismo veneto e scienza moderna*, 104–124.

[12] Gilbert, 'Galileo and the School of Padua', 224.

Galileo's writings knows how often and violently he expressed his opposition to *the Aristotelians*'.[13] Therefore, it is doubtful that Galileo based his own theories on the doctrines of the Aristotelian Zabarella. Third, 'the methodology of the Aristotelians relied exclusively on the syllogism; but Galileo specifically insists that the syllogism has no value in scientific discovery, whatever its other uses may be'.[14] Finally, 'there is no mention of Zabarella in the whole mass of Galileo's writings, and there is no evidence that Galileo ever owned a copy of Zabarella's logic … no copy of Zabarella's logic, abundantly available at the time, is known to have been owned by Galileo'.[15] Gilbert concludes that 'there can be no doubt that the formative influence on Galileo … was that of Archimedes and Greek mathematics … after all, "method" is a much more conspicuous concept in Plato's dialogues than in Aristotle's treatises, and the Humanists or their students were quick to grasp its importance'.[16] In short, Randall's reconstruction should be rejected because it is based on false presuppositions and not grounded in supporting evidence.

Charles B. Schmitt attacks Randall's thesis from a different standpoint, carefully elaborating the historical and geographical contexts within which the methodological revolution emerged. He first of all contests Randall's use of vague labels to characterize the 'School of Padua' and 'modern science'. According to Schmitt, it is impossible to deal with the 'School of Padua' individually; one must rather consider 'Venetian Aristotelianism' as a whole.[17] His first reason is that the mobility of the Italian professors of the time made impossible the establishment of discrete local intellectual traditions.[18] The second reason, connected with the first, is that the great philosophical similarities among the various Italian universities of the epoch made it hard to distinguish one specific school from the others. On the contrary, we should deal with 'Venetian Aristotelianism', and the combined impact of Padua and Venice on the development of Aristotelianism,[19] with respect to both theoretical innovation and publication. Moreover, the Aristotelianism propounded at Padua changed radically over two and a half centuries. The period between Paul of Venice and Jacopo

[13] Ibid.

[14] Ibid.

[15] Ibid.

[16] Ibid. 230.

[17] Cf. Schmitt, 'Aristotelianism in the Veneto and the Origins of Modern Science: Some Considerations on the Problem of Continuity', 107–109.

[18] Cf. Charles B. Schmitt, 'Filosofia e scienza nelle università italiane del XVI secolo', in *Il Rinascimento. Interpretazioni e problemi* (Rome-Bari, 1979), 353–398; Charles B. Schmitt, 'Science in the Italian Universities in the Sixteenth and Early Seventeenth Centuries', in Maurice Crosland (ed.), *The Emergence of Science in Western Europe* (London, 1975), 35–56.

[19] On the peculiarities of the Padua-Venice axis, cf. Lorenzo Minio-Paluello, 'Attività filosofico-editoriale aristotelica dell'Umanesimo veneziano', in Vittore Branca (ed.), *Umanesimo europeo e umanesimo veneziano* (Florence, 1964), 245–262; Bruno Nardi, *Saggi sulla cultura veneta del Quattro e Cinquecento* (Padua, 1972), 3–98; Enzo Riondato, 'Aristotelismo ed editoria scientifica del Cinquecento a Venezia e nel Veneto', in *Trattati scientifici nel Veneto fra il XV e il XVI secolo* (Venice, 1985), IX-XXI; Giovanni Santinello, *Tradizione e dissenso nella filosofia veneta* (Padua, 1991), 5–9, 162–176.

Zabarella, in Schmitt's view, witnessed a profound change not only in the knowledge of Aristotle, but also in the conceptual elaboration of many Aristotelian doctrines. As both Cesare Vasoli and Schmitt thoroughly demonstrate, Paul of Venice brought to Italy, from England, the heritage of Oxford logic and natural philosophy, which had already vanished by Zabarella's time. On the other hand, Zabarella, in comparison to Paul of Venice, knew Aristotle in the Greek, as well as his Greek commentators, Alexander of Aphrodisias, Ammonius, Eustratius, Philoponus, Simplicius and Themistius.[20] Paduan logicians of the sixteenth century are characterized by their profound knowledge of the Peripatetic tradition, which marked a new way of teaching logic in the university and made possible new philosophical questions foreign to the fifteenth-century masters. For this reason, the so-called 'School of Padua' was extremely heterogeneous, even within the space of a century. Schmitt has even shown that two contemporary Aristotelians of the same period, Zabarella and Cesare Cremonini, had different and opposite attitudes towards Aristotelian doctrines, thus dismantling the idea of a unified and coherent School of Padua: 'Zabarella strongly emphasized observation of the external world as a source of knowledge, while stressing that reason—and not Aristotle—is the ultimate foundation of valid knowledge. … Cremonini, on the other hand, refused to look through Galilei's remarkable telescope, being content to rely upon the words of Aristotle'.[21]

But the scope of Randall's argument was narrower and less ambitious than either Gilbert or Schmitt realized, as is clear from his article 'Paduan Aristotelianism Reconsidered'.[22] He aimed simply to demonstrate certain conceptual analogies between the thought of some Paduan Aristotelians and that of the early scientists, in their use of particular terms such as 'analysis', 'synthesis', 'induction' etc.

In fact, in its weak form, Randall's thesis remains cogent. If he could not reconstruct Galileo's philosophy and science, he was at least able to define a broader philosophical evolution among Galileo's contemporaries, away from dialectical and rhetorical topics, typical of the humanist work of Rudolph Agricola and Petrus Ramus, towards scientific and methodological studies. Schmitt himself admitted that 'though it is dubious whether Randall's thesis can be maintained, his work

[20] Cf. Cesare Vasoli, 'Su alcuni problemi e discussioni logiche del Cinquecento italiano', in Id., *Studi sulla cultura del Rinascimento* (Manduria, 1968), 257–344, esp. 261–262; Charles B. Schmitt, 'Towards a Reassessment of Renaissance Aristotelianism', *History of Science*, 11 (1970), 159–193, esp. 160. On the impact of Simplicius on sixteenth-century readings of Aristotle cf. Bruno Nardi, *Saggi sull'aristotelismo padovano dal secolo XIV al XVI* (Florence, 1958), 365–442.

[21] Charles B. Schmitt, *Aristotle and the Renaissance* (Cambridge, Mass., 1983), 11. On this topic cf. Philip L. Drew, 'Some Notes on Zabarella's and Cremonini's Interpretation of Aristotle's Philosophy of Nature', in Olivieri (ed.), *Aristotelismo veneto e scienza moderna*, 647–660. Pietro Ragnisco sarcastically notes the divergence of Aristotelianism*s* in Padua: 'it is reasonable to believe that, if [Zabarella] had been a contemporary of Galileo in Padua, he would not have given the unfortunate impression of the Paduan philosophy given by his successor, the fool Cremonini'. Cf. Ragnisco, 'La polemica tra Francesco Piccolomini e Giacomo Zabarella nella Università di Padova', 1252.

[22] Cf. John H. Randall, 'Paduan Aristotelianism Reconsidered', in Paul O. Kristeller and Edward Mahoney (ed.), *Philosophy and Humanism* (Leiden, 1976), 275–282.

compelled a number of scholars to focus their attention to the Aristotelian element of early modern culture'.[23]

The early modern revival of interest in science, attributed by other historians of philosophy to the rediscovery of Platonic mathematicism,[24] was contextualized by Randall within the Aristotelian tradition. In particular he contested the idea that Platonism, with its mathematical orientation, propelled the birth of modern science. Randall argued against the 'reluctance to admit that the Aristotelian tradition of philosophical and scientific thought did not come to an abrupt end, […] if a continuity is admitted, then it is insisted that it must have been through the Platonic, not the Aristotelian, tradition. The uniqueness of modern science, compared to medieval, has been its mathematizing mode of thought; and as the Aristotelians were little given to this kind of thinking, it is concluded that early modern scientists, like Galileo, must necessarily have found the Aristotelian tradition sterile'.[25] Randall's thesis was not completely new, but a reassessment of an idea elaborated some decades before by Ernst Cassirer,[26] who was the first to recognize that the logic of Paduan Aristotelianism, and in particular that of Zabarella, was in many respects the precursor of some important epistemological topics in early modern thought. According to Cassirer, Zabarella had the great merit 'of freeing logic from ontological admixtures and elaborating a methodology of thought and science',[27] because 'the consideration and the classification of science were no longer based … on the order of the object, but only on the order of knowledge'.[28] In Zabarella there would be a definitive split between the cognitive and ontological levels, favouring the former, a preference which Vasoli has attributed to a particular kind of nominalism and conceptualism underlying Zabarella's logic.[29]

Clearly, Paolo Rossi is correct to point out that the continuity between the Paduan school and modern science is a myth, resting on wider assumptions: that there was a unique entity and methodology of 'modern science', and that this method was

[23] Charles B. Schmitt, 'William Harvey and Renaissance Aristotelianism. The Praefatio to De generatione animalium (1651)', in Gundolf Keil and Rudolf Schmitz (eds.), *Humanismus und Medizin* (Weinheim, 1984), 119–120.

[24] Cf. Alexandre Koyré, 'Galileo and Plato', *Journal of the History of Ideas*, 4 (1943), 400–428; Id., 'Galileo and the Scientific Revolution of the Seventeenth Century', *The Philosophical Review*, 52 (1943), 333–348.

[25] William F. Edwards, 'Randall on the Development of Scientific Method in the School of Padua – A Continuing Reappraisal', in John P. Anton (ed.), *Naturalism and Historical Understanding* (New York, 1967), 53–68, esp. 54.

[26] Cassirer subsequently sustained the primarily Platonic character of modern science; cf. Ernst Cassirer, 'Galileo's Platonism', in *Studies and Essays in the History of Science and Learning Offered in Homage to George Sarton* (New York, 1946), 276–297.

[27] Ernst Cassirer, *Das Erkenntnisproblem in der Philosophie und Wissenschaft der neueren Zeit* (Berlin, 1922), vol. 1, 144.

[28] Ibid. 141.

[29] Cf. Cesare Vasoli, 'Jacopo Zabarella e la natura della logica', *Rivista di storia della filosofia*, 1 (2011), 1–22.

the engine of and decisive factor in the development of the progress of science.[30] In Rossi's opinion, it is nonsensical to ask whether a scientist like Galileo was 'fundamentally a Platonist, a follower of the Aristotelian method, a disciple of Archimedes, or an engineer who was able to generalize particular and concrete experience'.[31] For 'every tradition on which he drew dictated rules and imposed prohibitions that had at the same time an ontological and a methodological scope. … But the emergence of the new means replacing old maps with new maps. The latter, obviously, say something about the same world, but they say it differently. Old maps are often absorbed by the new ones, but the relations among the various elements are configured irremediably in a different way'.[32]

This book aims to investigate how the map of Paduan Aristotelianism was replaced by and absorbed into the movement known as 'British empiricism', and not into modern science. In this sense, I want to follow the very relevant suggestion of William F. Edwards that 'it is a mistake to narrow this question of continuity to Aristotelianism and modern science only',[33] and that 'to evaluate the contribution of the Paduan Aristotelians … we must begin where we should have begun in the first place, viz., with a careful study of the development of logical and methodological thought in the late sixteenth, and early seventeenth, centuries'.[34] Specifically, the present investigation deals with the impact and influence of Jacopo Zabarella's philosophy—which represents 'the convergence of almost all points of view that were previously elaborated by the School of Padua, their simplification and their rational arrangement', to such an extent that it may be considered 'the climax reached by the long elaboration of the methodology of the School of Padua'[35]—on the genesis of some fundamental topics of empiricist philosophy.

When we think of Zabarella and his philosophical works, we usually consider his logic, which undoubtedly represents his most significant contribution, and his careful reading of Aristotle. The most important historian of logic of the twentieth

[30] Cf. Paolo Rossi, 'Aristotelici e moderni: le ipotesi e la natura', in Olivieri (ed.), *Aristotelismo veneto e scienza moderna*, 125–154, esp. 125. On the problem of the continuity between medieval, Renaissance and modern science cf. Garin, *Scienza e vita civile nel Rinascimento italiano*, VI-VIII.

[31] Ibid. 151.

[32] Ibid. 153.

[33] William F. Edwards, 'Paduan Aristotelianism and the Origins of Modern Theories of Method', in Olivieri (ed.), *Aristotelismo veneto e scienza moderna*, 205–220, esp. 206. Timothy J. Reiss follows Edwards' suggestion in his reconstruction of the impact of Zabarella's methodology on Descartes, cf. Timothy J. Reiss, 'Neo-Aristotle and Method. Between Zabarella and Descartes', in Stephen Gaukroger, John Schuster and John Sutton (eds.), *Descartes' Natural Philosophy* (London, 2000), 195–227.

[34] Ibid. 220.

[35] Cf. Angelo Crescini, *Le origini del metodo analitico. Il Cinquecento* (Trieste, 1965), 168. In opposition to Cassirer, Randall, Garin, Gilbert, Corsano, Risse, Crescini, and Vasoli, Giovanni Papuli is the only one to challenge the claim that Zabarella was the culmination of the School of Padua. In particular Papuli disagrees with the interpretation that Zabarella has the merit of separating logic from metaphysics on the basis of his instrumental conception of logic. Cf. Giovanni Papuli, *Girolamo Balduino. Ricerche sulla logica della Scuola di Padova nel Rinascimento* (Manduria, 1967), 11–12.

century, Wilhelm Risse, bluntly defined Zabarella as the greatest logician after Aristotle and his most faithful interpreter.[36] As evidence of Zabarella's importance, Mario Mignucci, in what remains the most comprehensive commentary on Aristotle's *Analytica Posteriora*, refers programmatically to Zabarella's work, accepting all of his interpretations.[37]

Zabarella's influence on Protestant areas, especially Germany, has been well studied.[38] My aim, by contrast, is to show not only that Zabarella's logical thought had a wide dissemination in the British Isles—an original claim in the historiography of early modern philosophy—but also that his doctrines contributed to some extent to the formation and the genesis of the basic ideas of empiricism.

What I want to show is a strange case of colonization by Italian philosophy, particularly that of Padua, of the English intellectual landscape, especially in Oxford, around the turn of the seventeenth century: a reverse of the colonization which had occurred in the fourteenth century with the dissemination of Oxford logic in Italy.[39]

This is a very risky historiographical operation and may be susceptible to the same criticisms levelled at Randall's investigation. As Rossi has perceptively remarked, 'much has been said about Zabarella's instrumentalism. Scholars have often taken his expressions out of context and, in some cases, they have celebrated the marriage between an Aristotelian methodology and an Aristotelian empiricism that would in fact generate an anti-Aristotelian science. Many pages of Antonino Poppi, Cesare Vasoli, Charles Schmitt, and Christopher Lewis have helped to restore to us a sense of proportion, and to put [Zabarella's] statements back in context'.[40]

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[36] Cf. Wilhelm Risse, *Einführung*, in *Jacobi Zabarellae Opera Logica* (Hildesheim, 1966), V.

[37] Cf. Mario Mignucci, *L'argomentazione dimostrativa in Aristotele. Commento agli Analitici secondi* (Padua, 1975).

[38] On the influence of Zabarella in Protestant areas cf. Peter Petersen, *Geschichte der aristotelischen Philosophie im protestantischen Deutschland* (Leipzig, 1921); Giorgio Tonelli, 'Zabarella inspirateur de Baumgarten, ou l'origine de la connexion entre esthétique et logique', *Revue d'esthétique*, 9 (1956), 182–192; Cesare Vasoli, 'Giulio Pace e la diffusione europea di alcuni temi aristotelici padovani', in Olivieri (ed.), *Aristotelismo veneto e scienza moderna*, 1009–1034; Ian Backus, 'The Teaching of Logic in Two Protestant Academies at the End of the Sixteenth Century: Reception of Zabarella in Strasbourg and Geneva', *Archiv für Reformationsgeschichte*, 90 (1989), 240–251; Friedrich Müller, 'Der Begriff der Methode in der Logica Hamburgensis: Jungius und Zabarella', in Peter Klein, *Praktische Logik. Traditionen und Tendenzen* (Göttingen 1990), 29–55; Francesco Raimondi, 'La filosofia naturale di G. Zabarella e la scienza moderna: connessioni e divergenze', *Physis*, 31 (1994), 372–391; Gregorio Piaia (ed.), *La presenza dell'aristotelismo padovano nella filosofia della prima modernità* (Padua, 2002); Jon Rohls, 'Aristotelische Methodik und protestantische Theologie: Von Melanchthon zu Zabarella', in Günter Frank (ed.), *Melanchthon und der Calvinismus* (Stuttgart-Bad Cannstatt, 2005), 75–105; Riccardo Pozzo, 'Umdeutungen der aristotelischen Habituslehre in der Renaissance', in Günter Frank and Andreas Speer (eds.), *Der Aristotelismus in der frühen Neuzeit. Kontinuität oder Wiederaneigung?* (Wiesbaden, 2007), 259–272; Marco Sgarbi, 'Kant, Aristotle and the Rise of Facultative Logic', in Ennio De Bellis (ed.), *Aristotle and the Aristotelian Tradition* (Soveria Mannelli, 2008), 405–416; Marco Sgarbi, *La* Kritik der reinen Vernunft *nel contesto della tradizione logica aristotelica* (Hildesheim, 2010).

[39] Cf. Alfonso Maierù (ed.), *English Logic in Italy in the 14th and 15th Centuries. Acts of the 5th European Symposium on Medieval Logic and Semantics, Rome, 10–14 November 1980* (Naples, 1982).

[40] Rossi, 'Aristotelici e moderni: le ipotesi e la natura', 142.

I shall begin, then, with an examination of the context, by means of a historiographical process of decolonization[41]; as Gilbert rightly points out, 'locating a thinker in his religious, economic, and social context helps to bring to light the assumptions and presuppositions that he absorbs from his environment. Often these assumptions are what make his arguments meaningful: in any event, awareness of them is essential to our evaluation of a man's philosophy'.[42] Paradoxically, decolonizing philosophy from its ideological assumptions and from historiographical categories such as that of 'continuity' and of 'precursors', it is possible to reconstruct the process by which Paduan Aristotelianism colonized philosophy in the British Isles.

1.2 'Aristotelianism' and 'Empiricism'

Broadly, my thesis is that it is not possible to understand empiricism and its genesis in the British Isles without a correct assessment of its Aristotelian framework and structure, which derives primarily from the re-elaboration of the doctrines of Paduan Aristotelianism. Empiricism did not recover a generic form of Aristotelianism and, as it has been claimed, 'a vague empiricism that can be found in almost any Aristotelian, or for that matter in any writer who thinks that we learn anything from observing the world around us'.[43] Instead, it was a coherent and uniform set of doctrines which empiricists of the British Isles drew from Paduan Aristotelianism, thanks to the mediation of British Aristotelians, as will become clear from the copious quotations from and references to the Paduan tradition that they inserted into their texts and handbooks, and professed during lectures. Undoubtedly, in the specific case of the logical influence of Paduan Aristotelianism in the British Isles, as Schmitt argued, 'the history of seventeenth-century philosophical textbooks would surprise us a great deal', at first because they present 'a level of eclecticism which is not highlighted by the adjective *Aristotelian*'.[44] The result is thus an Aristotelianism tempered and modified by heterogeneous elements which differs from that expounded in the scholastic textbooks of the previous centuries. The close analysis of these textbooks 'presents its own advantages and gives important information', but a wider investigation on the *forma mentis* of the time undoubtedly offers 'a different vision and another kind of comprehension',[45] towards the movement that characterized early modern philosophy, namely empiricism.

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[41] Cf. Gregorio Piaia, 'Storia della filosofia e decolonizzazione del passato', in Id., *Il lavoro storico-filosofico. Questioni di metodo ed esiti didattici* (Padua, 2007), 11–30, esp. 19–21.

[42] Gilbert, 'Renaissance Aristotelianism and Its Fate: Some Observations and Problems', 42.

[43] Gilbert, 'Galileo and the School of Padua', 227. On fourteenth-century Aristotelian empiricism cf. Henrik Lagerlund, 'The Changing Face of Aristotelian Empiricism in the Fourteenth Century', *Quaestio*, 10 (2010), 315–327.

[44] Charles B. Schmitt, *La tradizione aristotelica: Fra Italia e Inghilterra* (Naples, 1985), 22.

[45] Ibid. 25.

It is true that 'Aristotelianism' 'cannot be defined a priori and without reference to the historical and geographical variations and transformations it underwent', and it must be 'understood historically and empirically through close study and analysis of those historical persons who took Aristotle as an authority and built upon the *corpus aristotelicum*'; but it is equally true that we must pay attention to 'to misinterpretations, deviations, and criticisms, including those based upon spurious texts', so that it would be better to use the term 'Aristotelianism*s*'.[46] In the present study, I will consider 'Paduan Aristotelianism', despite Schmitt's critical caveats,[47] as a philosophy 'with a clear experimental, physical and logical orientation, … alien to metaphysical questions and closed to theology'[48] and the greatest exponent of which, in relation to logic, was Zabarella. It is a fluid label which will become better defined over the course of this investigation and which encompasses Aristotelian authors from various philosophical positions (lawyers and physicians, as well as logicians), who nevertheless all shared Zabarella's interpretation of Aristotle, which had a wide dissemination throughout Europe in the late sixteenth and early seventeenth century.

In this period, Paduan Aristotelianism coincided with a sort of 'Zabarellism', which did not merely and slavishly adopt Zabarella's views, but constantly revised and modified them, depending on the different contexts in which they took root and on the varying perspectives of the thinkers who re-elaborated them.

Finally, Aristotelianism in the British Isles may be discussed as a distinctive philosophical movement, an eclectic and heterodox form of Aristotelianism strongly biased towards an empirical perspective in the fields of logic and epistemology[49]; this movement drew its topics and its arguments from Padua, in particular against the Ramist position, which has generally been regarded as dominating the English philosophical landscape of the sixteenth and early seventeenth centuries.[50] The impact of Paduan Aristotelianism on logic led to the genesis of British Aristotelianism, which exerted in turn its influence on the rise of empiricism. Ultimately, British Aristotelianism may be understood as a series of betrayals and

[46] Charles B. Schmitt, *John Case and Aristotelianism in Renaissance England* (Kingston-Montreal, 1983), 221. Cf. Schmitt, 'Towards a Reassessment of Renaissance Aristotelianism', 159–163, esp. 160: 'the Aristotelians of the Renaissance do not form a single compact school, in any but the vaguest of senses'. Cf. Schmitt, *Aristotle and the Renaissance*, 10–63. On the difficulty of characterizing what precisely 'Aristotelian' means, cf. Lorenzo Minio-Paluello, 'La tradition aristotélicienne dans l'histoire des idées', in Id., *Opuscula. Latin Aristotle* (Amsterdam, 1972), 405–424.

[47] Cf. Schmitt, 'Aristotelianism in the Veneto and the Origins of Modern Science: Some Considerations on the Problem of Continuity', 104–108.

[48] Antonino Poppi, *Introduzione all'aristotelismo padovano* (Padua, 1991), 14.

[49] Cf. Schmitt, *Aristotle and the Renaissance*, 89–99.

[50] Feingold has been the first to question this general assumption, arguing that Ramist texts rarely dominated the small section of the university curriculum devoted to logic and rhetoric, that Ramist textbooks were used in conjunction with other texts, and that it is wrong to assume that Ramism was the prevailing logical system in England. Cf. Mordechai Feingold, 'English Ramism: A Reinterpretation', in Mordechai Feingold, Joseph S. Freedman and Wolfgang Rother (eds.), *The Influence of Petrus Ramus* (Basel, 2001), 132–134.

re-elaborations of Zabarella's methodological and epistemological doctrines; from these betrayals, the basic ideas of empiricism emerged.

The label 'British empiricism', commonly used in intellectual history, is difficult to define. Which philosophers can actually be called 'empiricists'? The common historiography of early modern philosophy begins with the triad of John Locke, George Berkeley and David Hume.[51] This stance is, however, very reductive and takes into account only the 'big names' of this philosophical movement, neglecting the 'shrivelled scholastics'[52] such as Samuel Smith and Robert Sanderson, whose institutional and academic activities had a powerful influence in England during the seventeenth century, including on philosophers and scientists such as Francis Bacon, William Harvey, Thomas Hobbes, Robert Boyle and Margaret Cavendish.

It is hard to define 'empiricism' a priori, and a single book cannot solve the problem. Nonetheless, historians have been able to identify certain fundamental issues of interest to the majority of the philosophers, and these can be used to characterize the empiricist movement as a whole. The basic issues are: (1) the problem of the sources of knowledge; (2) the problem of method; (3) a rejection of metaphysics; (4) conceptualism or nominalism.

On the first question, empiricism maintains that all knowledge comes from experience and is therefore primarily sense-based. There is no innate knowledge; everything which we know is acquired either by means of sensation, or by reflection on sensation. Sensation is therefore the sole source of knowledge, and all other operations of the mind are grounded in it.

If all knowledge is grounded in sensation, then the knowledge of the first principles of demonstration is also based on the senses, as is the demonstrative syllogism, which is grounded in those principles. In general, empiricism rejects the demonstrative syllogism as a method of discovery in favour of induction, that is, generalization from the particular data of the senses. Induction has an epistemological priority over syllogistic demonstration, which does not discover or find new knowledge, but only explains and orders the knowledge already acquired by sensation or induction. The method of discovery always begins from what is most knowable by human beings, namely sensible objects, and infers what is most knowable by nature, namely the principles which form the bases of more complex logical arguments.

Since all knowledge is at first sensible knowledge, it has validity only with regard to what the senses can experience, namely, what the mind perceives and knows. The empirical approach does not discuss the ontological structure of the world but only the way in which the mind acquires knowledge. The first principles are no longer *principia essendi*, but instead *principia cognoscendi*. Beginning from this assumption, the possibility of real knowledge of substance collapses, unless it is reduced to a mere

[51] Cf. James D. Collins, *The British Empiricists: Locke, Berkeley, Hume* (Milwaukee, 1967); Jonathan Bennett, *Locke, Berkeley, Hume. Central Themes* (Oxford, 1971); Ram A. Mall, *Der operative Begriff des Geistes: Locke, Berkeley, Hume* (Freiburg-Munich, 1984); John Dunn and Alfred J. Ayer (eds.), *The British Empiricists: Locke, Berkeley, Hume* (Oxford, 1992); Renée Bouveresse-Quilliot, *L'empirisme anglais: Locke, Berkeley, Hume* (Paris, 1997); Stephen Priest, *The British Empiricists* (London, 2006).

[52] Schmitt, *La tradizione aristotelica: Fra Italia e Inghilterra*, 11.

aggregate of external marks, such as primary and secondary qualities, which describe the object of knowledge.

Sensible knowledge is always the knowledge of particulars; therefore, all universals are a product of mental abstraction. Mental concepts themselves have no immediate correspondence with the things of the world; rather, they have a direct and immediate relation with the operation of the mind through which the object of knowledge becomes meaningful. Words do not necessarily and naturally correspond to real existing objects and they do not directly signify their referents, having only an instrumental purpose in relation to the mind itself.

The main thesis of this book is that these basic ideas *were suggested* by the conceptual elaboration of the British Aristotelians, who developed their own doctrines out of the Paduan tradition; unlike Cassirer and Randall, however, I do not claim a direct genealogy. In the work of British and Irish Aristotelians and of the early empiricist philosophers, we can recognize the manifest influence of Paduan logic and, in particular, that of Zabarella. Even when the Paduan presence is not explicit, its concepts, ideas and doctrines were the basis of British philosophical debates throughout the seventeenth century.

In the present work I will consider only those authors who were directly engaged in the attempt to elaborate a new kind of empirical approach in the field of logic up to the publication of Locke's *Essay* in 1689, which is usually considered the mark of the beginning of a new era in the history of logic.[53]

Of course many other experimental philosophers, physicians and scientists contributed to the elaboration of the empiricist perspective, but such investigation is well beyond the scope of this book, which concerns the Aristotelian strand of late sixteenth- and seventeenth-century logic in the British Isles, and it would require several volumes and the effort of many scholars to encompass the task exhaustively.[54]

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[53] Cf. James G. Buickerood, 'The Natural History of the Understanding: Locke and the Rise of Facultative Logic in the Eighteenth Century', *History and Philosophy of Logic*, 6 (1985), 157–190. This is the reason why I do not consider John Sergeant's thought, whose Aristotelian work *The Method to Science* (London, 1696) must be carefully measured against Locke's empiricism, which cannot be carried out in this volume. The second edition refers directly to Locke's *Essay*, cf. *Solid Philosophy asserted, against the Fancies of the Ideists or the Method to Science farther illustrated with Reflexions on Mr. Locke's Essay concerning Human Understanding* (London, 1697).

[54] On these topics cf. Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, 1985); Steven Shapin, 'House of Experiment in Seventeenth-Century England', *Isis*, 77 (1988), 373–404; Micheal Hunter, *Science and the Shape of Orthodoxy: Intellectual Change in Late Seventeenth-Century Britain* (Woodbridge, 1995); Peter Dear, *Discipline and Experience: The Mathematical Way in the Scientific Revolution* (Chicago, 1995); Sarah Hutton, 'In Dialogue with Thomas Hobbes: Margaret Cavendish's Natural Philosophy', *Women's Writing*, 4 (1997), 421–432; Micheal Hunter, *Robert Boyle (1627–91): Scrupulosity and Science* (Woodbridge, 2000); Peter R. Anstey, *The Philosophy of Robert Boyle* (London, 2000); Stephen Gaukroger, *The Emergence of a Scientific Culture: Science and the Shaping of Modernity, 1210–1685* (Oxford, 2006), 352–399; Kourken Michaelian, 'Margaret Cavendish's Epistemology', *British Journal for the History of Philosophy*, 17 (2009), 31–53; Sorana Corneanu, *Regimens of the Mind: Boyle, Locke, and the Early Modern Cultura Animi Tradition* (Chicago, 2012).

Beyond the apparent and explicit criticism of the old Scholastic and Aristotelian philosophy, which has been very well recognized by the scholarship in the twentieth century and which has contributed to the false notion that early modern philosophy emerged as a reaction to Aristotelianism,[55] in the present research I examine the continuity, the original developments and the impact of Aristotelian doctrines and terminology in logic and epistemology as the background of the rise of empiricism. This book is the first comprehensive history of British Aristotelian logic in the late sixteenth and seventeenth centuries that focuses on and emphasizes particularly its empiricist import.

1.3 Status Quaestionis

Few historians have credited early modern British Aristotelianism with any positive contribution to the history of philosophy, not even to the rise of empiricism. In 1983, in his fundamental work on John Case and English Aristotelianism, Schmitt stated that 'a full study of the influence of Zabarella in Britain during the [Renaissance] period is lacking'[56] and that 'no English Aristotelian of the sixteenth or seventeenth century has been subjected to anything approaching a serious dissection'.[57] His complaints were entirely justified, and careful studies of this topic are still lacking today.

The most comprehensive work on the English logic of this period was carried out by Wilburn S. Howell, who not only fails to mention Zabarella among the possible logical sources of the time, but instead attributes to Ramus the dissemination of specific doctrines typical of Zabarella.[58] Since Howell, scholarship has made numerous advances in uncovering the sources of English logic and in reconstructing the general intellectual background; and a number of monographs on the relationship between particular authors and Aristotle have been published.[59]

Ivo Thomas has carried out a careful study of seventeenth-century Oxford logic with the aim of ascertaining both its medieval heritage and its innovations. Thomas considers a good number of handbooks and textbooks, read or published in Oxford, making an almost complete analysis of the logical works of the first half of the century. Although Thomas recognizes the main logical trends of the Oxford intellectual

[55] The recent volume, Tom Sorell, John G. A. Rogers and Jill Kraye (eds.), Scientia *in Early Modern Philosophy: Seventeenth-Century Thinkers on Demonstrative Knowledge from Initial Principles* (Dordrecht, 2010), has definitively dismanteld this picture.

[56] Schmitt, *John Case and Aristotelianism in Renaissance England*, 37.

[57] Ibid. 6.

[58] Cf. Wilburn S. Howell, *Logic and Rhetoric in England 1500–1700* (New York, 1961). E. Jennifer Ashworth rightly says that Howell's research 'can only be described as bizarre. In general, Howell's work must be handled with extreme caution, for his details are often inaccurate and his judgment faulty', E. Jennifer Ashworth, 'Introduction', in Robert Sanderson, *Logicae artis compendium* (Bologna, 1985), IX–LV, esp. XXIII.

[59] These monographic studies will be considered in the particular treatment of each author.

background, his research is marred by his focus on extrinsic and less important elements of logical doctrine. For instance, he does not investigate whether or not in this period there were nominalistic and conceptualist tendencies, which were typical of the logical thought of the fourteenth century.[60]

An important contribution to the history of logic in England is Lisa Jardine's precise reconstruction of the intellectual background of Cambridge at the turn of the sixteenth century.[61] Through a careful examination of the catalogues and the indexes of the books owned by learned men and scholars at Cambridge, Jardine has documented the study of classical authors such as Boethius, Cicero and Quintilian, and found a strong presence of the humanist logic and logicians Lorenzo Valla (1405/1407–1457), Rudolph Agricola (1444–1485), Philipp Melanchthon (1497–1560) and Johann Sturm (1507–1589). She has shown how in Cambridge interest in humanist dialectic fostered and accentuated the dissemination of Ramist works.

James McConica has carried out a similar investigation of the logical landscape of Oxford.[62] He has shown the circulation and the dissemination of medieval logicians such as Walter Burley (1275–1344), Antonio Andreas (1280–1320), and Robert Holcot (1290–1349), as well as the appropriation of their doctrines. McConica has pointed out that in Oxford, by contrast to Cambridge, there was a general lack of interest in Ramist logic, and he has shown that even those works which can be included within this logical framework depended more on the work of humanists such as Juan Louis Vives (1492–1540).

John A. Trentman was the first to pay attention to Aristotelianism in England and to its originality.[63] He states that 'what is most characteristic about all the thought of the period is that it generally represents an Aristotelian revival after the anti-scholastic and usually (but not invariably) anti-Aristotelian trends in the thought of reformers and Ramists in the sixteenth century'; he adds that 'there was a clear and conscious attempt round the beginning of the seventeenth century sympathetically to restate Aristotelian and scholastic positions',[64] and that there was 'English Aristotelian revival',[65] a real movement 'back to Aristotle'.[66] Trentman's research is mainly focused on the new relations between logic and the philosophy of language which were born at the beginning of the seventeenth century in Oxford, but he fails to identify the sources and does not acknowledge the historical significance of these doctrines.

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[60] Cf. Ivo Thomas, 'Medieval Aftermath: Oxford Logic and Logicians of the Seventeenth Century', in *Oxford Studies Presented to Daniel Callus* (Oxford, 1964), 297–311.

[61] Cf. Lisa Jardine, 'The Place of Dialectic Teaching in Sixteenth-Century Cambridge', *Studies in the Renaissance*, 21 (1974), 31–62; ead., 'Humanism and the Sixteenth-Century Cambridge Arts Course', *History of Education*, 4 (1975), 13–31.

[62] Cf. James McConica, 'Humanism and Aristotle in Tudor Oxford', *The English Historical Review*, 371 (1979), 291–317.

[63] Cf. John A. Trentman, 'The Study of Logic and Language in England in the Early 17th Century', *Historiographia linguistica*, 3 (1976), 179–201.

[64] Ibid. 179–180.

[65] Ibid. 183, 189.

[66] Ibid. 180.

Undoubtedly the most important contribution to the reconstruction of English Aristotelianism and its logic is represented by the works of Schmitt, which have already been mentioned. Beginning in the later 1960s, in the wake of a renewed and growing interest in Renaissance Aristotelianism in Italy, Schmitt devoted many studies to English Aristotelianism, especially focusing his attention on the figure of John Case. His groundbreaking research is still the primary point of reference in this field, on account of his extremely rigorous analysis of the intellectual background of English Aristotelianism. As well as his investigations into the Aristotelian tradition in general,[67] of particular interest are his examinations of the relationship between Italian and English Aristotelianism*s*, which represent the mature phase of his historiographical work. Schmitt was aware that 'one can certainly not claim that English Aristotelianism of the period 1575–1650 ranks as one of the creative highpoints of Western philosophical history, but it does have an integrity and historical significance that have not generally been recognized'.[68] He shows that the publication of logical textbooks in England beginning in the last quarter of the sixteenth century was not the sole preserve of the Ramists, but instead favoured Aristotelianism, at least until Francis Bacon. Moreover, according to Schmitt, 'by 1600 Aristotelian logic had a stronger foundation in England than it had had at any time since Henry's break with Rome'.[69] In particular, he acknowledges a growing interest in the Aristotelian philosophy, which was absent at the beginning of the sixteenth century in favour of humanistic logic, but which assumed a pivotal role in academic life towards the end of the century. Schmitt's arguments establish, first, that 'the general level of interest in the Aristotelian tradition [in England] was far below what we find in continental Europe', and, second, that, despite this, 'the influence of Aristotle in England, especially during the hundred years after 1575, was more significant than has previously been realized'.[70]

Following Schmitt's method, E. Jennifer Ashworth concentrated on the Oxford logic of the seventeenth century and, especially, on the figure of Robert Sanderson (1587–1663).[71] Ashworth argues that English logic was generally poor and unoriginal, both in the period of the dissemination of humanist logic and during the defence of Ramism. A new impulse was given at the end of the sixteenth century by the circulation of Continental works of logic, which led to a renewed interest in the subject and to the publication of new textbooks. A careful analysis of these works is necessary, in Ashworth's view, in order to understand the complexity of British philosophy

[67] Cf. Schmitt, *Aristotle and the Renaissance*, 110–118.

[68] Schmitt, *John Case and Aristotelianism in Renaissance England*, 8.

[69] Ibid. 37.

[70] Ibid. 76.

[71] Cf. Ashworth, *Introduction*, IX–LV; E. Jennifer Ashworth, 'Logic in Late Sixteenth-Century England: Humanist Dialectic and the New Aristotelianism', *Studies in Philology*, 88 (1991), 224–236.

before Locke[72]: 'to judge the true stature of such men as Locke it is helpful to know both what they were taught and how their teaching affected others; but to judge the intellectual quality of the seventeenth century as a whole, such a wider knowledge is essential. Great men stand to some extent outside their period, and it is only the minor thinkers who can provide a safe basis for generalization about that period'.[73]

Hannah Dawson, in her thorough research on theories of language in early modern thought, has recently demonstrated the decisive impact of Aristotelian scholastic philosophy upon Locke and the empiricist tradition. The present inquiry has a similar concern.[74] It picks up the suggestions and the ideas developed, above all, by Schmitt and Ashworth, aiming to examine the impact of the logic of Paduan Aristotelianism in the British Isles through a study of the logical textbooks of the time, and to show how its dissemination brought about decisive changes in the field of logic. Moreover, it seeks to show that the logical ideas of Paduan Aristotelianism present in these textbooks were fundamental for the genesis of British empiricism.

[72] On philosophy in British Isles before Locke cf. Jill Kraye, 'British Philosophy Before Locke', in Steven Nadler (ed.), *A Companion to Early Modern Philosophy* (Oxford, 2002), 283–297.

[73] Ashworth, 'Introduction', LIV–LV.

[74] Cf. Hannah Dawson, *Locke, Language and Early-Modern Philosophy* (Cambridge, 2007).

Chapter 2
Logic in the British Isles During the Sixteenth and Seventeenth Centuries

2.1 From Scholastic Logic to Humanist Logic

After two centuries of intense creativity of the terministic logic and of the *calculatores* in Oxford,[1] which had a great success and impact all over Europe, and most of all in Italy,[2] the philosophical culture in the British Isles underwent a period of severe crisis and decline, which lasted throughout the fifteenth and sixteenth centuries. Schmitt has stated that 'the picture that emerges from a consideration of the philosophical and scientific culture of England during the fifteenth and sixteenth centuries is one of a steady decline from the position held during the fourteenth century',[3] while Ashworth has concluded that 'the intellectual life at Oxford and Cambridge in the fifteenth century was somewhat sluggish … there seems to be no record of any original writing on logical subjects until the mid-sixteenth century'.[4]

In this period three kinds of logical works were circulating: commentaries on the Aristotelian *Organon*, works that deal directly with Aristotelian logic, and logical textbooks for the universities.[5] In particular, in the British Isles, there were two

[1] Cf. E. Jennifer Ashworth, *Language and Logic in the Post-Medieval Period* (Boston-Dordrecht, 1974), 1–25; Edith D. Sylla, 'The Oxford Calculators', in Nicolas Kretzmann, Anthony Kenny and Jan Pinborg (eds.), *The Cambridge History of Later Medieval Philosophy* (Cambridge, 1982), 540–563; E. Jennifer Ashworth, 'The Eclipse of Medieval Logic', in Nicolas Kretzmann, Anthony Kenny and Jan Pinborg (eds.), *The Cambridge History of Later Medieval Philosophy*, 787–796.

[2] Cf. Eugenio Garin, 'La cultura fiorentina nella seconda metà del '300 e i barbari britanni', *La Rassegna della Letteratura Italiana*, 64 (1960), 181–195; Cesare Vasoli, 'Per una ricognizione delle fonti della scienza in Italia. Scritti di logica e metodologia e letteratura magico-astrologica nei secoli XIV–XVI', in Carlo Maccagni (ed.), *Atti del I Convegno internazionale di ricognizione delle fonti della scienza italiana nei secoli XIV–XVI* (Florence, 1967), 31–105.

[3] Schmitt, *John Case and Aristotelianism in Renaissance England*, 25.

[4] Ashworth, 'Introduction', XXIII.

[5] Cf. Ibid. XVII.

M. Sgarbi, *The Aristotelian Tradition and the Rise of British Empiricism*, Studies in History and Philosophy of Science 32, DOI 10.1007/978-94-007-4951-1_2,

collections of texts which were particularly widespread, and whose fortunes have been reconstructed by Lambertus M. de Rijk[6]: the *Libellus sophistarum ad usum cantabrigiensium* and the *Libellus sophistarum ad usum oxoniensium.*[7] A brief glance at the treatises in these collections shows unequivocally the impact of medieval Scholastic logic.[8] These collections had a wide dissemination during the fifteenth century and, as McConica has shown, they survived, especially in Oxford, at least until the late 1570s.[9]

In the early sixteenth century, under the innovative impulse advocated especially at Cambridge, and partially under Erasmus' influence,[10] humanism became the primary cultural movement in England. But English humanism, as Schmitt noted, did not show the same splendour as its Italian counterpart,[11] although there were some outstanding figures such as Thomas More (1478–1535). Regarding Aristotelian philosophy and science in particular, English humanists 'were not nearly so successful in sixteenth-century England as on the European mainland',[12] so far that 'during the half-century in question (1525–1575) England produced nothing of the sort flowing from Continental presses at such a great rate'[13]: 'the period 1525–1575 marked a serious decline in England's fortunes as an intellectual power in Europe'.[14]

The victory of humanism saw the wide dissemination of works of humanist logic, which favoured dialectical and rhetorical modes of argumentation. The shift of interest from terministic logic to dialectic was governed by the idea that an argument need not be valid in its form to be psychologically persuasive. This led logicians to abandon

[6] Cf. Lambertus M. De Rijk, 'Logica Cantabrigiensis. A Fifteenth-Century Cambridge Manual of Logic', *Revue internationale de philosophie*, 113 (1975), 297–315; Lambertus M. De Rijk, 'Logica Oxoniensis. An Attempt to Reconstruct a Fifteenth-Century Oxford Manual of Logic', *Medioevo*, 3 (1977), 121–164.

[7] On the use of these texts in Cambridge and Oxford cf. E. Jennifer Ashworth, 'The Libelli Sophistarum and the Use of Medieval Logic Texts at Oxford and Cambridge in the Early Sixteenth Century', *Vivarium*, 17 (1979), 134–158.

[8] The Cambridge compendium included works such as the *Summulae, De suppositionibus, De consequentia, De resolutionibus, De obligationibus, Obiectiones consequentiarum, De sophismatibus, De obiectionibus casuum, De terminis modalibus, De sincathegoreumatibus, De terminis relativis, Consequentiae Allyngton, De fallaciis, Liber Naturarum, De proportionibus, De Insolubilibus, and De potentia;* while the Oxford book contained the *Summulae, De consequentia, De suppositionibus, De dictionibus, De resolubilibus, De obligationibus, De obiectionibus consequentiarum, De modo dandi contradictoria, Regulae modales, Tractatus argumentationis, De reduplicationibus, De insolubilibus, Liber apparentiarum, Tractatus de naturalibus, and Tractatus de proportionibus.*

[9] Cf. McConica, 'Humanism and Aristotle in Tudor Oxford', 296–297.

[10] Cf. Joan Simon, *Education and Society in Tudor England* (Cambridge, 1979), 102–123; Schmitt, *John Case and Aristotelianism in Renaissance England*, 19.

[11] Cf. Schmitt, *John Case and Aristotelianism in Renaissance England*, 23.

[12] Ibid. 6.

[13] Ibid. 23.

[14] Ibid. 24.

the criterion of formal validity of an argument: demonstrative inferences no longer had a priority over non-demonstrative inferences.[15] This was the general orientation of early humanist logic in the British Isles, whose exponents looked to the rhetorical works of Cicero for effective ways to make weaker cases appear more plausible, often taking over non-deductive strategies.[16] An example of this attitude towards Aristotle's *Rhetorica* is John Rainolds (1549–1607): 'Aristotle teaches the same rules of constructing both a probable and a necessary argument. Albeit a dialectician would make a more absurd distinction between "probables" and "necessaries" than a clothes dealer would between red and black cloth, in that the same cloth cannot be both red and black, and yet with regard to the art of sewing there is almost no difference. Since the same argument can be both necessary and probable, the distinction is irrelevant to the art of discourse'.[17] If we consider Rainolds' perspective, it is no wonder that in this age the works of Lorenzo Valla, Rudolph Agricola,[18] Johannes Caesarius,[19] Juan Louis Vives[20] and Philipp Melanchthon had a large dissemination.[21] The overwhelming victory of humanist logic over Scholastic logic was officially enshrined in 1535 by the royal decree of Henry VIII.[22]

The logical textbooks of humanists such as Agricola and Melanchthon were substituted for the frivolous and obscure works of Duns Scotus, Thomas Burley, Antonio Trombetta—in short, they completely replaced the Scholastic culture, which had

[15] Cf. Lisa Jardine, *Humanistic Logic*, in Charles B. Schmitt and Quentin Skinner (eds.), *The Cambridge History of Renaissance Philosophy* (Cambridge, 1988), 173–198, esp. 187.

[16] Cf. Lisa Jardine, 'Lorenzo Valla and the Intellectual Origins of Humanist Dialectic', *Journal of the History of Philosophy*, 15 (1977), 143–164.

[17] Lawrence D. Green (ed.), *John Rainolds's Oxford Lectures on Aristotle's* Rhetoric (Newark, 1986), 219.

[18] On Agricola's influence cf. James R. McNally, 'Prima pars dialecticae: The Influence of Agricolan Dialectic upon English Accounts of Invention', *Renaissance Quarterly*, 21 (1968), 173–176,

[19] On Ceasarius' influence cf. Jardine, 'Humanism and the Sixteenth Century Cambridge Arts Course', 24–25.

[20] On Vives' influence cf. McConica, 'Humanism and Aristotle in Tudor Oxford', 302–309.

[21] Cf. Peter Mack, *A History of Renaissance Rhetoric 1380–1620* (Oxford, 2011), 33–135.

[22] *Statuta Academiae Cantabrigensis* (Cambridge, 1785), 137–138: 'qui in artium facultate sunt educandi elementa dialectices rhetorices arithmetices geographiae musices et philosophicae descripta ex purissimis earum artium scriptoribus et praelectos sibi habeant Aristotelem Rodolphum Agricolam Philippum Melanchthonem Trapizuntium et hujus notae nomine nec aliquando corrumpi sinant illorum studia aut animos tenebris plus quam cimmeriis et frivolis quaestiunculis caecisque et oscuri glossematis Scoti Burlei Anthoii Trombetae Bricoti Burliferii et aliorum ejus farinae hominum'. Charles H. Cooper, *Annals of Cambridge* (Cambridge, 1842), vol. 1, 375. An unfortunate fate similar to that of the medieval texts befell the Aristotelian works, according to the testimonies of Gabriel Harvey, Edward J. L. Scott (ed.), *Letter-Book of Gabriel Harvey* (London, 1884), 79: 'Aristotle's Organon is nighhand as little redd as Dunses Quodlibet', or Alexander B. Grosart (ed.), *The Works of Gabriel Harvey* (London, 1884), vol. 1, 69: 'Aristotle much named, but little read'. On the Henrician reformation cf. Simon, *Education and Society in Tudor England*, 165–178; Maria Dowling, *Humanism in the Age of Henry VIII* (London, 1986), 75–139.

dominated in the British Isles for nearly two centuries. James B. Mullinger has rightly stated that this decree marked 'the line that in university history divides the mediaeval from the modern age' and 'the downfall of scholasticism in England'.[23] It is particularly clear that 'in the years separating Henry's break with Rome and Elizabeth's accession many changes were made in the universities, and much of the medieval tradition withered away'.[24]

The historical delay in the victory of humanism in the British Isles may be attributed to the country's geographical isolation and its conservative culture, monopolized by the clergy.[25]

In the field of logic, early British humanism, in opposition to the Italian movement, was not characterized by a careful and philological study of ancient works. For instance, Aristotle was not yet read in Greek, but only in Latin or in Italian translation.[26] Important for British humanism was not the 'return of ancient philosophers' *per se*, but only what these philosophers could offer to the culture of the time. This explains the rapid dissemination and study of Latin authors such as Cicero and Quintilian, whose language was more accessible than the Greek authors studied with such interest on the Continent.

British humanists did, of course, revive ancient philosophy, but they did not adopt their doctrines, for the logicians themselves were no great philosophers. Their concern was instead practical and pedagogical, focused on grammar and rhetoric.[27] The discipline of logic, which in the Middle Ages dealt with epistemology, was reduced to a mere rhetoric,[28] without any philosophical import, which it would regain only at the end of the sixteenth century with the diffusion of the Aristotelian works.

The appropriation of ancient and modern European works was chiefly 'scholastic', i.e. in a strict relation with the scholastic institutions. In the British Isles, the idea of

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[23] James B. Mullinger, *The University of Cambridge. From the earliest Times to the Royal Injunctions of 1535* (Cambridge, 1873), vol. 1, 611.

[24] Schmitt, *John Case and Aristotelianism in Renaissance England*, 18–19. On this topic cf. also Paul O. Kristeller, 'Humanism and Scholasticism in the Italian Renaissance', in Id., *Renaissance Thought and Its Sources* (New York, 1979), 85–105; Riccardo Fubini, 'Humanism and Scholasticism: Toward an Historical Definition', in Angelo Mazzocco (ed.), *Interpretations of Renaissance Humanism* (Leiden, 2006), 127–136; Paul R. Blum, *Studies in Early Modern Aristotelianism* (Leiden, 2012), 3–20.

[25] Cf. Roberto Weiss, *Humanism in England during the Fifteenth Century* (Oxford, 2009), 11, 271.

[26] This is the case, for instance, of John Wilkinson's translation of *Ethica Nicomachea*, cf. Schmitt, *John Case and Aristotelianism in Renaissance England*, 23.

[27] Cf. Peter Mack, *Elizabethan Rhetoric. Theory and Practice* (Cambridge, 2002), 75: 'University training in rhetoric and dialectic was essentially propaedeutic, pursued for the sake of studies in history, ethics and natural philosophy. Dialectic was connected with further studies particularly through disputation'.

[28] Cf. Richard McKeon, 'Renaissance and Method in Philosophy', *Studies in the History of Ideas*, 3 (1937), 37–114; Peter Mack, 'Humanistic Rhetoric and Dialectic', in Jill Kraye (ed.), *The Cambridge Companion to Renaissance Humanism* (Cambridge, 1996), 82–99; Eckhard Kessler, 'Renaissance Humanism: the Rhetorical Turn', in Mazzocco (ed.), *Interpretations of Renaissance Humanism*, 181–198.

a humanism independent from schools and universities is misleading.[29] This was principally because the British Isles, unlike Italy, lacked a group of humanists who could be considered independent from the academic institutions, and because 'being a humanist' never became a profession in the British Isles as it did in Italy.[30]

Evidence for the establishment of this 'Scholastic humanism' is the adoption of humanistic logical textbooks and the production of humanistic handbooks for the university curriculum. For instance, Agricola's *De inventione dialecticae* had a great impact, particularly in Cambridge, where it was used in logical lectures.[31] The most evident result of its influence was the 1545 *Dialectica* of John Seton (1508/1509–1567), entirely based on Agricola's logical system. The work circulated in manuscript for a long time among students and professors at Cambridge before its publication. A second edition in 1570, edited by Peter Carter (1530–1590), enjoyed a great success, being subsequently republished in London in 1572, 1574, 1577, 1584, 1587, 1599, 1611, 1617, and 1639, and in Cambridge in 1631. The work advertised its allegiance to Aristotle and Agricola in the front-matter: 'optimae Aristoteles logicae scripsit, proximium habes illi docte Rodolphe locum',[32] although in the preface Seton designated Melanchthon's dialectic as his preferred model. Dialectic, according to Seton, is 'scientia, probabiliter de quovis themate disserendi. Huius munus est rectae dividere, definire, & ratiocinari'.[33] Logic is divided into two parts, *iudicium* and *inventio*, which, however, under the Ramist influence were reversed by Carter in the annotations to his edition.[34] The handbook contained four books, of which three dealt with *iudicium* and in particular with simple terms, proposition and argumentation, while the final book was completely devoted to invention. Seton's work was a good example of English logic in the first half of the sixteenth century—a clear textbook, but ultimately poor and lacking in originality.

In 1551 Thomas Wilson (1523/1524–1581) published the first logical textbook in English, which can be considered a vernacular version of Seton's work. The handbook

[29] Cf. Charles G. Nauert, 'Humanist Infiltration into the Academic World: Some Studies of Northern Universities', *Renaissance Quarterly*, 43 (1990), 799–812.

[30] Cf. Weiss, *Humanism in England during the Fifteenth Century*, 13. On the diversities and analogies between British humanism and Italian humanism cf. Piero Rebora, 'Aspetti dell'Umanesimo in Inghilterra', *La Rinascita*, 2 (1939), 366–414; Roberto Weiss, 'New Light on Humanism in England during the Fifteenth Century', *Journal of the Warburg and Courtauld Institutes*, 14 (1951), 21–33; Roberto Weiss, 'Il debito degli umanisti inglesi verso l'Italia', *Lettere italiane*, 7 (1955), 298–313. On the peculiarities of Italian humanism, see the fundamental works of Garin and Kristeller, Eugenio Garin, *L'umanesimo italiano. Filosofia e vita civile nel Rinascimento* (Rome-Bari, 1994), 25–93; Paul O. Kristeller, *L'umanesimo italiano del Rinascimento e il suo significato* (Naples, 2005). On Paduan humanism cf. Ronald G. Witt, *In the Footsteps of the Ancients. The Origins of Humanism from Lovato to Bruni* (Leiden, 2000), 81–173.

[31] Cf. Mullinger, *The University of Cambridge. From the earliest times to the royal injunctions of 1535*, vol. 1, 410–413.

[32] John Seton, *Dialectica brevem in contextum constricta* (London, 1545), A1r.

[33] Ibid.

[34] Cf. John Seton, *Dialectica Joan. Setoni Cantabrigensis, annotationibus Petri Carteri, ut clarissimis ita brevissimis explicata* (Cambridge, 1631).

was *The Rule of Reason, conteinyng the Arte of Logique, set forth in Englishe* and it had the intention of expounding in English the main doctrine of Aristotle's *Organon* through the mediation of Agricola's logic. In general Wilson characterized logic as 'an art to reason probably on both partes, of all matters that be put furth, so farre as the nature of every thing canne beare'.[35] Logic was then divided into two parts: the first part dealt with *iudicium*, the second with *inventio.*[36] Overall, Wilson's textbook was an honest but ineffectual attempt to write a treatise of logic, which could be useful in rhetorical argumentation for someone with no Latin. The book was nonetheless republished four times in 1552, 1563, 1567 and in 1580, and ceased to arouse interest only with the dissemination of the early Ramist textbooks.[37]

In 1568 (or likely in 1570) Lewis Evans (1532–1576) published *The Abridgement of Logique*, which was nothing other than a brief summary of Wilson's work. Evans characterized logic as the 'arte to define the nature of things, to devide them into parts, to knit true arguments, and to detect the false'.[38] It had two parts, 'thone in *finding* out matter, and shewing the places, whence all Arguments doe spring: the other in *adiudging* and framing of suche matter founde, aptlye togither, and for the purpose'.[39] It is noteworthy that unlike all the other humanist logicians and following Agricola's conceptions, Evans reversed the two parts of logic, placing *inventio* first and *iudicium* second. However, within the text, Evans dealt first with *iudicium* and then with *inventio*. Thus the initial reversal of the two parts of logic should not be understood as a specific philosophical position of the author, but rather as stylistic variation without any claim to theoretical innovation.

An author both dependent on and distinct from Seton was Ralph Lever (1530–1585), who published in 1573 his *The Arte of Reason, rightly termed Witcraft*. The originality of his textbook consisted in the elaboration of new logical terminology in English, 'to prove that the arte of Reasoning may be taught in englishe'.[40] For instance

[35] Thomas Wilson, *The Rule of Reason, conteinyng the Arte of Logique, set forth in Englishe* (London, 1551), B2v. Logic is defined in a more specific way as 'an Arte to try the corne from the chaffe, the truthe from every falshed, by defining the nature of anything, by dividing the same, and also by knitting together true Argumentes and untwining all knotty Subtiltees that are bothe false, and wrongfully framed together'.

[36] Cf. Ibid, B1r.: 'This Arte is devided into .ii. partes. The first part standeth in framing of thinges aptlye together, in knitting woordes, for the purpose accordingly, and in Latin is called *Iudicium*. The second parte consisteth in finding out matter, and searching stuffe agreable to the cause, and in Latine is called *Inventio*'.

[37] On Wilson's logic cf. Peter E. Medine, *Thomas Wilson* (Boston, 1986), 29–54; Quentin Skinner, *Reason and Rhetoric in the Philosophy of Hobbes* (Cambridge, 1996), 52–53.

[38] Lewis Evans, *The Abridgement of Logique* (London, 1568), C1r.

[39] Ibid.

[40] Ralph Lever, *The Arte of Reason, rightly termed Witcraft* (London, 1573), A1r. Cf. Joseph S. Subbiondo, *Ralph Lever's* Witcraft*: 16th-Century Rhetoric and 17th-Century Philosophical Language*, in Kurt R. Jankowsky (ed.), *History of Linguistics 1993: Papers from the Sixth International Conference on the History of the Language Science, Washington D.C. 9–14 August 1993* (Amsterdam, 1993), 179–186.

logic was called ‘witcraft’, rhetoric was ‘speechcraft’, predicate was ‘backset’, subject was ‘foreset’ and so on, category was ‘storehouse’, proposition was ‘saying’, definition was ‘saywhat’, affirmation was ‘yeasay’, negation was ‘naysay’, induction was ‘reason by example’, deduction was ‘rule by reason’, premise was ‘foresaye’, and conclusion was ‘endsaye’. Lever, like Seton, divided logic into four parts, of which three were devoted to the *iudicium*, the last to *inventio*. Lever’s textbook may seem extravagant on account of its language, but it was a serious attempt to expound and explain complex logical doctrines using terms with self-evident meanings.

The last humanistic logic, published after the spread of Ramist logic, is *The Lawyers Logike* (1588) of Abraham Fraunce (1559–1592/1593).[41] Fraunce aimed to elaborate a specific logic for legal cases. He was convinced that law without logic would be insignificant, but he recognized that the logic of the ‘sterile’ methodological controversies did not help legal studies.[42] It was necessary, according to Fraunce, to conceive a kind of logic that was not concerned with subtleties, as the Scholastic logic was, but whose precepts were helpful to lawyers, and by whose means law could be considered a science.[43]

It is impossible to deny that these attempts are part of the long and varied history of logic; but they certainly did not make a great contribution to the advancement of the discipline. Because of their simplicity, they were soon abandoned in favour of a more complex logical perspective—Ramism.

2.2 The Rise and Fall of Ramism (1574–1585)

The impact and influence of Agricola’s logic was weakened with the early dissemination of Ramist works. The reason for the great success of Ramist logic must be found in the particular cultural and social context of the British Isles in the Elizabethan period, and in the reformist background that emerged over those years, with severe conflicts among the different religious factions, reflecting a variety of philosophical positions. Petrus Ramus’s death during the St Bartholomew’s Day massacre, in defence of his Calvinist and anti-Catholic positions, and his anti-Scholastic, anti-Aristotelian and anti-conservative perspectives, bolstered his reputation among English reformers, and especially among learned men influenced by

[41] Cf. Abraham Fraunce, *The Lawyers Logike* (London, 1588). Among Fraunce’s logical manuscripts cf. *The Sheapheardes Logike*, *BM*, Ms. 34361, and *Tractatus de usu dialectices*, *BD*, Ms. *Rawl.* D 345, 1–16.

[42] Fraunce was probably thinking of the controversy between Temple and Digby.

[43] Fraunce, *The Lawyers Logike*, epistle to the reader: ‘when I prooved, I then perceaved, the practise of Law to bee the use of Logike, and the methode of Logike to lighten the Lawe. So that after application of Logike to Lawe, and examination of Law by Logike, I made playne the precepts of the one by the practise of the other, and called my booke, The Lawyers Logike; not as though Logike were tyed only unto Law, but for that our Law is most fit to expresse the praecepts of Logik’. On ‘legal dialectics’ cf. Mack, *A History of Renaissance Rhetoric 1380–1620*, 278–281.

humanistic culture.[44] The victory of Ramism was also a result of the Church Settlement of 1559, through which the Elizabethan government established 'a series of policies with the aim of obtaining a voluntary exodus or the resignation and the forced removal from the universities—in parallel with the "purge" which happened at the same time in Elizabeth's administrative and judicial offices—of the teachers more sympathetic to Marian Catholicism, more ideologically intransigent, and more hostile to the Anglican Church'.[45] These teachers usually professed a logic still connected with the ancient Scholastic and Aristotelian traditions.

One of the first testimonies to a knowledge of Ramist thought in the British Isles was Roger Ascham (1514/1515–1568), who, in a letter to the humanist Johann Sturm, on one hand praised the French logician for his criticism of scholastic Aristotelianism, and on the other hand acknowledged the limits of his knowledge of the Ciceronian philosophy.[46]

However, the first important Ramist scholar in the field of logic was Roland MacIlmaine, who in 1574 published Ramus' *Dialecticae libri duo*, as well as an English translation.[47] From MacIlmaine's point of view, the reason for adopting Ramist logic was its brevity which could serve orators, scientists, preachers, lawyers and any other kind of learned man.[48]

The centre of British Ramism was Cambridge. The first advocate of Ramist logic was Laurence Chaderton (1536–1640), who at that time taught at Christ's College (a Catholic institution), and lectured on Ramus' *ars logica* with great success: among his students we may note Gabriel Harvey (1552/1553–1631) and George Downham (1560–1634).[49] Within a few years Ramism had a large following in the British Isles, with the publication of successful textbooks. In 1580 William Temple (1554/1555–1627) published the *Admonitio de unica P. Rami methodo*,[50] from which heated debates between Ramists and anti-Ramists arose; there followed the publication of various works in defence of Ramist logic as the *Pro Mildapetti de unica methodo* in 1581,[51] the *Epistola de dialectica P. Rami* in 1582, and the

[44] Cf. Louis A. Knafla, 'Ramism and the English Renaissance', in Louis A. Knafla, Martin S. Staum and Timothy Travers (eds.), *Science, Technology, and Culture in Historical Perspective* (Calgary, 1976), 26–50; Guido Oldrini, *La disputa del metodo nel Rinascimento. Indagini su Ramo e sul ramismo* (Florence, 1997), 85–102.

[45] Oldrini, *La disputa del metodo nel Rinascimento. Indagini su Ramo e sul ramismo*, 230. The historian Perry Miller does not hesitate to state that in logic Ramus exerted on Puritanism the same influence that Augustine and Calvin exerted in theology, Perry Miller, *The New England Mind*: *The Seventeenth Century* (New York, 1939), vol. 1, 116.

[46] Cf. Lawrence V. Ryan, *Roger Ascham* (Stanford, 1963), 147–149.

[47] Petrus Ramus, *The Logike of the moste Excellent Philosopher P. Ramus Martyr, Newly translated, and in divers places corrected, after the mynde of the Author* (London, 1574). Cf. Mack, *A History of Renaissance Rhetoric 1380–1620*, 140–141.

[48] Cf. Howell, *Logic and Rhetoric in England 1500–1700*, 183.

[49] Cf. Evelyn S. Shuckburgh, *Laurence Chaderton* (London, 1884), 5.

[50] Cf. William Temple, *Admonitio de unica Rami methodo reiectis Caeteris retinenda* (London, 1580).

[51] Cf. William Temple, *Pro Mildapetti de unica methodo* (London, 1581).

edition of the *P. Rami Dialecticae libri duo scolii G. Tempelli illustrati* in 1584.[52] In 1589 John Sanderson (1540–1602) published his *Institutionum dialecticarum libri quatuor*, which had four editions within a few years.[53]

In 1581 began the publication in the British Isles of the works of Continental Ramists, such as the *In P. Rami dialecticae libri duo* by Friedrich Beurhusius (1535–1609) and the *In Rami dialecticam animadversiones* by Johann Piscator (1546–1625).[54] In 1582 was printed the *De P. Rami dialecticae praecipuis capitibus* by Friedrich Beurhusius (1535–1609), in 1583 the *Triumphus logicae Rameae*[55] by Wilhelm Adolf Scribonius (1550–1600) and in 1584 *The Artes of Logike and Rhetorike* by Dudley Fenner (1558–1587).[56] The last Ramist logic of the sixteenth century was the *Quaestiones et responsiones in Petri Rami dialecticam* by Nathaniel Baxter (1552/1553–1611),[57] which was published in 1585. In the seventeenth century the Ramist tradition continued to prosper, although its exponents were of a low and modest profile, such as Alexander Richardson (d. 1621), whose handbook, *The Logicians School-Master or a comment upon Ramus Logicke,*[58] was published in 1629, and William Ames (1566–1633), whose works, the *Demonstratio logicae verae* and the *Theses logicae*, were printed in exile in 1632 and 1646 respectively.[59] The last important Ramist logic was probably John Milton's (1608–1674) *Artis logicae plenior institutio ad Petri Rami methodum concinnata*,[60] published in 1672.[61] The fact that these last Ramist works were, for the most part, published posthumously or presented as a collection of lecture notes, leads us to believe that the Ramist position in the seventeenth century was not so strong as it had been in the sixteenth, and no longer attracted the interest of scholars with the intense publication of textbooks and commentaries.

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[52] Cf. William Temple (ed.), *Rami Dialecticae libri duo scolii G. Tempelli illustrati* (Cambridge, 1584).

[53] Cf. John Sanderson, *Institutionum dialecticarum libri quatuor* (Antwerp, 1589).

[54] Cf. Friedrich Beurhusius, *In P. Rami dialecticae libri duo* (London, 1581); Johann Piscator, *In Rami dialecticam animadversiones* (London, 1581).

[55] Cf. Wilhelm A. Scribonius, *Trimphus logicae Rameae* (Middleburg, 1583).

[56] Cf. Dudley Fenner, *The Artes of Logike and Rhetorike* (London, 1584). On Fenner's Ramism cf. Skinner, *Reason and Rhetoric in the Philosophy of Hobbes*, 61–62.

[57] Cf. Nathaniel Baxter, *Quaestiones et responsiones in Petri Rami dialecticam* (London, 1585).

[58] Cf. Alexander Richardson, *The Logicians School-Master or a comment upon Ramus Logicke* (London, 1629). On Hartlib's judgment of Richardson's useless logic cf. Stephen Clucas, 'In Search of "the True Logick": Methodological Eclecticism among the "Baconian Reformers"', in Mark Greengrass, Michael Leslie and Timothy Raylor (eds.), *Samuel Hartlib and Universal Reformation: Studies in Intellectual Communication* (Cambridge, 1994), 57.

[59] Cf. William Ames, *Demonstratio logicae verae* (Leiden, 1632); William Ames, *Theses logicae* (Cambridge, 1646). Ames' Ramism is quite explicit in his theory of method, cf. William Ames, *Demonstratio logicae verae* (Cambridge, 1646), 38–39: 'Prius in *methodo* est, quod clarius est, et lucem adfert praerequisitam ad sequentium intellectum, tale autem est, quod prius est in natura. … Resolutio igitur et compositio non sunt duae methodi, sed duae actiones, quae possunt in uno axiomate exerceri, et in hac unica methodo quodammodo observantur ambae'. Among the last Ramist textbook cf. Robert Fage, *Peter Ramus of Vermandois, The Kings Professor, his Dialectica in two bookes* (London, 1632); Edward Phillips, *The Art of Reason in the Art of Logicke* (London, 1658).

[60] Cf. John Milton, *Artis logicae plenior institutio ad Petri Rami methodum concinnata* (London, 1672).

[61] Cf. P. Albert Duhamel, 'Milton's alleged Ramism', PMLA, 67 (1952), 1035–1053.

There were three distinctive elements of Ramist logic: (1) the inversion of *inventio* and *iudicium*, following Agricola's perspective; (2) the existence of only one method because 'universalia sunt absolute notiora specialibus'[62]; Ramist scholars denied that there were two distinct methods, one *ab nobis* and one *ab natura*; (3) the fundamental character of the *lex veritatis* (*de omni* ο κατὰ παντός), of the *lex justitiae* (*per se*, καθ'αὑτό), and of the *lex sapientiae* (*universale primum* ο καθ'ὅλου πρῶτον).[63]

The peculiarity of British Ramism, in comparison to Continental Ramism, as some scholars have noted and as I have already sketched,[64] is its subordination to the new reformed religion, as can be seen, for instance, in the *Syntagma logicum or the Divine Logike* by Thomas Granger (1578–1627), whose subtitle stated 'serving especially for the use of Divines in the practise of preaching, and for the further helpe of iudicious Hearers, and generally for all. … Ad usum inprimis Theologicum summo con iudicio accomodavit Ramus Christianus'.[65]

British Ramist logicians, as many humanist logicians were, were ideologically oriented, but apart from some rare exceptions, such as Temple, they were not philosophically gifted. They introduced nothing new in the field of logic, but simply applied the rules of Ramist logic to different fields and disciplines, from law to theology. We cannot disagree with Ashworth's evaluation that 'the English logic scene in 1590 [was] somewhat depressing. We are faced with elementary manuals which have lost sight of important medieval developments in logic, and which have failed to make anything theoretically interesting of the humanistic innovations'.[66] Indeed, 'if one compares the writings of Ramus on method with those of his near contemporary, Zabarella, it becomes clear how lacking in breadth and perception they were. The principles he laid down are not invalid, but they are exceedingly limited. They offer nothing to the scientist, and they would serve only to blister the dogmatism of a mind already convinced that it perceived the truth in an orderly manner … basically he said nothing new'.[67] Feingold goes further arguing that British Ramism 'failed to make significant inroads into English culture because it represented a frame of mind that was an anathema to the heightened scholarly and literary sensibilities of the educated public'.[68]

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[62] Temple, *Pro Mildapetti de unica methodo*, 102.

[63] The three laws, which were unanimously accepted by all British Ramists, come from the first chapters of the first book of Aristotle's *Analytica posteriora*, I.4–9, 73 a 21–76 a 31. On the three laws, cf. Oldrini, *La disputa del metodo nel Rinascimento. Indagini su Ramo e sul ramismo*, 85–102.

[64] Cf. Keith L. Sprunger, 'Ames, Ramus, and the Method of Puritan Theology', *Harvard Theological Review*, 59 (1966), 133–151; Donald K. McKim, 'The Functions of Ramism in William Perkins' Theology', *The Sixteenth Century Journal*, 16 (1985), 503–517; John C. Adams, 'Ramus, Illustrations, and the Puritan Movement', *Journal of Medieval and Renaissance Studies*, 17 (1987), 195–210; Oldrini, *La disputa del metodo nel Rinascimento. Indagini su Ramo e sul ramismo*, 263; Feingold, 'English Ramism: A Reinterpretation', 141–143.

[65] Thomas Granger, *Syntagma logicum or the Divine Logike* (London, 1620), A1r.

[66] Ashworth, 'Logic in Late Sixteenth-Century England: Humanist Dialectic and the New Aristotelianism', 235.

[67] Ashworth, *Language and Logic in the Post-Medieval Period*, 15–16.

[68] Feingold, 'English Ramism: A Reinterpretation', 175–176.

If it is true that British Ramist logic did not lead to the formulation of original philosophical systems, it is equally true that it had the merit of reviving logical debate, through heated controversies, at the end of the sixteenth century: 'debates pitting Ramus against Aristotle became characteristic of the intellectual landscape of sixteenth-century England; from them came a raising of the level of English work in logic'.[69]

2.3 The Advent of Aristotelianism

As Schmitt has rightly pointed out, it was in reaction to the dissemination of Ramist logic that the Aristotelian movement gained a new momentum. For it was only from the end of the sixteenth century that Aristotelianism began 'to show some of the vigour it had previously enjoyed on the Continent and to regain some of the force it had exerted at Oxford during the thirteenth and early fourteenth centuries'.[70] However, it would be wrong to consider this kind of Aristotelianism as a revival of fourteenth-century Scholastic Aristotelianism,[71] of which some traces were still present, as McConica has observed.[72] It was a very different kind of Aristotelianism from that of the *calculatores* and of the humanists.

It is therefore necessary to understand the origin and substance of this new kind of Aristotelianism. Schmitt suggested that 'at least part of the explanation lies in an Elizabethan re-evaluation of the situation as a whole resulting in a new awareness that the comprehensive nature and persisting validity of the Aristotelian synthesis still had value for the age … The Aristotelian revival was probably part of a more general intellectual reawakening in Britain during the same period'.[73] However, this can only be a partial explanation, and cannot solve the question in all its complexity. Ashworth argued that there were at least three elements which contributed to the renaissance of the Aristotelianism in the British Isles, or at least, to a new interest in Aristotelian studies.[74]

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[69] Schmitt, *John Case and Aristotelianism in Renaissance England*, 35. Cf. Gilbert, *Renaissance Concepts of Method*, 197–212.

[70] Ibid. 6.

[71] Hugh Kearney, instead, argues for a continuity of Scholastic Aristotelianism in the late sixteenth century in the chapter 'The Revival of Scholasticism', cf. Hugh Kearney, *Scholars and Gentlemen. Universities and Society in Pre-Industrial Britain 1500–1700* (London, 1970), 77: 'Scholasticism in the first generation of the sixteenth century, humanism in the second, Ramism in the third; such had been the pattern. A further twist was given to intellectual change in the last decade of the century, with a revival of scholasticism … there was a general willingness to return to a fuller version of Aristotelianism than Ramus was willing to allow'.

[72] Cf. McConica, 'Humanism and Aristotle in Tudor Oxford', 296.

[73] Schmitt, *John Case and Aristotelianism in Renaissance England*, 27.

[74] Cf. Ashworth, 'Introduction', XVIII.

The first element would have been the impact of humanism, characterized by new translations and editions of Aristotle and by a direct reading of the Greek text, an element which Schmitt already emphasized.[75] However, as I have previously remarked, British humanist logicians had no great knowledge of the Greek language and the Aristotelian works were often ignored in favour of textbooks and companions. Moreover, in the British Isles this epoch was characterized, as we have seen, by the reformist movements hostile to the Aristotelian tradition associated with Catholicism.[76] Therefore humanism was hardly a determining factor for the renaissance of Aristotelianism in the British Isles.

The second factor was the wide diffusion of the Greek commentators on Aristotle—Alexander of Aphrodisias, Themistius, Ammonius, Philoponus and Simplicius; the third was the publication throughout Europe of Giunti's edition of Aristotle (1550–1552), which shifted interest away from Aristotle's rhetoric and ethics, the primary focus of the humanists, towards his logic and science.[77]

Indeed, if we examine the first important genuine Aristotelian work published in the British Isles in 1570, Richard Stanyhurst's (1547–1618) *Harmonia seu catena dialectica,*[78] it mentions all the Greek commentators of Aristotle among its sources, as well as a small number of Scholastic philosophers, besides the common humanist logicians. It was not concerned with Ramist logic, which became popular only after 1574. It is however striking that Stanyhurst often referred to the 'schola Veneta', from which he drew his knowledge of the Greek commentators. Also the frequent references to Averroes were due not only to the use of the Giunti's edition, but to the mediation of the Paduan Aristotelians, and especially of Nifo.

Everard Digby (1550–1605) published his *Theoria analytica* in 1579[79] and his *De duplici methodo libri duo* in 1580[80]; neither these works, nor the controversy against Ramism which followed, would be conceivable outside the framework of the reappraisal of Aristotle's Greek commentators, of Giunti's edition and also of the Platonic and Neo-Platonic commentaries.[81] Unfortunately, Digby did not

[75] Cf. Schmitt, *John Case and Aristotelianism in Renaissance England*, 38.

[76] Cf. Luca Bianchi, 'Una caduta senza declino? Considerazioni sulla crisi dell'aristotelismo fra Rinascimento ed età moderna', in Id., *Studi sull'aristotelismo rinascimentale* (Padua, 2003), 133–172, esp. 134.

[77] Cf. Charles B. Schmitt, 'Aristotle's Ethics in the Sixteenth Century: Some Preliminary Considerations', in Walter Rügge and Dieter Wuttke (eds.), *Ethik im Humanismus* (Boppard, 1979), 87–112; Jill Kraye, 'Renaissance Commentaries on the Nicomachean Ethics', in Olga Weijers (ed.), *The Vocabulary of Teaching and Research between Middle Ages and Renaissance* (Turnhout, 1995), 96–117.

[78] Cf. Richard Stanyhurst, *Harmonia seu catena dialectica in Porphyrianas institutiones* (London, 1570).

[79] Cf. Everard Digby, *Theoria analytica* (London, 1579).

[80] Cf. Everard Digby, *De duplici methodo libri duo* (London, 1580).

[81] Jacob Freudenthal emphasized Digby's Neoplatonism, cf. Jacob Freudenthal, 'Beiträge zur Geschichte der englischen Philosophie', *Archive für Geschichte der Philosophie*, 4 (1891), 450–478, 578–633, esp. 599.

mention the Paduan Aristotelians, and so we cannot say for certain whether the similarity between some of his doctrines and those of the Paduans is merely coincidental, or whether he did, in fact, like Stanyhurst, draw on ideas from this tradition. It is perhaps not by chance, however, that all of Digby's works were published in the years immediately following the publication of Zabarella's *Opera logica* in 1578, which had a wide dissemination throughout Europe and influenced the new logicians at the turn of the century.

In 1584 John Case (1540/1541–1600)[82] published his *Summa veterum interpretum in universam dialecticam Aristotelis*.[83] In this work the echo of humanist logic was still strong, but we can already perceive the impact of Paduan Aristotelianism and of the Greek commentators; this became more marked in his *Lapis philosophicus* (1599),[84] where Nifo, Zabarella and Pace were direct sources, suggesting the increased knowledge of these authors over the 15 years.

During those years, indeed, the Paduan works had an unprecedented circulation in the British Isles, probably following changes in the university statutes, such as those adopted in Oxford in 1586, which required students to pay greater attention to the reading of Aristotle himself and his faithful interpreters.[85] Thus Zabarella's *Opera logica* was plundered by Griffith Powell (1560/1561–1620) for his *Analysis analyticorum posteriorum sive librorum Aristotelis de Demonstratione* published in 1594, which examined Aristotle's *Analytica posteriora* 'quibusdam scholiis ex optimis quibusque interpretibus desumptis'.[86]

Moreover, in 1584 Giulio Pace published his bilingual Greek-Latin edition of Aristotle's *Organon*,[87] which had a wide diffusion in the British Isles and was adopted in the universities for the reading of Aristotle's logical works. Besides the edition of the Aristotelian texts, Pace published in 1597 the *In Porphyrii Isagogen et Aristotelis Organum commentarius analyticus*.[88] In the British Isles, Pace was also known for his textbooks, the *Institutiones logicae* (1597) and the *Logicae rudimenta* (1612)[89]; these marked the final entry of Paduan Aristotelianism into the British Isles, and the decline of humanist and Ramist logical handbooks. In the British Isles, towards the end of the sixteenth century we can recognize a growing appreciation of the quality of the Paduan logicians: therefore not only Ramus was

[82] On the life and works of Case, cf. Schmitt, *John Case and Aristotelianism in Renaissance England*, 77–105.

[83] Cf. John Case, *Summa veterum interpretum in universam dialecticam Aristotelis* (London, 1584).

[84] Cf. John Case, *Lapis philosophicus* (Oxford, 1599).

[85] Cf. Schmitt, *John Case and Aristotelianism in Renaissance England*, 43.

[86] Griffith Powell, *Analysis analyticorum posteriorum* (Oxford, 1594), A1r.

[87] Cf. Giulio Pace, *Aristotelis Stagiritae peripateticorum principis Organum* (Morges, 1584).

[88] Cf. Giulio Pace, *In Porphyrii Isagogen et Aristotelis Organum commentarius analyticus* (Frankfurt, 1597).

[89] Giulio Pace, *Institutiones logicae* (Cambridge, 1597); the first edition was published in Sedan in 1595. Giulio Pace, *Logicae rudimenta* (London, 1612); the first edition was published in Spira in 1610.

taught, but also Nifo, Zabarella and Pace.[90] Probably the best example of the overwhelming victory of Paduan Aristotelianism is the posthumous publication in 1619 of the *Tractatus de demonstratione methodicus et polemicus* by John Flavell (1596–1617), a companion to Zabarella's logic.[91] As Schmitt has noted, the works of Powell and Flavell are the best indication of the fundamental change in logic from rhetoric to epistemology: both authors would understand that 'Zabarella's work on scientific demonstration, growing out of the *Posterior Analytics*, must be the basis for any high-level discussion of method along traditional Aristotelian lines'.[92]

In this period, given the anti-Ramist perspective, not only were the Paduan works popular, but also the writings of an Italian refugee in London, Giacomo Aconcio (1492–1567).[93] In particular Thomas Blundeville (1522–1606) in his treatise *The Art of Logike*, in which he intended to teach logic in English 'according to the doctrine of Aristotele as of all other moderne and best accounted Authors thereof', reclaimed Aconcio's methodology against Ramist philosophy.[94] Choosing Aconcio as a logical authority and as the greatest interpreter of Aristotelian philosophy appears very significant in this period. First, the insertion of Aconcio among the authorities on Aristotelian logic established the primacy of the Italian interpreters of Aristotle in the British Isles. Second, Aconcio was strongly anti-Catholic, and so an affiliation with his ideas, unlike those of the Paduans, involved no confessional difficulty for an English Protestant.[95] The anti-Catholic Pace, likewise, had a great success in the British Isles.

But widespread anti-Catholicism did not prevent the rise of Paduan Aristotelianism, and in fact, Paduan logic was supported by the spread in the British Isles of Continental (and largely Protestant) Aristotelian work, which summarized the doctrines of

[90] Cf. Schmitt, *John Case and Aristotelianism in Renaissance England*, 35.

[91] John Flavell, *Tractatus de demonstratione methodicus et polemicus* (Oxford, 1619).

[92] Schmitt, *John Case and Aristotelianism in Renaissance England*, 36. Peter Mack recognizes a similar process in the field of rhetoric, a shift of interest away from Humanist rhetorics to Aristotle's rhetorics, cf. Mack, *A History of Renaissance Rhetoric 1380–1620*, 24–25.

[93] On Giacomo Aconcio and his works cf. Paolo Rossi, *Giacomo Aconcio* (Milan, 1952). Cf. also Charles D. O'Malley, *Jacopo Aconcio* (Rome, 1955).

[94] Thomas Blundeville, *The Art of Logike* (London, 1599), A1r.

[95] Blundeville was Aconcio's friend as the dedicatory epistle to *The True Order and Methode of Wryting and Reading Hystories* shows; here the English author mentions 'myne olde friende of good memorie, Accontio'. Cf. Hugh G. Dick, 'Thomas Blundeville's The True Order and Methode of Wryting and Reading Hystories (1574)', *The Huntington Library Quarterly*, 2 (1940), 149–170, esp. 155. It is possible that the presence of Aconcio in Britain was one of the reasons for the new interest in methodological issues. On the dissemination of Aconcio's thought in Britain cf. Jean Jacquot, 'Acontius and the Progress of Tolerance in England', *Bibliothéque d'Humanisme et Renaissance*, 16 (1954), 192–206; Vittorio Gabrieli, 'Aconcio in Inghilterra (1559–1566)', *La cultura*, 21 (1983), 309–340. On the impact of Aconcio's methodology on the Hartlib circle cf. Clucas, 'In Search of "the True Logick": Methodological Eclecticism among the "Baconian Reformers"', 59–62.

Zabarella and Pace. Particularly common and popular works were Bartholomäus Keckermann's (1572–1609) *Systema logicae* (1600), republished in London in 1606 with the title *Gymnasium logicum*,[96] Christoph Scheibler's (1589–1653) *Introductio logica* (1613),[97] Franco Burgersdijk's (1590–1635) *Institutionum logicarum libri duo*,[98] Johann Stier's (1599–1648) *Praecepta doctrinae logicae*,[99] and Gijsbrecht Isendoorn's (1601–1657) *Cursus logicus systematicus et agnosticus*.[100]

Jesuit logicians, whose works showed traces of Zabarellan and Conimbricensian doctrines, were carefully studied in Britian, despite their religion.[101] In England were printed Martin Smiglecki's (1564–1618) *Logica*[102]; and Philippe Du Trieu's (1580–1645) *Manuductio ad Logicam*, the latter with an appendix on apodictic logic by Thomas Tully (1620–1676).[103]

An example of the influence of new Continental trends on early Aristotelianism in the British Isles is John Argall's (1545–1606) *Ad artem dialecticam introductio* (1605)[104]; in this work Zabarella is frequently mentioned, but the real authority is Keckermann. Argall's work is particularly instructive because Keckermann's *Gymnasium logicum* had not yet been published in the British Isles, showing its early reception.

In the wake of Continental and Paduan Aristotelianism, English logicians published a series of popular textbooks and companions, which went on to define the teaching of logic during the seventeenth century. The most influential textbooks were Samuel Smith's (1587–1620) *Aditus ad logicam*, published for the first time in 1613 with nine further editions before the end the century,[105] and Edward Brerewood's (1565–1613) *Elementa logicae*,[106] published posthumously in London in 1614 with ten further editions within a few years. But undoubtedly the most successful was

[96] Cf. Bartholomäus Keckermann, *Gymnasium logicum* (London, 1606).

[97] Cf. Christoph Scheibler, *Introductio logica* (Giessen, 1613).

[98] Cf. Franco Burgersdijk, *Institutionum logicarum libri duo* (Cambridge, 1637). On the dissemination of Burgersdijk's works in Britain cf. Mordechai Feingold, 'The Ultimate Pedagogue: Franco Petri Burgersdijk and the English Speaking Academic Learning', in Egbert Bos and Henri A. Krop (eds.), *Franco Burgersdijk (1590–1635). Neo-Aristotelianism in Leiden* (Amsterdam, 1993), 151–165.

[99] Cf. Johann Stier, *Praecepta doctrinae logicae …* (Cambridge, 1647); Johann Stier, *Praecepta logicae peripateticae* (Erfurt, 1657).

[100] Cf. Gijsbrecht Isendoorn, *Cursus logicus systematicus et agnosticus* (Oxford, 1658).

[101] On the dissemination of Jesuit learning in Britain cf. Jean-Louis Quantin, 'Les jésuites et l'érudition anglicane', *Dix-septième siècle*, 4 (2007), 691–711.

[102] Cf. Martin Smiglecki, *Logica* (Ingolstadt, 1618); Martin Smiglecki, *Logica* (Oxford, 1634). The first edition was published in Ingolstadt in 1618 and subsequently the second edition in Oxford in 1634.

[103] Cf. Philippe Du Trieu, *Manuductio ad Logicam* (Douai, 1614); following we will quote from Philippe Du Trieu, *Manuductio ad Logicam* (Oxford, 1662). Du Trieu's textbook came out in Douai 1614, but it was subsequently reprinted in Oxford in l662 and in 1678.

[104] Cf. John Argall, *Ad artem dialecticam introductio* (London, 1605).

[105] Cf. Samuel Smith, *Aditus ad logicam* (London, 1613).

[106] Cf. Edward Brerewood, *Elementa logicae* (London, 1614).

Robert Sanderson's (1587–1663) *Logicae artis compendium*, first published in 1615 and running to 14 editions by 1841.[107]

In the meantime, Francis Bacon (1561–1626) became a prominent and influential figure of English culture. In his *Novum organon* (1620),[108] he openly attempted to reform the Aristotelian logic of his time. However, his reform was not followed by other British logicians, who continued to propound and teach Aristotelian doctrines, sometimes including topics from the medieval tradition, which had returned with the dissemination of the Jesuit authors, sometimes attacking the new philosophies.[109] Thus logicians such as Richard Crakanthorpe (1567–1624), Christopher Airay (1603–1670) and John Prideaux (1578–1650)—not coincidentally, all Oxford professors—published textbooks on the model of earlier Aristotelian handbooks, with the addition of a few nominalistic doctrines.

In the second half of the seventeenth century, a new generation of textbooks, dependent not only on Paduan Aristotelianism, but also on the early British Aristotelians, began to flourish. This was the case, for instance, with John Newton's (1621–1678) *An Introduction to the Art of Logick*,[110] which referred directly to the works of Smith, Robert Sanderson, Burgerdijk and Airay; and with Narcissus Marsh's (1638–1713) *Institutio logicae*,[111] and looked back not only to Zabarella, Pace and Robert Sanderson, but also to Everard Digby.

In the meantime the works of non-academic philosophers such as William Harvey (1578–1657) and Thomas Hobbes (1588–1679) became influential. In their writings, too, we can find traces of the Paduan Aristotelianism. An example of the union of the new philosophical trends and Aristotelian doctrines, accompanied by a good knowledge of Greek, was John Wallis' (1616–1703) *Institutio logicae*, published in Oxford in 1687.[112]

Philosophy in Europe underwent profound changes from the end of the sixteenth century to the late seventeenth[113]; but these changes were almost imperceptible in

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[107] On the life and works of Sanderson, cf. Izaak Walton, 'The Life of Dr. Sanderson, Late Lord Bishop of Lincoln', in *The Works of Robert Sanderson* (Oxford, 1854), vol. 6, 273–350. Cf. Robert Sanderson, *Logicae artis compendium* (Oxford, 1615).

[108] Cf. Francis Bacon, *Novum organon* (London, 1620).

[109] For instance, this is the case of Thomas White (1593–1676), who argues against scepticism in his *An Exclusion of Scepticks from all Title to Dispute: Being an Answer to the Vanity of Dogmatizing* (London, 1665), professing Aristotelian philosophy. See also Thomas White, *Institutionum peripateticarum ad mentem summi viri, clarissimique philosophi Kenelmi Equitis Digbaei* (London, 1647). On White's logical Aristotelianism cf. Dorothea Krook, *John Sergeant and his Circle. A Study of Three Seventeenth-Century English Aristotelians* (Leiden, 1993), 41–49.

[110] Cf. John Newton, *An Introduction to the Art of Logick* (London, 1671).

[111] Cf. Narcissus Marsh, *Institutio logicae in usum juventutis Academicae Dublinensis* (Dublin, 1679).

[112] Cf. John Wallis, *Institutio logicae* (Oxford, 1687).

[113] For an overview on the changes in the early modern philosophy in the field of methodology cf. Stephen Gaukroger, 'Knowledge, Evidence, and Method,' in Donald Rutherford (ed.), *The Cambridge Companion to Early Modern Philosophy* (Cambridge, 2006), 39–66.

the British Isles in the field of logic. The new Aristotelian tradition established in English universities supplanted Ramism and was deeply influenced by Paduan Aristotelianism. Logical issues of Paduan Aristotelianism were debated for at least a century, up to the rise of the new facultative logic elaborated by John Locke (1632–1704) with his 1689 *Essay concerning the Human Understanding*,[114] and beyond.[115]

In order to assess how and why the Aristotelian tradition was so deeply rooted in the universities of the British Isles, we must carefully examine the teaching of logic and the logical textbooks used in classrooms of the period.

[114] On the rise of facultative logic cf. Buickerood, 'The Natural History of the Understanding: Locke and the Rise of Facultative Logic in the Eighteenth Century', 157–190.

[115] On post-Lockean Aristotelianism in England cf. Krook, *John Sergeant and His Circle. A Study of Three Seventeenth-Century English Aristotelians*, 67–113; Pauline Phemister, 'Locke, Sergeant, and Scientific Method', in Tom Sorell (ed.), *The Rise of Modern Philosophy. The Tension between the New and Traditional Philosophies from Machiavelli to Leibniz* (Oxford, 1993), 231–249.

Chapter 3
Logic in the Universities of the British Isles

3.1 Cambridge

In England, as we have seen in the previous chapter, Cambridge was the stronghold first of humanism and then of Ramism. The latter was particularly successful at Cambridge with the institution of its lectureship of dialectic.[1] For instance, as Lisa Jardine has pointed out, of the nine courses required by statute in Trinity College in 1560,[2] five were devoted to dialectic: the first lectureship taught Aristotle's *Topica*, which was the basic text for the study of logic; the second explained Agricola's *De inventione dialecticae* or Aristotle's *Elenchi sophistici* and *Analytica priora*; the third taught Porphyry's *Isagoge* or Aristotle's *De interpretatione*; the fourth and fifth lectureship taught using Seton's textbook.[3]

This predominance of dialectic was due to the introduction of a norm in the statute, which established as a minimum requirement for the admission to the higher faculties the knowledge of the rudiments of dialectic: 'nec quisquam ad ullum collegium assumatur nisi instructus et praeparatus fuerit ad dialecticam discendam'.[4] The centrality of logic in the Cambridge curriculum has been recognized by Jardine through a careful study of the inventories of the books owned by students and teachers of the time, of varied contents but all related to humanist logic.

[1] Cf. Schmitt, *John Case and Aristotelianism in Renaissance England*, 45.

[2] Cf. Jardine, 'The Place of Dialectic Teaching in Sixteenth-Century Cambridge', 44.

[3] Cf. Samuel R. Maitland, 'Archbishop Whitgift's College Pupils', *The British Magazine and Monthly Register of Religious and Ecclesiastic Information*, 32 (1847), 508–528, esp. 509: 'Primus legat Topica Aristotelis. Secundus exponat vel Rodolphum Agricolam de Inventione, vel librum de Elenchis vel libros qui Analytici dicuntur. Tertius Praedicabilie Porphyrii, vel Praedicamente Aristot: vel libros ejusdem de Interpretatione, prout classis ipsius postulat. Quartus et infimus interpretetur Dialecticae introductionem Johannis Setoni, sic ut classis infima commoda introductione veniat ad Porphyrium paratior'.

[4] *Documents relating to the University and Colleges of Cambridge* (London, 1852), vol. 1, 492.

M. Sgarbi, *The Aristotelian Tradition and the Rise of British Empiricism*, Studies in History and Philosophy of Science 32, DOI 10.1007/978-94-007-4951-1_3,

The *Ratio studiorum* of 1559, confirmed subsequently in 1570, established that 'primus annus rhetoricam docebit: secundus et tertius dialecticam. Quartus adjungat philosophiam'[5] and added that the 'professor of dialectic' had to teach Aristotle's *Elenchi sophistici* or Cicero's *Topica*, while the lecturer of rhetoric had to teach Quintilian's *Institutio oratoria* or Cicero's works.[6]

The logical education in Cambridge conformed strictly to the humanist standard, but despite the *Directions*, we know from Ascham that the Aristotelian works were little known and taught.[7] From Ascham's words, we can deduce that in Cambridge there was not direct study of the Aristotelian writings, but rather of short textbooks such as that of Seton. It is also noteworthy that Ascham mentions in his letter the Paduan logician and Zabarella's mentor, Tomitano, as an excellent man learned in Aristotelian philosophy, which is a sign that already in the mid-sixteenth century there was a certain knowledge of and interest in the works of Paduan Aristotelianism.

The humanist vocation of Cambridge University was one of the reasons for the early acceptance of Ramism among professors and students; with its anti-Scholastic and partially anti-Catholic character, it was destined for rapid success. The most important Ramist scholars of the British Isles were educated at Cambridge, or at least maintained a strict relationship with this university. All the academic institutions of Cambridge University, as we have seen, were dominated by Ramist philosophy. The birthplace of the dissemination of Ramism was Christ's College with Chaderton, who later moved to Emmanuel College, Harvey, later at Pembroke College, and Downham, who remained for his entire career at this college. Very early, however, all the other colleges were strongly influenced by Ramist ideas. At Saint John's College there was Fraunce, who after an initial vague humanist position professed Ramism; Richardson taught at Queen's College; at King's College, besides Temple, William Gouge (1575–1653) was appointed as professor of logic, while Anthony Wotton (1561–1626) taught dialectic at Gresham College.

Although Cambridge was undoubtedly the English stronghold of Ramism, towards the end of 1570s some opposition to Ramist logic began to emerge, in particular with

[5] *Statuta Academiae Cantabrigensis*, 229.

[6] Cf. Ibid. 228: 'dialectices professor Aristotelis elenchos aut topica Ciceronis. Praelector rhetorices Quintilianum Hermogenem aut aliquem alium librum oratoriarum Ciceronis. Quos omnes libros vulgari lingua pro captu et intelligentia auditorum explicabit interpretabiturque'.

[7] Cf. William A. Wright (ed.), *English Works of Roger Ascham* (Cambridge, 1904), 277–278: 'I thinke, I never saw yet any Commentarie upon Aristotles Logicke, either in Greke or Latin, that ever I lyked, bicause they be rather spent in declarying scholepoynt rules, than in gathering fit examples for use and utterance, either by pen or talke. For precepts in all Authors, and namelie in Aristotle, without applying unto them, the Imitation of examples, be hard, drie, and cold, and therfore barrayn, unfruitfull and unpleasant. But Aristotle, namelie in his Topickes and Elenches, should be, not one lie fruitfull. But also pleasant to, if examples out of Plato, and other good Authors, were diligentlie gathered, and aptlie applied unto his most perfit preceptes there. And it is notable, that my frende Sturmius writeth herein, that there is no precept in Aristoteles Topickes, wherof plentie of examples be not manifest in Platos workes. And I heare say, that an excellent learned man, Tomitanus in Italie, hath expressed everie fallacion in Aristotle, with diverse examples out of Plato'.

the figure of Digby. In addition to his important struggle with Temple, Digby's hostility to Ramism was symptomatic of an intellectual framework which never completely accepted Ramist doctrines, even if they survived well beyond the second half of the seventeenth century. The hostility against Ramism was institutionalized, when the influence of the early Ramists began to wane and the Reformist setting subsided, and when rhetorical outbursts were no longer necessary for anti-Catholic preaching. In universities, Ramism lost its struggle with the new elaborations of logic, which aimed at the actual knowledge of reality, following the programme of influential authors such as Bacon. Already the *Synopsis totius philosophiae*, composed by Robert Booth (d. 1657) probably between 1610 and 1620, showed the total absence of any reference to Ramist thought, in favour of the Paduan Aristotelian philosophy, particular that of Zabarella, in the fields of both logic and natural science.[8]

The *Directions for a Student in the Universitie* of Emmanuel College, where Chaderton lectured on dialectic since its foundation, provide evidence of a radical change in the study of logic.[9]

The *Directions* required an intensive study of logic mainly during the first years, which occupied all the classes in the morning. During the second and third years, its study was drastically reduced, disappearing completely in the fourth year. The teaching of logic was divided into two parts: the first called 'systema logicum', dealing with the basic and advanced elements of logic itself, and the second called 'controversiae logicae',[10] in which the various logical systems were compared, confronted and debated. The academic year and its lessons were well-determined. Between January and March, but in any case for no more than 2 months, the students learned the so-called 'systema brevius', i.e. the fundamental elements, precepts and rules of logic. In the remaining weeks of March they were taught the 'systema majus', i.e. complex logical principles using Burgersdijk's textbooks. Indeed, Burgersdijk's

[8] *BL*, Ms. *Harl*. 5356.

[9] The drafting of the *Directions* has been attributed to Richard Holdsworth, but it is quite uncertain when they became effective. Harry F. Fletcher has dated their application back to 1615; but some works listed in the *Directions* were not yet available, and so Trentman dated the text (in its current form) instead to the late 1630s. Cf. Harris F. Fletcher, *The Intellectual Development of John Milton* (Urbana, 1961), vol. 2, 85; John A. Trentman, 'The Authorship of Directions for a Student in the Universitie', *Transactions of the Cambridge Bibliographical Society*, 7 (1977–1978), 170–183. Kearney, by contrast, dated the *Directions* to 1648–1650, mainly following some other directions present in two manuscripts of those years. Cf. Kearney, *Scholars and Gentlemen. Universities and Society in Pre-Industrial Britain 1500–1700*, 103–104. The two manuscripts considered by Karney are *CUL*, Ms. *Add*. 6160 and *BD*, Ms. *Rawl.* D. 200. A further proof, although not conclusive, can be Nathaniel Sterry's *Guide* included in *BD*, Ms. *Tanner* 88 f. 5, which suggested the same books of the *Directions*. In particular it recommended the reading of Aristotle's *Organon* with the use of the Pace's commentary and the study of Zabarella's methodology of natural philosophy. Cf. Mordechai Feingold, 'The Humanities', in Nicholas Tyacke (ed.), *The History of the University of Oxford. IV. Seventeenth-Century Oxford* (Oxford, 1997), 211–358, esp. 299, 322–324.

[10] According to Trentman, the *Directions* had a particular setting, which favoured the study of logical controversies, rather than system of logic. Cf. Trentman, 'The Study of Logic and Language in England in the Early 17th Century', 182–183.

work is the real protagonist of the *Directions*, for its widespread use in every year of every course. It was preferred for its effective explanations of Aristotelian terminology, and for its articulation of logical doctrines lacking in Ramist handbooks, such as Keckermann's *Gymnasium logicum* or Pierre du Moulin's (1568–1658) *Elementa logices.*[11] Burgersdijk's textbooks were not taught in class by the professor, but read directly by the student, who had the ability to understand its doctrines. Having acquired this competence, the students learned the logical controversies during the months of April and May, still following Burgersdijk's handbook,[12] as well as reading two or three textbooks such as Brerewood's *Elementa logicae*, Eustachius' (1563–1640) *Summa philosophiae quadripartita de rebus dialecticis, moralibus, physicis et metaphysicis*,[13] Didacus Mas' (1553–1608) *Commentaria in Porphyrium et in universam Aristotelis logicam, una cum quaestionibus, quae a gravissimis viris agitari solent*,[14] Smiglecki's *Logica*, or the Coimbran *Commentarii in universam dialecticam.*[15] In June the students studied the 'systema logicum' from a new textbook: the *Directions* suggested Keckermann's *Gymnasium logicum*, Crakanthorpe's *Logicae libri quinque*, Moulin's *Elementa logices* and Sanderson's *Logicae artis compendium.*[16]

During the second year the teaching of logical controversies was on the logical textbooks of the previous year, but the *Directions* added two significant names, Zabarella and Piccolomini, for the study of natural philosophy as well. Only during the third year was it possible to read Aristotle's *Organon* directly, which would be helpful in the study of the controversies, in the learning of Greek and finally in making the students serious scholars.

In the *Directions*, as we have seen, there was no room for Ramist logic, but there was a clear interest in the reappraisal of the eclectic Continental Aristotelianism of Protestant authors, who were inspired by the logical doctrines of Paduan Aristotelianism. The *Directions*, listing so many Aristotelians, are, according to Schmitt, irrefutable proof that in Cambridge 'the Aristotelian tradition is much more deeply entrenched than it had been a half-century earlier'.[17] The institutional philosophy of Cambridge

[11] Cf. Pierre Du Moulin, *Elementa logices* (Leiden, 1596). Du Moulin's textbook was translated into English from the French edition in 1624, cf. Pierre Du Moulin, *The Elements of Logick* (London, 1624). However, it is unlikely that the English translation was used for teaching, since all the other textbooks were in Latin. The book was quite simple and did not offer any innovation in the field of logic. It was useful only for didactic purposes.

[12] Cf. Holdsworth, *Directions for a Student in the Universitie*, 635.

[13] Cf. Asseline Eustachius a Sancto Paulo, *Summa philosophiae quadripartita de rebus dialecticis, moralibus, physicis et metaphysicis* (Paris, 1609); later published in Cambridge in 1640 and in 1648.

[14] Cf. Didacus Mas, *Commentaria in Porphyrium et in universam Aristotelis logicam, una cum quaestionibus, quae a gravissimis viris agitari solent* (Köln, 1617).

[15] Cf. *Commentarii collegii Conimbricensis in universam dialecticam* (Coimbra, 1606).

[16] Cf. Holdsworth, *Directions for a Student in the Universitie*, 636.

[17] Schmitt, *John Case and Aristotelianism in Renaissance England*, 46.

for the first half of the seventeenth century and beyond, was, at least in logic, Aristotelian.[18] Platonism, which had a great success in other fields after 1650, played only a marginal role in logic.[19]

3.2 Oxford

The history of logic at Oxford University was quite different from that at Cambridge, although they are often equalled. For instance, humanist logic never had a great success in a conservative university such as Oxford, which was more concerned with epistemic logic and the theory of knowledge, rather than with rhetoric. However, this does not mean that there was not significant teaching in logic during the humanist period: Rainolds' teaching at Corpus Christi, which I mentioned in the previous chapter, is a striking example.[20] Although some scholars consider him an exponent of Ramism,[21] Rainolds is a typical humanist: his sources were Cicero, Valla, Agricola and Vives, and certainly not Ramist logic.[22] It is true that Rainolds attacked the Aristotelians, not for the same reasons as the Ramists, but for those used by the humanist logicians and rhetoricians against scholasticism. McConica confirmed Rainolds' humanist background,[23] showing that he was convinced that the Ramist attack was not against Aristotle himself, but against the pedantic Aristotelians of Paris: 'Aristotelem Sorbonistae vociferabantur fundamentum theologiae: haereticum, qui dissentiret. Ut non tam in Aristotelem, quam in Aristoteleos acerbiora Rami dicta stringantur'.[24] If McConica's supposition is right, we could argue that Rainolds' intention was to criticize the French Aristotelian logicians, who at the time had among their ranks many English, Scottish and Irish philosophers, who still professed

[18] In support of this claim we can mention the manuscript probably owned by Lawrence Bretton at Queen's College Library of Cambridge bound with the title *From the President's Lodge 1932* and which can be dated to the first half of the seventeenth century; it states 'vera et sana philosophia est vera Aristotelica'. On the importance of this manuscript cf. William T. Costello, *The Scholastic Curriculum at Early Seventeenth-Century Cambridge* (Cambridge, 1958), 30, 175; Kearney, *Scholars and Gentlemen. Universities and Society in Pre-Industrial Britain 1500–1700*, 84. Isaac Newton's case is particularly paradigmatic because it seems that he studied the *Directions*. In fact, the manuscript *CUL*, Ms. *Add*. 3996, from around 1661, shows clearly that Newton read the Aristotelian works and studied the *Organon*, Sanderson's textbook and the commentaries of Eustachius and Magirus. See especially f. 3r–15r.

[19] Cf. Sarah Hutton, 'Thomas Jackson, Oxford Platonist, and William Twisse, Aristotelian', *Journal of the History of Ideas*, 39 (1978), 646–656.

[20] Cf. McConica, 'Humanism and Aristotle in Tudor Oxford', 302–310.

[21] Cf. Mark Curtis, *Oxford and Cambridge in Transition 1558–1642. An Essay on Changing Relations between the English Universities* (Oxford, 1959), 252–253.

[22] Cf. McConica, 'Humanism and Aristotle in Tudor Oxford', 305.

[23] Cf. Ibid. 306.

[24] Ibid.

a kind of logic strictly related to the Scholastic tradition.[25] The fact that Rainolds was not a Ramist but a humanist is evident from his contempt for Ramus' lack of moderation in his criticism.[26]

The *Nova statuta* of 1564/1565 do not show in the field of logic a humanist setting. For the teaching of rhetoric required the study of Cicero and Quintilian's *Orationes* and *Praeceptiones rhetoricae* and Aristotle's *Rhetorica*, while the teaching of logic required the study of Porphyry's *Institutiones* and Aristotle's *Topica*, but no particular humanist textbook was recommended.[27]

Moreover, in Oxford the humanist movement favoured rhetoric instead of dialectic. For instance, at St John's College it was recommended to study logic from Porphyry and Aristotle, but more often used were the rhetorical works of Aristotle, Cicero, Hermogenes, Quintilian, Demosthenes, Isocrates, Sallust, and Virgil.[28] The study of rhetoric at the time seems to have predominated over humanist logic, so that 'there was less attention given to dialectic, and proportionately more to grammar and rhetoric, than at Cambridge, to judge from the number of terms allotted to each part of the curriculum'.[29] This was probably due to the fact that 'the works of scholastic logic continued to turn up in inventories through the century'.[30] The impossibility of renouncing the Scholastic tradition in Oxford should not be understood as a reactionary attitude, but simply as a general orientation towards an epistemic logic as a basis for the scientific knowledge of reality. In fact, at the end of the sixteenth century, in Oxford, Scholasticism was extremely compatible with the new methodological and scientific ideas from Padua.

This is the main reason why at Oxford Ramism was rejected and never formed a school, despite what Howell has written.[31] Although some scholars have cited the Oxford Ramists Charles Butler (1560–1647) and John Barebone,[32] these were figures of secondary importance and were often marginalized by the rest of the faculty. This was precisely the case with Barebone, who was forced by the university to choose

[25] Cf. Alexander Broadie, 'Scottish Philosophers in France: The Earlier Years', *Journal of Irish and Scottish Studies*, 2 (2009), 1–12; Alexander Broadie, *A History of Scottish Philosophy* (Edinburgh, 2009), 87–93.

[26] Cf. McConica, 'Humanism and Aristotle in Tudor Oxford', 307.

[27] Cf. Strickland Gibson (ed.), *Statuta Antiqua Universitatis Oxoniensis* (Oxford, 1931), 390: 'In quaque facultate, hos potissimum ad explicandum scriptores adhibento … in rhetorica, Ciceronis aut *Praeceptiones* aut *Orationes*, aut Aristotelis *de Rhetorica*, libros; in dialectica aut *Institutiones* Porphirii, aut Aristotelem de quacunque dialectices partes'.

[28] Cf. *Statutes of the Colleges of Oxford* (Oxford-London, 1853), vol. 3, 50.

[29] McConica, 'Humanism and Aristotle in Tudor Oxford', 292–293. Cf. Charles Webster, 'The Curriculum of the Grammar Schools and Universities, 1500–1660', *History of Education*, 4 (1975), 51–68.

[30] Ibid. 296.

[31] Cf. Howell, *Logic and Rhetoric in England 1500–1700*, 65.

[32] Cf. Oldrini, *La disputa del metodo nel Rinascimento. Indagini su Ramo e sul ramismo*, 245–246.

between a fine or expulsion for his profession of Ramism and his attack on Aristotle.[33] Probably, just to make sure that cases like Barebone were not repeated in the future, it was established in 1576 that 'eyther in Logick or Philosophy, nothing be defended against Aristotle'.[34] The hostility to Ramism in Oxford was quite evidently a result of the struggle between Digby and Temple. Robert Batt of Brasenose College, in a 1583 letter to his cousin at Cambridge, wished for someone in Oxford who might one day confute Temple's Ramist doctrines.[35] The decision of 1576 was confirmed in a 1586 statute[36] and in a 1589 injunction of Christopher Hatton (1540–1591).[37] McConica is correct to state that 'the evidence for a "reception" of Ramus, if by that we mean the establishment of a group of scholars who single-mindedly advocates Ramus' critique of Aristotle, seems to me however to be tenuous indeed'.[38]

The Oxford statutes of 1586 were a perfect mirror of the changes of interest towards Aristotle and Paduan Aristotelianism, after the publication of Zabarella's *Opera logica* and Pace's edition of Aristotle's *Organon*, which very soon became extremely popular, thanks also to the anti-Ramist decree.[39]

For the teaching of logic the statute stipulated the direct study of Aristotle's works by means of the textbooks and commentaries of his most 'faithful interpreters',[40] by which was traditionally meant the Greek commentators and the Paduan Aristotelians.[41]

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[33] Cf. Anthony à Wood, *The History and Antiquities of the University of Oxford* (Oxford, 1796), vol. 2, 176.

[34] Ibid. vol. 2, 139. Evidences of anti-Ramist positions in favour of Aristotelianism cf. *BD*, Ms. *Rawl.* D. 274.

[35] Cf. *BD*, Ms. *Rawl.* D. 985, f. 52v: 'Expectamus avide Tempelli Cantabrigiensis refutationem ab Oxoniensibus elaboratam'. Against Gabriel Harvey's *De restitutione logica* (1583) and the hope in the coming of anti-Ramist as Henry Savile or William Fulbecke cf. *BD*, Ms. *Rawl.* D. 985, f. 46 r-v. On the anti-Ramist position of Batt cf. Schmitt, *John Case and Aristotelianism in Renaissance England*, 55; Mack, *Elizabethan Rhetoric. Theory and Practice*, 61. Many other letters included in this manuscript reveal interesting anti-Ramist and anti-Ciceronian elements. On the content of Batt's letters cf. Robert W. Jeffery, 'History of the College 1547–1603', in *Brasenose College Quatercentenary Monographs* (Oxford, 1909), vol. 2, 12–16.

[36] Cf. Gibson (ed.), *Statuta Antiqua Universitatis Oxoniensis*, 437.

[37] Cf. Christopher Wordsworth, *Scholae academicae. Some Account of Studies at the English Universities in the Eighteenth Century* (Cambridge, 1910), 124.

[38] McConica, 'Humanism and Aristotle in Tudor Oxford', 301.

[39] Pace's edition of Aristotle's *Organon* was published in 1585, the year before the statutes, which seem to have contributed to the rapid dissemination of this and related works.

[40] Gibson (ed.), *Statuta Antiqua Universitatis Oxoniensis*, 437: 'Praeterea cum authorum varietas multas peperisset in scholis dissentiones, statuerunt vel Aristotelem secundum vetera et laudabilia universitatis statuta, vel alios authores secundum Aristotelem defendendos esse, omnesque steriles et inanes quaestiones ab antiqua et vera philosophia dissidentes, a scholis excludendas et exterminandas'. The aim of the new statutes was to attack Ramism. On the teaching of logic in Oxford during this period cf. E. Jennifer Ashworth, 'Die philosophischen Lehrstätten. 1. Oxford', in Jean-Pierre Schobinger (ed.), *Grundriss der Geschichte der Philosophie. Die Philosophie des 17. Jahrhunderts. Bd. 3. England* (Basel, 1988), 6–9.

[41] Cf. Johann Jakob Brucker, *Historia critica philosophiae* (Leipzig, 1766), vol. 5, 148–352.

According to Charles Schmitt, these statutes were a decisive factor in the development of a new Aristotelian school, characterized by a shift in emphasis from humanistic dialectic to the logic of science set out in Aristotle's *Analytica posteriora*: 'other evidence shows an Aristotelian revival during the final quarter of the sixteenth century, which was possible within the existing statutes. This revival represents a turning away from the language arts of the humanists back to the solid *scientia* of the Stagirite'.[42] However, the statutes of 1586, even if they characterized an important and decisive turn to Aristotelianism, were still vague in defining the true Aristotle or his faithful interpreters. McConica has suggested that among the latter were included the modern *restauratores* of Aristotle, i.e., the anti-Scholastic Aristotelians, including also the exponents of humanist logic or even Ramists. However, the multiple injunctions against positions deviating from Aristotelianism, and in particular Ramism, lead us to conclude with some degree of certainty that the main objective was to pursue an educative model based on Aristotle, who had a great fortune in the Continental universities of the Renaissance, such as Padua, with which Oxford exchanged a number of students and scholars.[43]

The Aristotelian position was consolidated by the statute of 1636, so much that Schmitt has observed that 'it was with the Laudian statutes of 1636 that Aristotle was re-established once again in the central position he had held in the Middle Ages'.[44] Schmitt was probably right in stating that 'the Laudian statutes with their strong Aristotelian emphasis have usually been interpreted by scholars as a triumph of conservatism and a failure of nerve',[45] but Oxford Aristotelianism was very advanced and open to the new scientific discoveries; it was no coincidence that Aristotelianism was professed not only by logicians or philosophers, but also by physicians such as Harvey.[46] Moreover, most of the Aristotelian works of the period dealt with methodological issues of physics and natural philosophy,[47] following Zabarella's doctrines above all.[48]

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[42] Schmitt, *John Case and Aristotelianism in Renaissance England*, 43.

[43] Against Ramism in favour of Aristotelianism cf. Daniel Fayreclough's *Oratio in laudem Dialecticae Aristotelis* of 1606 included in *BD*, Ms. *Rawl.* D. 47. On the mathematical and scientific errors of the Ramist cf. Brian Twyne's notes in *CCC*, Ms. F. 263. Both Fayreclough and Twyne referred to Zabarella to emend Ramist's error. Cf. Ashworth, *Introduction*, XXVIII–XXXI.

[44] Schmitt, *John Case and Aristotelianism in Renaissance England*, 43.

[45] Ibid. 44.

[46] Cf. Nicholas Tyacke, 'Science and Religion at Oxford before the Civil War', in Donald H. Pennington and Keith Thomas (eds.), *Puritans and Revolutionaries* (Oxford, 1978), 73–93.

[47] On the Aristotelianism of natural philosophy and mathematical sciences in the English universities, cf. Mordechai Feingold, 'Aristotle and the English Universitities in the Seventeenth Century: A Re-Evaluation', in Helga Robinson-Hammerstein (ed.), *European Universities in the Age of Reformation and Counter Reformation* (Dublin, 1998), 135–148. On the Aristotelianism of seventeenth-century textbooks of natural philosophy, see Patricia Reif, 'The Textbook Tradition in Natural Philosophy, 1600–1650', *Journal of the History of Ideas*, 30 (1969), 122–138.

[48] Various manuscripts, not exclusively from Oxford, testify to the importance of Zabarella for the methodology of physics, cf. *BL*, Ms. *Arun*. 284; *BL*, Ms. *Harl*. 6292; *BL*, Ms. *Harl*. 6929; *BD*, Ms. *Rawl*. D. 274; *BD*, Ms. *Rawl*. D. 986; *BD*, Ms. *Rawl.* D. 1146; *BD*, Ms. *Rawl*. D. 1413; *EL*, Dc. 3. 89.

Ashworth has discovered evidence for the Aristotelian readings of the time.[49] For instance, Thomas Sixsmith, teacher of logic at Brasenose College during 1620–1640 and editor of Brerewood's works, in his *A Direction for my Schoollers, what Bookes to Buy*, considered the works of 'Pacius, Smiglesius, Rubio, Brierwood, Keckarman, Crakenthorp' as the best textbooks in the field of logic.[50] Other manuscripts of the second half of the seventeenth century confirm the predominance of the Aristotelian tradition beyond modern logicians.[51] That Aristotelian philosophy formed the core of education in Oxford throughout the seventeenth century is confirmed by Seth Ward's *Vindiciae Academiarum*, in which the author wrote that the main reasons why Aristotle was so pervasive in the university courses were the universality of his problems and the concision of his methods, rather than the truth or the infallibility of his doctrines.[52] Furthermore, Ward wrote also that Aristotelian works were no longer read directly by the students, who preferred the brief companions and commentaries as easier to read and to understand.[53] The list of books which Locke wrote for his students around 1661–1666 also confirms that Aristotle was known through the textbooks, in particular those of Smith, Robert Sanderson, Smiglecki, and through Zabarella's commentaries.[54] Ten years later, Obadiah Walker

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Sometimes Aristotelian natural doctrines were related to corpuscular theories, cf. Stephen Clucas, 'The Infinite Variety of Formes and Magnitudes: 16th- and 17th-Century English Corpuscular Philosophy and Aristotelian Theories of Matter and Form', *Early Science and Medicine*, 3 (1997), 251–271.

[49] Cf. Ashworth, 'Introduction', XIV–XV.

[50] Ibid. XV. The text of Sixsmith in *BD*, Ms. *Brasenose* 80 includes many references to Aristotelian treatises also in physics and metaphysics. In the Bodleian Library in the collection *Rawl*. there are some manuscripts that testify to the support of Zabarella's interpretation of Aristotle's *Physica*, *BD*, Ms. *Rawl.* D. 1423.

[51] Cf. Ibid.: '1. Preface to Mons Le Clercs Ars Ratiocinandi. 2. Scholastic Logic. Sanderson or Aristotle himself. Wallis Du Trieu Stierius & Smith with Brerewoods Elementa may be read as Comments on Sanderson. Burgersdicius Herebord Cracanthorp Alstedius &c either read or occasionally consulted 4. For Disputations Vallius and Smiglecius. 4. For an Insight into the antient Socratic or Platonic Methodo of Disputing, Mr Le Clercs last Chapt. De Socrat. disputat. Methodo in his Ars Ratiocin. & for Example of it see Platos first and 2^{a} Alcibiades & other Dialogues of his about Definit. Divis. &c. may not be useless. 5. For y^{e} new Logic Ars Cogitandi Colberti Logica Cartesius de Methodo Du Hamel de mente humanâ. 6. For y^{e} better under standing of Tullies and other Classic Authors Arguing Miltons Logic'. Ashworth refers to *BD*, Ms. *Rawl.* D. 1178.

[52] Cf. Seth Ward, *Vindiciae Academiarum* (Oxford, 1654), 39: 'The chief reason as I conceive why *Aristotle* hath been universally received as *Magister Legitimus* in *schooles* hat been: the universality of his enquiries; the brevity and method fitting them for institutions and not the truth or infallibility of his works'.

[53] Cf. Ibid. 25: '*Aristoteles Organon* is not read to the youth of this University, (how justly I contend not) neither was it ever understood'. This does not mean, however, that professors did not read or know the Aristotelian works in depth. Ward's attitude was generally critical towards Aristotelian philosophy; see Allen G. Debus (ed.), *Science and Education in the Seventeenth Century: The Webster-Ward Debate* (London, 1970).

[54] Cf. *BD*, Ms. Locke f. 11. Paul Schuurmann, *Ideas, Mental Faculties and Method. The Logic of Ideas of Descartes and Locke and Its Reception in the Dutch Republic 1630–1750* (Leiden, 2004), 12.

(1616–1699) in his *Of Education*, published for the first time in 1673 and printed five more times before the end of the century, considered Aristotelian philosophy as the best for its solid grounds and its empirical approach.[55]

As late as the 1680s, Aristotelian logic had predominance over all other philosophical movements.[56] The deep roots of Aristotelianism in Oxford, even after the Lockean revolution, is proven by the fact that at St John's College in 1705 Thomas Heywood recommended the study of Sanderson's logic or of Aristotle himself, identifying the doctrines of the former with those of the latter, while 'Wallis Du Trieu Stierius & Smith with Brerewood's Elementa may be read as comments on Sanderson'.[57]

3.3 Scottish Universities

Scottish universities, after initially being a centre of Ramist logic with St Andrews,[58] officially adopted Aristotelian philosophy, including in the field of logic. The reason for the early success of Ramism in Scotland was probably due to its close relationship with French universities. In the past, important figures such as Hector Boece (1465–1536), John Major (1467–1550),[59] George Lockhart (1485–1547),[60] who

[55] Cf. Obadiah Walker, *Of Education especially of Young Gentlemen* (Oxford, 1673), 120–121: 'Besides that *Aristotle* himself, whom all *Universities*, Christian, have followed about 400 years … but *Grecians* and *Arabians* much longer time, was not a novice in *natural history*; witness those most learned works in that subject. Yet did he write his philosophy conformable, not contradictory, to his knowledge in particulars; and therefore it must needs be very difficult to overthrow that *which* is so well grounded, *which* was product of so much experience; and by none but those who are better versed in that learning than himself'. The frontmatter reveals that it is a second edition with some new annotations, but we have no information about the first edition, which was probably printed in the same year.

[56] Cf. Ashworth, 'Introduction', XV: 'Nomina Auctorum cum Abbreviaturis Smiglecius Crakanthorpus Isindorn Pacius in Arist. organ. Burgesdicius Sanderson Fasciculus Logicae Brerewood de praed. Stierius Derodon Herebord in Burg. Keckerman Miltonus Zaberella Flavel Scheiblerus Du Trieu'.

[57] Ibid. XIV.

[58] The curricula of Scottish universities towards the end of the sixteenth century were based, according to Alexander Grant and Robert S. Rait, on the Ramist teaching of Andrew Melville, cf. Alexander Grant, *The Story of the University of Edinburgh During Its First Three Hundred Years* (Edinburgh, 1884), 78–82; Robert S. Rait, *The University of Aberdeen. A History* (Aberdeen, 1895), 105–117. On the same opinion see Christine M. Shepherd, *Philosophy and Science in the Arts Curriculum of the Scottish Universities in the 17th century* (Edinburgh, 1975), 30–31. Melville's teaching of logic involved the study of Ramus' *Dialectica* and of Omer Talon's *Rhetorica*. The official documents, as we shall see, seem to deny the adoption of Ramism.

[59] On John Major and his impact on the history of logic cf. Alexander Broadie, *The Circle of John Mair: Logic and Logicians in Pre-Reformation Scotland* (Oxford, 1985).

[60] On George Lockhart and his impact on the history of logic cf. Alexander Broadie, *George Lokert: Late-Scholastic Logician* (Edinburgh, 1983).

taught in Paris, returned to Scotland and promulgated Continental trends in the field of logic.[61] Furthermore there were some Scottish professors who, after completing their doctorates, moved to the Continent while maintaining strong relationships with their alma mater, so much that they became authorities in Scotland. Among these professors, in the field of logic may be noted Robert Balfour (1555–1621), professor at Bordeaux and author of a commentary on the *Organon*,[62] Mark Duncan (1570–1640), professor at Saumur and author of the *Institutionis logicae libri quinque*,[63] William Chalmers (1596–1678), professor at Anjou and author of the *Disputationes philosophicae* and the *Introductio ad Logicam*,[64] and Walter Donaldson (1594–1630), professor at Sedan and author of the *Synopsis locorum communium.*[65] Thus Scottish universities were profoundly influenced by Continental teachings, to a greater extent than Cambridge or Oxford.[66] There is no doubt, therefore, that Ramism found an easy path for its dissemination through this special kind of intellectual exchange.

But as I have said, after the first wave of professors coming from the Continent, Ramism yielded to Aristotelian philosophy. In fact, at least up to the 1670s, but even afterwards, Scottish lectures were based on commentaries on Aristotelian texts, they were taught from Aristotelian textbooks, and finally the theses were strictly Aristotelian, even if some mentioned Descartes and Locke's logic.[67] Slowly but progressively, the universities of St Andrews, Glasgow, Aberdeen and Edinburgh grounded their curricula on Aristotelian philosophy, and especially on Zabarella's interpretation with the dissemination of his works, but also on Keckermann and Burgersdijk.[68]

The curriculum at Edinburgh was one of the most complete in the study of logic outside Oxford and Cambridge. The first year was devoted to the study of Classical Latin authors, the Greek language and the first rudiments of Ramist logic. The second year required the study of Omer Talon's *Rhetorica*, but most of all Aristotle's *Organon*, Porphyry's *Isagoge* and general introductory textbooks. Half of the third year was devoted to Aristotle's *Analytica posteriora* and *Ethica*, while in the fourth

[61] On the Aristotelian school of Scottish scholars working in France cf. Broadie, *A History of Scottish Philosophy*, 93–97.

[62] Cf. Robert Balfour, *Commentaria in organum logicum Aristotelis* (Bordeaux, 1616).

[63] Cf. Mark Duncan, *Institutionis logicae libri quinque* (Saumur, 1612). According to William Hamilton this textbook of logic was the model for Burgersdijk's work, who was a colleague of Duncan in Saumur. Cf. William Hamilton, 'In Reference to the Recent English Treatises on that Science', in Id., *Discussions on Philosophy and Literature* (New York, 1861), 120–173, esp. 123.

[64] Cf. William Chalmers, *Disputationes philosophicae* (Paris, 1630); William Chalmers, *Introductio ad Logicam* (Anjou, 1630).

[65] Cf. Walter Donaldson, *Synopsis locorum communium* (Frankfurt, 1612).

[66] Cf. John Veitch, 'Philosophy in the Scottish Universities (I)', *Mind*, 5 (1877), 74–91; Id., 'Philosophy in the Scottish Universities (II)', *Mind*, 6 (1877), 207–234;

[67] Cf. C.M. Shepherd, *Philosophy and Science in the Arts Curriculum of the Scottish Universities in the 17th Century*, 61.

[68] Cf. Ibid. 64.

the students studied Aristotle's natural philosophy.[69] The teaching of Aristotelian philosophy thus overtook the study of Ramist logic.

A further indication of the victory of Aristotelianism in Edinburgh and of the aversion to Ramism can be found in the theses of William Craig (d. 1616) and John Adamson (1576–1651), respectively published in 1599 and in 1600, in which the Ramists were attacked for their lack of interest in grounding a logical system for the acquisition of epistemic knowledge.[70] James Knox (d. 1633) brought up a similar objection to Ramist logic, preferring Aristotle in his *Theses logicae* published 1605.[71] In these academic writings Zabarella was considered the most important and faithful interpreter of Aristotle's logic and natural philosophy.[72] We can find Zabarellan echoes in the theses directed by James Reid in 1610, 1618 and 1622.[73] William King's *Theses philosophicae*, published in 1612,[74] 1616 and 1624,[75] are particularly interesting because not only do they show Zabarellan traces, but they remarked on the worth of experience in acquiring knowledge. The Zabarellan instrumental conception of logic, probably known via Keckermann's works, was also present in Andrew Stevenson's *Theses logicae*, published in 1625 and 1629.[76] In 1628 John Brown lectured on the *Analytica posteriora* following Zabarella's commentary, while in 1632 Robert Rankine taught logic using Pace's commentary to Aristotle's *Organon*, even though his main reference was Zabarella.[77] Rankine's debt to Paduan Aristotelianism was already clear in his *Theses philosophicae*, published in 1631, in which he took up, albeit implicitly, the doctrines of Zabarella and Keckermann.[78] In 1652 Thomas Craufurd (d. 1662) taught the *Elenchi sophistici*, referring frequently to Zabarella and Smiglecki. Similarly in 1660 John Wishart lectured on logic using Zabarella, Smiglecki, the Conimbriacenses and some Scholastic philosophers as his main references, while in 1666 he taught Ramist logic, even if

[69] Cf. Thomas Craufurd, *History of the University of Edinburgh from 1580 to 1646* (Edinburgh, 1808), 58–60; Alexander Morgan (ed.), *University of Edinburgh: Charters, Statutes and Acts of the Town Council and the Senatus 1583–1858* (Edinburgh, 1937), 110–114. This curriculum became standard in the Scottish universities cf. *Evidence, Oral and Documentary, Taken and Received by the Commissioners Appointed by His Majesty George IV … for Visiting the Universities of Scotland, Stationery* (London, 1837), vol. 2, 257; vol. 3, 205.

[70] Cf. Shepherd, *Philosophy and Science in the Arts Curriculum of the Scottish Universities in the 17th Century*, 71.

[71] Cf. James Knox, *Theses philosophicae* (Edinburgh, 1605).

[72] Cf. John Adamson, *Theses philosophicae* (Edinburgh, 1604).

[73] Cf. James Reid, *Theses philosophicae* (Edinburgh, 1610); James Reid, *Theses philosophicae* (Edinburgh, 1618); James Reid, *Theses philosophicae* (Edinburgh, 1622).

[74] Cf. William King, *Theses philosophicae* (Edinburgh, 1612).

[75] Cf. William King, *Theses philosophicae* (Edinburgh, 1616); William King, *Theses philosophicae* (Edinburgh, 1624).

[76] Cf. Andrew Stevenson, *Theses philosophicae* (Edinburgh, 1625); Andrew Stevenson, *Theses philosophicae* (Edinburgh, 1629).

[77] Cf. Shepherd, *Philosophy and Science in the Arts Curriculum of the Scottish Universities in the 17th Century*, 66.

[78] Cf. Robert Rankine, *Theses philosophicae* (Edinburgh, 1631).

he used Burgersdijk's companion and Duncan's *Institutiones logicae*, both of which were strongly influenced by the logical perspective of Paduan Aristotelianism.[79] In his *Theses logicae* (1661) Wishart, questioning whether logic was a science, an art or an instrumental habit, did not hesitate to defend the Zabarellan view.[80] In another thesis published in 1668, Wishart once again praised Duncan, but mostly Balfour, who published an edition of Aristotle's *Organon*, based on that of Pace. In this thesis the name of Hobbes as a logician appeared for the first time.

The lectures of Aristotelian logic using the works of Zabarella and Pace continued with the course of James Pillans in 1662 and with that of William Paterson in 1668 entitled *De argumentationis fabrica.*[81] We can evince the long-lasting reception of Aristotelian philosophy from Alexander Cockburn's thesis published in 1675, in which he stated that: 'Meritis Syllogismi fabricam laudibus celebrant *Peripatetici*, cujus nomine & aeternitate dignus *Aristotiles*'.[82] In 1680–1681 Andrew Massie attempted for the first time to reconcile Descartes' new philosophy with Aristotelian thought.[83] The fourfold analysis of logic in the three operations of the mind and method was of Zabarellan heritage, echoed also by the logic of Port-Royal.[84] Herbert Kennedy in his lectures of 1687–1688 also attempted to bridge Descartes and Aristotle, even if the latter had the prominent position.

As far as concerns the University of Glasgow, Aristotelianism was even more firmly rooted since its foundation.[85] Statutes required the complete study of the Aristotelian works and of the most important medieval commentators,[86] as the

[79] Cf. Shepherd, *Philosophy and Science in the Arts Curriculum of the Scottish Universities in the 17th Century*, 67.

[80] Cf. Ibid. 71.

[81] Cf. Ibid. 67.

[82] Cf. Alexander Cockburn, *Theses philosophicae* (Edinburgh, 1675), 5.

[83] Descartes was never an authority in Britain in the field of logic as he was in metaphysics, cf. John G.A. Rogers, 'The English Turn in Cartesian Philosophy', in Paola Dessì and Brunello Lotti (eds.), *Eredità cartesiane nella cultura britannica* (Florence, 2011), 11–27.

[84] The first English translation of Port-Royal's logic was published only in 1685.

[85] Cf. Shepherd, *Philosophy and Science in the Arts Curriculum of the Scottish Universities in the 17th Century*, 75.

[86] Cf. *Munimenta Alme Universitatis Glasguensis. II Statutes and Annals* (Glasgow, 1854), 25–26: 'Ordinaria vero audienda sunt haec. Primo scilicet, in veteri arte, liber Universalium Porphyrii, liber Praedicamentorum Aristotelis, duo libri Peri Hermeneias ejusdem. In nova logica duo libri priorum [Analyticorum], duo posteriorum, quatuor ad minus Topicorum, scilicet primus, secundus, sextus et octavus, et duo Elenchorum. In Philosophia, octo libri Phisicorum, tres de caelo et mundo, duo de generatione et corruptione, tres libri de Anima, etiam de sensu et sensato, de memoria et reminiscentia, de somno et vigilia, et septem libri Metaphysicae. Audiantur libri extraordinarii in toto vel in parte, ubi facultas mature dispensabit, si fiat defectus: scilicet in logica textus Petri Hispani, cum syncathegorematibus; tractatus de distributionibus, liber G. Po[rretani], sex principiorum. In Philosophia, tres libri meteorologicorum, tractatus de sphera sine dispensatione; sex libri ethicorum, si legantur; perspectiva; algorismus; et principia geometriae, si legantur et ut studium juvenum de bono in melius usque in finem optimum laudabiliter suscipiat incrementum statuimus et ordinamus quod vetus ars legatur per sex septimanas Priorum per tres Posteriorum per tres Topicorum et Elenchorum per totidem continue perlegantur'.

library registers show.[87] But as well as Aristotle himself, we can find a lot of works by Renaissance Aristotelians, often related to the Paduan tradition, such as Francesco Burana (1475–1503), Nifo, Zabarella and Pace.[88]

Statutes changed little in a century, for the lectures around 1650 followed more or less the same model. The lectures on logic were based on the *Organon* and Pace's commentary, while the secondary authors were Zabarella and Smiglecki, as shown by James Dalrymple's (1619–1695) thesis published in 1646[89] and the courses of Andrew Burnet in 1659–1660 and William Mair in 1665. In 1678 John Tran introduced his lectures on logic with a brief history of the Aristotelian tradition up to Scholastic philosophy.[90] Gershom Carmichael (1672–1729), considered by William Hamilton as 'the real founder of the Scottish school of philosophy',[91] in his lectures on logic in 1697 and 1708 reassessed Locke's works in the light of Aristotelian logic; he especially compared the first operation of the mind, the *apprehensio*, to the perception of the ideas of modes, substance and relation.[92]

The conditions in Aberdeen were not different from Glasgow: Aristotle was the centre of the educational and pedagogic system, so much that Alexander Bain has characterized the faculty of arts as 'a dreary, single-manned Aristotelian quadriennium'.[93] At the beginning, in 1593, the curriculum of Marischal College required the teaching of logic only for the second year. The study of the 'organum logicum' had to follow the division of the system of the rules of invention and the system of the rules of judgment, which was typical of Ramist logic.[94] Beginning from the *nova fundatio* of King's College, established towards the end of the sixteenth century but probably becoming effective only in the early years of the seventeenth, Aristotle assumed a central role in the study of logic.[95] William Forbes (1585–1634), professor

[87] Cf. *Munimenta Alme Universitatis Glasguensis. III List of Members and Internal Economy* (Glasgow, 1854), 403–406.

[88] Cf. Ibid. 409–411.

[89] Cf. James Dalrymple, *Theses logicae, metaphysicae, physicae, mathematicae et ethicae* (Glasgow, 1646).

[90] Cf. Shepherd, *Philosophy and Science in the Arts Curriculum of the Scottish Universities in the 17th Century*, 76.

[91] William Hamilton, *Preface*, in *The Works of Thomas Reid* (Edinburgh, 1863), 30.

[92] Cf. Shepherd, *Philosophy and Science in the Arts Curriculum of the Scottish Universities in the 17th Century*, 79.

[93] Alexander Bain, *Practical Essays* (New York, 1884), 184; Rait, *The University of Aberdeen. A History*, 56–57. Kearney confirms Bain's and Rait's supposition, cf. Kearney, *Scholars and Gentlemen. Universities and Society in Pre-Industrial Britain 1500–1700*, 89: 'Aberdeen, the seat of episcopalianism, seems to have been the most Aristotelian of the Scottish universities'.

[94] Cf. *Evidence, Oral and Documentary, Taken and Received by the Commissioners Appointed by His Majesty George IV … for Visiting the Universities of Scotland*, vol. 4, 236.

[95] Rait, *The University of Aberdeen. A History*, 117. Peter J. Anderson (ed.), *Notes on the Evolution of the Arts Curriculum in the Universities of Aberdeen* (Aberdeen, 1908), 2: 'Primae et infimae classi praefectus Graecae linguae institutionem profitebitur, addita enarratione quam facillimorum et optimorum authorum utriusque linguae, eosdemque frequenti styli exercitio … Proximus

of logic at Marischal College from 1602 to 1606, openly defended Aristotelian philosophy from the Ramists' attacks.[96] In a thesis published in 1622 Alexander Lunan epitomized the syllogism as the monument of Aristotle's eternal genius.[97] In the theses of William Lealey and James Sibbald (1595–1647), both published in 1625,[98] the favourite sources were Zabarella and Keckermann. John Seton professed his Aristotelianism in his thesis published in 1631, referring to Aristotle as 'princeps Philosophorum principis' and 'felicissimi naturae discipuli',[99] as well as 'Praeceptoris nostri',[100] although probably he wanted to refer unequivocally to the 'doctissimus Zabarella', given the number of times that he explicitly declared himself to have followed his doctrines.[101] Zabarella, together with Smiglecki, is the chief authority of Patrick Gordon's *Theses philosophicae*, published in 1643.[102]

In Aberdeen 'Aristotle was still supreme in the middle of the seventeenth century',[103] as the documents of 1647 of the reunion of the four Scottish universities attest. At King's College, at the very heart of second-year teaching was the study of Ramus' *Dialectica*, Porphyry's *Isagoge*, Aristotle's *Categoriae*, *De interpretatione* and *Analytica priora*, while during the third year the professor taught Aristotle's *Analytica posteriora*, *Topica* and *Elenchi sophistici.*[104] At Marischal College, instead, a textbook was taught to the second class, along with Prophyry's *Isagoge* and Aristotle's *Organon*, probably using Pace's commentary.[105] The official documents of King's College and Marischal College drawn up in the same period show

praecepta inventionis, dispositionis et elocutionis quam possit facili methodo suos auditores docebit, usumque praeceptorum ex optimis utriusque linguae authoribus praeceptis adjunget, adolescentesque tum scribendo tum declamando exercebit, ut in utriusque linguae facultate pares ad Philosophiae praecepta capessenda magis idonei evadere possint … Tertius Arithmeticae et Geometriae rudimenta, selectionem ex Aristotelis organo logico unicum ejusdem libris ethicen et politicen e Graeco contextu enarrabit … Quartus, quem subprincipalem nominamus … Physiologiam omnem eamque quae de natura animalium utpote imprimis necessario de Graeco Aristotelis contextu enarrabit'.

[96] Cf. Rait, *The University of Aberdeen. A History*, 33.

[97] Cf. Alexander Lunan, *Theses philosophicae* (Aberdeen, 1622). Cf. Shepherd, *Philosophy and Science in the Arts Curriculum of the Scottish Universities in the 17th Century*, 83.

[98] Cf. Ibid.

[99] John Seton, *Theses philosophicae* (Aberdeen, 1631), 3.

[100] Ibid.

[101] Ibid. 5, 8, 14.

[102] Cf. Patrick Gordon, *Theses philosophicae* (Aberdeen, 1643).

[103] Rait, *The University of Aberdeen. A History*, 154.

[104] Cf. Anderson (ed.), *Notes on the Evolution of the Arts Curriculum in the Universities of Aberdeen*, 4: 'to the second classe, Rami dialectica; Vossii retorica; some elements or arithmetick; Porphyrie; Aristotill his categories, de interpretatione and prior analyticks, both text and questiones. To the third classe, the rest of the logicks'.

[105] Cf. Ibid.: 'unto the second classe a breiff compend of the Logickis, the text of Porphirie and Aristotellis organon accuratly explained, the haill questiones ordinarly disputed to the end of the demonstrationes'.

that the Ramist works were taught in the class of rhetoric, and the works of Aristotle and Porphyry in that of logic.[106]

Among Scottish universities, St Andrews was initially the most Ramist. But the 1588 statutes of St Leonard's College show that the teaching of logic for the first year expounded Porphyry's *Isagoge* and Aristotle's *Categoriae*, while the second year was devoted to the study of the entire *Organon*.[107]

Evidence for the survival of Ramist ideas in St Andrews is provided by James Weymss's thesis published in 1612,[108] in which Zabarella's view was set against those of Ramus and of the Italian Aristotelian, Francesco Piccolomini. Even in 1643 at St Leonard's College, James Sharp (1618–1679) opposed Aristotelian logic to Ramist logic. In his *Theses logicae* published in 1629,[109] John Wedderburn (1599–1679), on the question 'de causis quas continere debent praemissae demonstrationis' answered using Zabarellan arguments. John Barclay's 1631 *Theses philosophicae* mentioned Zabarella favourably,[110] and Thomas Glegg's lectures at St Salvator College in 1647 were based on Pace's canonical commentary on the Aristotelian works — evidently, Aristotelianism still aroused some interest.

It would be misleading to conclude that Scottish professors were focused only on Zabarella and related authors, but we are sure that they were 'at least … acquainted with their works and were frequently prepared to accept them over the older [Scholastic] Aristotelian commentaries'.[111] Knowledge of Zabarella and other Paduans was a common heritage of the Scottish universities, which lasted up to the end of the seventeenth century.

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[106] For the King's College, Ibid. 5: 'studiosis secundi ordinis praelegantur Rami dialectica, Talei aut Vossii Rhetorica, Alstedii compendium Arithmeticae et Geometricae ex ejusdem admirandis Mathematicis, Porphyrii Isagoge, ex Aristotelis Organo lib. Categor., lib. de Interpretatione, libri duo priores analytici, Topicen libri 1 et 8, cum caeterorum epitome, et lib. de Sophist. Elenchis. … Studiosis tertii ordinis praelegantur libri duo posteriores Analytici'. For the Marischal College, Ibid. 6: 'Prima classis … Augusti in Dialecticis quae ex Ramo addice exercetor … Secunda classis … Augusti in Aristotelis organo logico versator. Tertiani ingressi examini se denuo subijciant, et ubi probarint diligentiam in grecis latinis Rhetorica et Dialectica, primo honoris gradu quem Baccalaureatum vocant ornentur; ornati hoc honore si quid in logicis adhuc superest addiscant; … Eodem anno acroamaticos Aristotelis libros praeceptor proponito'.

[107] Cf. *Evidence, Oral and Documentary, Taken and Received by the Commissioners Appointed by His Majesty George IV … for Visiting the Universities of Scotland*, vol. 3, 195.

[108] Cf. James Weymss, *Theses philosophicae* (Edinburgh, 1612).

[109] Cf. John Wedderburn, *Theses philosophicae* (Edinburgh, 1629).

[110] Cf. James Barclay, *Theses philosophicae* (Edinburgh, 1631).

[111] Shepherd, *Philosophy and Science in the Arts Curriculum of the Scottish Universities in the 17th Century*, 100.

3.4 Dublin

To conclude the reconstruction of university teaching of logic in the British Isles, it is necessary to say a few words also on the University of Dublin. Since its foundation in 1592, the university held a Ramist position, due to the influence exerted by Temple, who served as the provost of Trinity College.[112] As a matter of fact, Dublin was the only university in the British Isles which did not mention Aristotle in its statutes, from which Aristotelian philosophy was substantially banished. The statutes of 1615/1616, written by Temple, are extremely significant in this regard. The first year was devoted to the *inventionis et elocutionis rhetoricae* and to the study of logic according to Ramist textbooks. The study of *inventio* and *judicium* was, instead, carried out during the second year, and always from Ramist handbooks. At the end of the third a thesis on logic was required of every student.[113] The statutes approved in 1629 and confirmed in 1636 also testify unequivocally to the continuity of Temple's model.[114] Yet something must have changed a few decades later, since in Marsh's textbook, *in usum juventutis Academicae Dublinensis*, there were no hints and traces of the Ramist philosophy, but rather a strong revival of the Aristotelian tradition linked with Paduan Aristotelianism, that he learned in Oxford during his university years. Probably even Dublin, although later, adopted Aristotelianism as its official philosophy.

[112] Cf. Edmund J.J. Furlong, 'The Study of Logic in Trinity College, Dublin', *Hermathena*, 58 (1941), 38–53.

[113] Cf. John W. Stubbs, *The History of the University of Dublin from Its Foundation to the End of the Eighteenth Century* (Dublin, 1889), 43–44.

[114] Cf. John Mahaffy, *An Epoch in Irish History. Trinity College, Dublin, Its Foundation and Early Fortunes 1591–1660* (Dublin, 1903), 351–352: 'in hac Classe Dialectica praelegatur: quam bis ad minimum quotannis integram praelegi volumus. Discipulus hujus Classis aliquam quavis hebdomada Analysin Inventionis et Elocutionis Rhetoricae praestato, eamque Praelectoris Examini et Censurae subjicito. Praelector secundae Classis controversa Logicae disciplinae capita explicato, et disceptato. Quae veritati consentanea reperientur, ea Auditoribus suis commendabit: Quae vero falsa fuerint, ea argumentorum viribus convicta repudiabit. Hujus Classis Discipuli aliquam Inventionis et Judicii Analysin per singulas Septimanas instituant'.

Chapter 4
Jacopo Zabarella's Empiricism

4.1 The Nature of Logic

In the previous chapter I have reconstructed the intellectual background in which the thought of Zabarella and other Paduan Aristotelians began to take root and spread. Before examining the impact of Paduan Aristotelianism on the genesis of empiricism, it will be necessary to focus on the most important Aristotelian doctrine from Padua to be received across the Channel, and the extent of its influence on native Aristotelianism. Furthermore, it is necessary to clarify some basic Paduan ideas, and in particular those of Zabarella, which were absorbed and re-elaborated by British Aristotelians, so that we can better assess the real innovations and originality of this movement.

One of Zabarella's most important contributions to the history of logic is undoubtedly his instrumental conception of logic, on which historians of philosophy have spilled rivers of ink.[1] In truth the Zabarellan perspective was not an original and revolutionary position in the history of thought, but a faithful return to the Greek Aristotelian sources, which considered logic as an *organum*,[2] namely an instrument able with its formal and apodictic character to guarantee the universality and necessary character of philosophy and other knowledge.

Zabarella reached the conclusion that logic is an instrument through an examination of the various disciplines, of their subjects and aims. He proceeded from the recognition of the existence of two kinds of things, those necessary and eternal and those contingent.[3]

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[1] On Zabarella's instrumentalism cf. Antonio Corsano, 'Lo strumentalismo logico di Giacomo Zabarella', *Giornale critico della filosofia italiana*, 42 (1962), 507–517; Francesco Bottin, 'Nota sulla natura della logica in Giacomo Zabarella', *Giornale critico della filosofia italiana*, 52 (1973), 39–51; Vasoli, 'Jacopo Zabarella e la natura della logica', 1–22.

[2] Cf. Heikki Mikkeli, *An Aristotelian Response to Renaissance Humanism: Jacopo Zabarella on the Nature of Arts and Sciences* (Helsinki, 1992), 46.

[3] Cf. Jacopo Zabarella, *Opera logica* (Frankfurt, 1597), c. 2 A–B: 'Res omnes in duo genera dividuntur ab Aristotele in tertio ca 6. libri de Moribus ad Nicomachum: alias enim necessarias, ac sempiternas esse dicit, alias contingentes, quae esse et non esse possunt'.

M. Sgarbi, *The Aristotelian Tradition and the Rise of British Empiricism*,
Studies in History and Philosophy of Science 32, DOI 10.1007/978-94-007-4951-1_4,

Necessary and eternal things are not under man's control and their causes must be sought outside the human will. They are the subject of 'contemplative disciplines',[4] that is, theoretical sciences which search for the causes of things. There are three contemplative disciplines: divine philosophy (metaphysics), natural philosophy (physics), and mathematics.[5]

Contingent things, by contrast, are under man's control, will and activity, and form the subject of operative disciplines (*disciplinae operatrices*).[6] These disciplines cannot be considered real sciences, because science, which is the knowledge of a thing in a necessary and rigorous way, is properly an intellectual habit, as Aristotle says in the sixth book of the *Ethica nicomachea.*[7] Since science is grounded on demonstration, and demonstration on principles, operative disciplines would not deal with the habit of the principles, i.e., the intellect. Moreover, since they deal with contingent things, operative disciplines cannot be the same as wisdom, which relates to necessary things. Operative disciplines, like ethics and poetics, Zabarella can only conclude, deal with prudence and art.[8]

Zabarella's aim is to show that logic is neither a contemplative nor an operative discipline and that it is not concerned with any of the intellectual habits. To demonstrate this, Zabarella makes the distinction between *primae notiones* and *secundae notiones*, a distinction that underlies and pervades his entire logical system. Logic would deal exclusively with *secundae notiones*, which are also called mental concepts.[9]

The 'first notions' are subject to investigation by the philosopher — that is, the natural philosopher, rather than the metaphysician. These are concepts which immediately designate real things independent of the power and activity of the mind.[10] It should be noted that, according to Zabarella, however, *primae notiones* are always concepts, they are not things, although they refer to and directly mirror things.[11] The fact that *primae notiones* were always concepts and not things is decisive because it

[4] Cf. Ibid. c. 3 C: 'Haec quum ita se habeant, disciplinae illae; quae in rebus necessariis versantur eo tantum scopo, et eas cognoscant, merito Scientiae contemplativae appellatae sunt'.

[5] Cf. Ibid. c. 3 D–E: 'si dicamus tre esse ad summum scientias contemplativas; divinam, quae Metaphysica dicitur, mathematicam et naturalem: divina quidem res ab materia penitus abiunctas considerat; naturalis autem res materiales, quatenus materiales sunt; mathematica vero eas, quae materiales quidem sunt, propterea quod sine materia non existerent; tamen quia earum essentia a sensili materia non pendent, ab ea per mentalem considerationem separantur'.

[6] Cf. Ibid. c. 3 E–F: 'Reliquae omnes disciplinae in rebus illis versantes, quae quod ab humana voluntate aeque fieri, ac non fieri possunt, contingentes ab Aristotele vocantur'.

[7] Cf. Ibid. c. 3 F.

[8] Cf. Gaukroger, *The Emergence of a Scientific Culture: Science and the Shaping of Modernity, 1210–1685*, 164–169.

[9] Cf. Zabarella, *Opera logica*, c. 6 A–C: 'Est omnium communis sententia, quod solae secundae (ut vocant) notiones, seu secundo intellecta a Logico tractentur, quum primas considerare Philosophi potius, quam Logici munus videatur'.

[10] Cf. Ibid. c. 6 B: 'Nominibus quidem primae notionis statim res ipsa significata extra animum respondet, quo circa haec opus nostrum esse non dicuntur: nemo enim coelum, elementa, animalia et stirpes opus humanum esse diceret'.

[11] Cf. Ibid. c. 6 A: 'Sunt autem primae notiones nomina statim res significantia per medios animi conceptus, ut animal et homo, seu conceptus ipsi, quorum haec nomina signa sunt'.

means that the natural philosopher never deals directly with things, even if he describes how things are. The natural philosopher deals with concepts which directly characterize things, and aims at explanatory strategies of natural things, i.e., the reasons why things are as they appear. It is eminently a conceptualist position, whose realist aspect can be saved by Zabarella only by asserting – without any demonstration – that there is a direct correspondence between things and concepts.

Secundae notiones, Zabarella seems to suggest, derive from *primae notiones* and are in some way dependent on them. However, the Paduan logician insists that *secundae notiones* are imposed names,[12] that is, they are the product of the human mind in the exercise of its cognitive faculties.[13] If even terms like 'man' and 'animal', which refer directly to things, can be considered *secundae notiones*, what is the real difference between them and the *primae notiones*? Zabarella answers clearly that *primae notiones* designate things as they are, while *secundae notiones* concern things as they are known and conceived in the mind—they are concepts that describe reality as it is thought.[14] Zabarella gives an example that comes from the *Analytica posteriora* II.19: if we know Socrates, Plato and Callias through perception, the mind forms a common concept of 'man', which is the concept of the thing (*conceptus rei*), that is, a *prima notio*. When we are aware that the concept of 'man' is the concept of every individual with the characteristic of the concept of 'man', this concept becomes a species, that is a *secunda notio.*[15] Zabarella's example is relevant to the adequate understanding of his view of the formation of the universals by means of the inductive process, which is expounded by Aristotle in the last chapter of the *Analytica posteriora*. The universals described in that chapter are *primae notiones*, not real universals of things, but directly signifying particulars by means of a general thing.

Given that *secundae notiones* are a product of the mind according to its own will, and therefore contingent, they cannot be the subject of science, because science, as we have already said, deals only with necessary things. Therefore logic is not and cannot be a science, 'unde patet logicam similiorem esse artibus quam scientiis in

[12] Cf. Ibid. c. 6 B: 'secundae vero sunt alia nomina his nominibus imposita, ut genus, species, nomen, verbum, propositio, syllogismus, et alia eiusmodi sive conceptus ipsi, qui per haec nomina significantur'.

[13] Cf. Ibid. c. 6 B–C: '… quia liceat omnia nomina ab hominibus inventa, et rebus imposita suo arbitratu fuerint, tamen dum illud, quod per tale nomen significatur, respicimus, id a nobis fieri non dicitur, ut animal ab homine factum non dicimus, etsi nomine huius vocis inventores fuerunt. At secundas notiones nemo negaret opera nostra, et animi nostri figmenta esse, homo quidem et equus sunt etiam nobis non cogitantibus, sed genus, et propositio, et syllogismus, ubinam sunt, nisi quando ab nobis fiunt? Nobis nihil horum cogitantibus nullum horum est'.

[14] Cf. Ibid. c. 6 C–E: 'Huius autem differentiae ea est ratio, quod nomina primae notionis res significant prout sunt: ideo illud, quod per illa significatur, etiam nobis non cogitantibus esse dicitur, quemadmodum sine ulla nostra cogitatione animal et stirpem, et elementa existere videmus: at nomina secundae notionis res significant, prout a nobis mente concipiuntur, non prout extra mentem sunt, propterea conceptus potius conceptuum, quam conceptus rerum significant, unde secundi conceptus et secundae notiones appellatae sunt: opera igitur, atque figmenta animi nostri iure nuncupantur'.

[15] Cf. Ibid. c. 6 E–7 A.

rerum consideratarum conditione'.[16] However, Zabarella explains, a particular kind of logic, the *logica utens*, may in one sense be considered a science: this is the logic 'quia potest philosophiae et rebus cognitu dignis applicari, et earum scientiam parere'.[17] Nonetheless not all logic is applied to science, but only demonstrative or apodictic logic.[18]

Thus Zabarella denies that dialectics could be in some way a science, allowing that possibility only to apodictic logic. Zabarella also denies that the *logica docens* is a science because it is not applied and does not concern any object of knowledge. Rather it determines in a peculiar way the a priori rules and principles of the *logica utens*. Zabarella gives a clear example of the interconnection between *logica docens* and *logica utens* in regard to natural philosophy: if a philosopher aims to acquire scientific knowledge of things, he should first consider the method to use in order to know (*logica docens*), and then he should apply it to the things which he aims to know (*logica utens*).[19] From this example we can understand that Zabarella conceives logic mainly as a method or an instrument in the service of science. Zabarella has not yet explained why logic is not an art. But the explanation is quite simple. With an art, the result of an operation is distinct from the operator and it is often associated with matter, while logical operations are entirely immanent in the mind.[20] Finally, Zabarella denies the possibility that logic is a faculty, because it concerns both contemplative and operative disciplines and because every intellectual habit refers to an operation of the mind.

Zabarella therefore defines logic as an instrumental discipline or habit: 'proinde genus logicae esse disciplinam instrumentalem, seu habitum instrumentalem'.[21] In particular, logic is a habit concerning *secundae notiones*, for 'secundae notionis instrumenta dicuntur: quoniam conceptus, qui per eas significantur, sunt instrumenta nostri intellectus'.[22] The value of logic consists in its capacity to order

[16] Ibid. c. 8 B.

[17] Ibid. c. 10 F–11 A.

[18] Cf. Ibid. c. 14 A: 'ut vero applicatur rebus, est vere scientia, non quidem scientia, quae dicatur logica, sed sit scientia naturalis, vel geometrica, vel alia, quoniam scientia naturalis nihil aliud est quae ea pars logicae, quae demonstrativa dicitur, ad contemplationem rerum naturalium, et ad earum scientiam ex earum propriis principiis comparandam applicata'.

[19] Cf. Ibid. c. 11 D–E: 'simili ratione philosophus volens ad rerum scientiam pervenire, viam prius meditatur, quae eo ducere possit; qua inventa, per eam ad rerum contemplationem progreditur, et meditationem illam praecedentem in usu ponere dicitur. Meditatio quidem viae logicae est, quae dicitur docens; executio vero et usus est ipsamet philosophia: et quemadmodum qui futurum iter meditatur, nullum adhuc iter facit, ita philosophus dum logicae cognitionem tradit, nullam adhuc scientiam alicuius rei parit, sed praecepta tantum et modum docet, quo scientia est adipiscendi: scire autem, seu scientia tradere tunc incipit, quando incipit uti, et ex habitu logicae in rebus philosophari'.

[20] Cf. Ibid. c. 17 B–C: 'ideo eius operatio est immanens, et omnino, ac vere immanens, quia in ipsa mente, in qua inest habitus logicae, ea operatio manet sine ulla communicatione cum corpore; est etiam operatio illa sine ulla materia: ipso namque intellectu, qui nullo corporeo organo utitur'.

[21] Ibid. c. 21 A–B.

[22] Ibid. c. 21 F–22 A.

concepts in the mind, and in its universal character which pertains to every mind, even though minds are determined by history and culture in a variety of ways, and for this last reason logic differs also from grammar.[23] In conclusion logic teaches 'quomodo conceptus rerum disponendo sint, ut ex notis cognitionem ignotorum adipiscamur'.[24]

If logic is an instrument of science, and has as its subject the *secundae notiones* derived from the *primae notiones*, which are the subject of science, it is possible to say that both logic and science have the same subject, i.e., the entirety of reality, but consider it differently.[25] For the natural philosopher, *secundae notiones* are the known subject of demonstration, while for the logician they are a subject of operations and must be produced. But what exactly does it mean to differ in the way of considering something? What does it mean to be a 'subject of operations'? Zabarella makes it clear by defining the subject of the science as the whole of reality, and stating that it has two parts: (1) a material part which is the *res considerata*, i.e. the object of the investigation, which is or can be common to several sciences; (2) a formal part which is the *modus considerandi*, i.e. the perspective through which this object is considered and which is specific to each science. The *modus considerandi* has the property of 'narrowing' the *res considerata* because it limits the generality of the thing, making it the subject of a specific science.[26] In an operative discipline such as ethics, the subject is the end, and so it seems that the *modus considerandi* is the real subject, which in contemplative disciplines like metaphysics seems to be rather the *res considerata*. So, what is the real subject of contemplative and operative disciplines? Zabarella answers that the subject of contemplative disciplines is the subject of the demonstration, i.e. *subiectum de quo*, while the subject of operative disciplines is properly the subject of the operations of

[23] Cf. Ibid. c. 23 A–B: 'Logica vero alia ratione instrumentum dicitur … in conceptibus ordinandis tota eius natura consistit; propterea una et eadem est omnibus gentibus et nationibus: quia apud omnes homines iidem sunt conceptus, tametsi non iisdem vocibus, neque iisdem literis apud omnes significaentur'.

[24] Ibid. c. 24 A.

[25] Cf. Ibid. c. 48 E–F: 'Hoc eodem discrimine logicus a philosopho diffidet in rerum consideratione; abveo enim non quidem hanc, vel illam rem sibi considerandam sumit, sed omnes: res igitur omnes considerat philosophus, res omnes logicus; ille ut eas cognoscat; hic ut in eis secundas notiones effingat, quae instrumenta cognoscendi sint: ibi quidem sunt subiectum demonstrationis; hic vero operationis'.

[26] Cf. Ibid. c. 39 D–F: 'unam veluti materiam, quae dicitur res considerata; alterum veluti formam, quae dicitur ratio, et modus considerandi; res quidem considerata non est cuiusque scientiae propria, sed potest ei cum aliis esse communis; modus autem considerandi cuique proprius est, et rem consideratam restringit, quae ipsa per se communis erat: ita in operatricibus solemus subiectum a fine restrictum nominare: ut dicimus subiectum in arte medica esse corpus humanum ut sanandum; videtur enim operatricis disciplinae subiectum rei consideratae in contemplativa, et finis operatricis modo considerandi illius proportione quadam respondere'. Cf. Riccardo Pozzo, 'Res considerata and modus considerandi rem: Averroes, Aquinas, Jacopo Zabarella and Cornelius Martini on Reduplication', *Medioevo*, 24 (1998), 151–176.

the mind, i.e. *subiectum in quo*.[27] Consequently, logic would be according to Zabarella an operative discipline, whose real subject is the end, which is, as we have seen, the ordering of concepts to acquire scientific knowledge—it is towards scientific knowledge that logic works.

To summarize: for the natural philosopher, concepts or concepts of concepts are what is known, while for the logician they are the subjects of mental operations. However, what is known as the subject of a demonstration cannot disregard what is subject to the operations, because the subject of the demonstration is known by those concepts that are ordered by the method of knowledge. This means that if the *primae notiones* are the ontological foundations of the *secundae notiones*, then the epistemological validity of the *primae notiones*—i.e., what Zabarella is seeking in his attempt to establish a new scientific method—is given by the *secundae notiones*. The *primae notiones* make us aware that the thing exists, and give us ontological certainty; however, the knowledge of the thing is guaranteed not by the *primae notiones*, but by the *secundae notiones*. Therefore, according to Zabarella, the mind is to guarantee the epistemological validity of the world, not the world in itself. In this specific way, logic deals properly with the *modus considerandi* by means of which the *res considerata* is known. The knowledge of the *res considerata*, although it is an ontological given, is posterior to the operations of the mind. Zabarella is therefore emphasizing the importance of the subjectivity of knowledge, by which he means the primacy of the mind over the world. Massimo Campanini rightly says that 'in science, "truth" rests on discourse rather on the objective truth external to the mind'.[28] Zabarella stresses 'the centrality of the active role of the subject in the construction of knowledge'.[29] However, we must not think that Zabarella is elaborating a form of idealism, because from his standpoint there is always a correspondence between the mind and the world, between *primae notiones* and *secundae notiones*. Ultimately, Zabarella is an ontological realist, but also an epistemological subjectivist. As Poppi puts it, 'all the notions and rules of logic are nothing other than truth regarding things in themselves or their corresponding concept, because they are underlying and concealed by the second notions of genus, species, demonstration, etc.…'[30] But such truth is grounded not on the things in themselves, but on mental concepts of them: the existence is given, the truth is discovered.

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[27] Cf. Ibid. c. 39–40 E–A: 'Quale igitur subiectum habeant scientiae contemplativae, quale disciplinae operatrices, ex his manifestum est nos autem ut alterum ab altero sine ulla confusione distinguamus, propriis utraque nominibus appellabimus, subiectum quidem quale scientiae habent, subiectum demonstrationis vocabimus, seu subiectum de quo: de ipso enim affectiones per principia demonstrantur; subiectum vero quale operatrices habent, vocabimus subiectum operationis, sive subiectum in quo; in eo enim operandum est, et efficiendum aliquid'.

[28] Massimo Campanini, 'Realtà della natura e verità del conoscere in Jacopo Zabarella', *Annali della Facoltà di Lettere e Filosofia dell'Università degli Studi di Milano*, 39 (1986), 51–72, esp. 53.

[29] Ibid.

[30] Poppi, *La dottrina della scienza in Giacomo Zabarella*, 148.

Zabarella concludes, then, that logic can be nothing other than an instrumental habit, namely a philosophical discipline which elaborates *secundae notiones* instrumental to knowing the truth and distinguishing it from falsehood.[31] If the epistemological validity of the ontological reality is grounded on the operations of mind, whose logic works on concepts, we can conclude that the study of these operations is essential for the understanding of science itself and its method. Indeed, Zabarella begins the second book of the *De natura logicae* with an analysis of mental operations. There are three principal operations: apprehension, enunciation and discourse and they are all in a strict relationship of subordination.[32] However, we must be careful not to misinterpret when we say that the logician deals with the three fundamental operations of the mind because their study pertains in the first place to psychology: logicians consider mental operations only in relation to the notions (i.e. *secundae notiones*), which are products of reflexion of those operations.[33]

If we want to investigate scientific method appropriately, we first need to know how these mental operations work psychologically in order to understand their logical function.

4.2 Knowledge and Experience

Zabarella deals with the operations of the mind from a psychological point of view in *De sensu agente*, in *De specibus intelligibilibus* and in *De ordine intelligendi*, which are included in *De rebus naturalibus libri triginta*. Broadly, the first treatise deals with the problem of sensation, the second with the object of the understanding, and third with the relation between these two faculties insofar as the sensible knowledge becomes intellectual knowledge. The transition from sensible object to intelligible species is of paramount importance for Zabarella's logical and epistemological theory, as is evident from the *Oratio in exordio lectionis philosophiae*, a preliminary lecture to the course of natural philosophy begun in Padua on 6th November 1585.[34] Almost all of the *Oratio* aims to show that, besides knowledge by divine revelation, there is also human knowledge, which proceeds from the senses

[31] Cf. Ibid. c. 52, B–C: 'est enim logica habitus intellectualis instrumentalis, seu disciplina instrumentalis ab philosophis ex philosophiae habitu genita, quae secundas notiones in conceptibus rerum fingit et fabricat, ut sint intrumenta quibus in omni re verum cognoscatur et falso discernatur'.

[32] Cf. Zabarella, *Opera logica*, c. 54 C–D: 'dixerunt tres esse nostri intellectus operationes ita dispositas, ut et prima ad secundam, et secundam ad tertiam tanquam pars ad totum referatur: prima est simplicium apprehensio … secunda est enunciatio, quae in affirmationem et negationem dividitur, quas etiam compositionem et divisionem vocant; tertia demum est ratiocinatio et discursus'.

[33] Cf. Poppi, *La dottrina della scienza in Jacopo Zabarella*, 136.

[34] Jacopo Zabarella, 'Una Oratio programmatica di G. Zabarella', *Rivista critica di storia della filosofia*, 3 (1966), 286–290.

to the understanding.[35] Zabarella established very clearly that all knowledge which leads to science, and which is not derived from revelation, is 'deduced' from the senses, even if it is initially imperfect and erroneous.[36]

All knowledge proceeds from sensation, but the process demands further analysis. Unlike many Scholastic philosophers, Zabarella here explicitly follows the Greek commentators, and in particular Alexander of Aphrodisias, according to whom sensation suffers and acts.[37] Zabarella is particularly interested in the active aspect of sensation as a judging faculty: 'sentire, hoc autem est iudicare, quod est agere'.[38] Zabarella is undoubtedly referring to sensation as an innate judging faculty (δύναμις σύμφυτον κριτική) as Aristotle expounds in the *Analytica Posteriora* II.19.[39] We must understand, he argues, how sensation is active as a discriminating faculty. For Zabarella sensation can be active in the same way that the understanding can be active: the understanding becomes the intelligible object, just as sensation becomes the sensible object, and this is the proper meaning of judgement. Judgement is a specific operation of the mind which is, according to Zabarella, the real effective cause (*effectrix*) of that operation by emanation.[40] The process of judgement is a form of emanation because sensation is affected by the external object, which is considered only for its form and not for its matter, and in the mind

[35] Cf. Ibid. 287: 'Quoniam nihil aliud esse videtur philosophari nisi rerum omnium quae sciri a nobis possint et digna cognitu sint scientiam indagare, et rei ignotae cognitio non requiritur nisi ex aliqua praecedente cognitione, proinde ex aliquibus principiis notis, oportuit philosophiam universam et quamlibet eius partem propriis niti principiis, quorum ope ad reliquorum demonstrationem progrediamur; ipsorum autem principiorum notitia (ut ait Aristoteles) non est nobis naturaliter insita, sed adventitia, liquide humana mens rudis penitus et omni cognitione carens nascitur, instar tabella in qua nihil scriptum sit, quamobrem cum ducere se ipsa non possit de potestate ad actum, necesse est ut aliunde principiorum cognitionem recipiat; ipse quidem Aristoteles putavit ab solis sensibus, at nos rectius sentientes dicimus vel ab sensu vel ab divina revelatione'.

[36] Cf. Ibid. 287–288: 'Tota namque humanis viribus nititur et eius principia … ab sensibus deducta sunt, quo circa et imperfecta admodum est et aliquo errore non caret, nec per eam omnino discimus quid secundum veritatem asserendum credendumque sit, sed solum ad quos terminos ratio nos humana perducat … nosque naturalibus viribus nostris nixi ab sensibus ad insensibilia cognoscenda progredi ratione duce debeamus'.

[37] Cf. Zabarella, *Opera logica*, c. 851 C–E: 'sequendam esse arbitror Graecorum sententiam, quam passim apud eos legimus in libris de Anima, et apud Alexandrum in I. suo de anima in libro in capite de intellectu practico et speculativo, et quam plures recentiores sequuti sunt; quum eadem sit facultas sensibilis, quae et agat, et patiatur variis rationibus: quum enim eadem anima duobus muneribus fungatur; tum informet organum, quod sine ipsa non esset organum nisi aequivoce; tum organo ab se informato utatur ad operandum: ratione prioris muneris patitur, proprium enim organi officium est speciem recipere, et pati, ideo anima sensibilis quatenus dat esse organo, constituit proprium receptivum speciei sensilis, et ad hanc receptionem refertur anima ut ratio recipiendi: facta autem receptione anima utitur organo dum speciem in eo receptam iudicat: itaque recipere est organi animati, iudicare autem est solius animae; et ratione iudicii anima dicitur agere, quia nihil aliud est, quam sensionem producere'.

[38] Ibid. c. 851 F.

[39] Cf. Aristotle, *Analytica posteriora*, II.19, 99 b 35.

[40] Cf. Zabarella, *Opera logica*, c. 853 C–F: 'intellectum intelligendo fieri rem intellectam, et sensum sentiendo fieri ipsum sensile … hoc igitur iudicare, et fieri rem ipsam iudicatam est proprium animae opus et anima est eius causa effectrix … per solam emanationem'.

itself this stimulation produces the sensible object, making what could have been anything *in potentia*, a determinate and specific thing in actuality. For this reason the operation of sensation is a form of judgment, because it distinguishes what had previously been indistinct from all other objects of knowledge. Sensation is an efficient cause by emanation because, even if affected by external objects, everything is immanent and internal to the mind; it is not an operation on the matter of the object of knowledge.[41] The acquisition by emanation of the sensible object is possible for Zabarella through a process of absorption (*imbibere*), which is characteristic of sensation: sensation absorbs the form of the sensible object, distinguishing it from matter and creating in the mind a particular image of the object.[42]

In conclusion, according to Zabarella, Thomas Aquinas' interpretation of Aristotle that sensation is only a kind of a passive affection is false. This is also proven by experience, which, in this specific case, provides evidence and support to the theory, for the mind is not aware of everything that it can actually see or hear, and that could affect it, but only of what it pays attention to, i.e. what it judges and discerns.[43]

Sensible knowledge, however, to form the basis of science, must first become intellectual knowledge, and this is possible only by the absorption of the sensible object at first as images (*phantasmata*) and then as an intelligible object, through a process of intellection.[44] From what Zabarella states, the intelligible species is generated in the moment of intellection,[45] so that the intelligible species and the act of intellection are one and the same thing; the distinction between them is only one of reason.[46] If there is identity between intellection and the intelligible species, and if scientific knowledge is based on the knowledge of intelligible species, we can

[41] Cf. Ibid. c. 854 A–B: 'agens enim per emanationem non agit in aliud, sed necessario in seipsum, emanat enim ab illo operatio, et in ipsomet remanet, ideo talis agentis actio nunquam est transiens, sed semper immanens … hoc modo anima est sensionis causa effectrix per emanationem'. On sensation as a judging faculty and as an inner, specific activity of the mind see James B. South, 'Zabarella and the Intentionality of Sensation', *Rivista di storia della filosofia*, 57 (2002), 5–25.

[42] Cf. Zabarella, *De rebus naturalibus libri XXX*, c. 854 B: 'Recepta igitur oculo coloris specie, cuius effectrix causa est color materialis externus, emanat ab ipsa natura animae ut in sua substantia imbibat illam speciem, et fiat spiritaliter color ille, quem sentire dicitur'.

[43] Cf. Ibid. c. 852 A, D: 'quare non est verum id quod a Thoma pro comperto assumitur, Aristot. nunquam dixisse sentire esse agere sed solum pati. … Hoc idem comprobatur argumento satis manifesto sumpto ab experientia: nam saepe contingit ut rem coloratam ob oculos apposita non videamus, quia liceat fiat impressio speciei in oculo (nullo enim existente impedimento id negari non potest) attamen anima aliis rebus intenta, speciem illam non iudicat: non sola igitur speciei receptio est visio, sed etiam iudicatio'.

[44] Cf. Ibid. c. 983 E: 'ita phantasmata quando lumine intellectus agentis sunt illustrata, et constituta in esse claro, et expresso, apparent intellectui, et nihil in eo imprimunt, sed intellectus fit res illa quam intelligit, et haec dicitur intellectio'.

[45] On the doctrine of species intelligibilis see Leen Spruit, *Species intelligibilis. From Perception to Knowledge. Volume 2. Renaissance Controversies, Later Scholasticism, and the Elimination of the Intelligible Species in Modern Philosophy* (Leiden, 1995), 225–236.

[46] Cf. Zabarella, *De rebus naturalibus libri XXX*, c. 989 A–B: 'discrimen est solum secundum rationem, hoc est, secundum diversas considerationes: nam si referatur ad ipsum intellectum, in quo est, et a quo iudicatur dicitur intellectio; si vero ad obiectum externum, vocatur species et imago illius, seu illud ipsum spiritaliter'.

argue that the mind acquires knowledge only in the act of intellection. But this is not possible for Zabarella, because, as we have seen, science is a habit that remains independent of the act of intellection. Intellection is only the final stage of the process of knowledge from particulars, the act of apprehension of the species, which, however, depends entirely on the habit which the intellect has acquired through experience.

The task of the treatise *De ordine intelligendi* is to explain the transition from the sensible to the intelligible object, clarifying the ambiguous relation between the habit of principles (i.e. the intellect) and the act of intellection.

First of all, according to Zabarella, the transition from the sensible to the intelligible object is guaranteed by the continuity of the process of knowledge and by the subordination of the faculties of the mind: 'quicquid cognoscit facultas inferior, cognoscat etiam superior, et ut ubi inferior facultas definit, illic superior incipiat'.[47] In other words, what is apprehended by sensation, the lowest faculty of knowledge, i.e., the singular object, is apprehended also by imagination, a higher faculty of knowledge.[48] The difference between sensation and imagination is that the former always works in the presence of the object, while the latter always works in the absence of the object. In turn, what is apprehended by imagination is also apprehended by the highest faculty, the intellect. Therefore the sensible object, through the image, is contained in the intelligible object, and the intellect can know the concrete singular object.[49] The difference between sensation, imagination and intellect lies in the fact that the latter acquires a universal knowledge, from which the other two faculties are precluded.

Zabarella offers further evidence for the capacity of the intellect to know singular objects, based on the mind's self-awareness of its own intellective act.[50] When the intellect knows its act of intellection, which is always singular with regard to the objects apprehended, the intellect knows not a universal but a particular thing. Therefore, Zabarella concludes, the intellect can also acquire knowledge of particulars.

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[47] Ibid. c. 1044 D.

[48] Cf. Ibid. c. 1044 E–F: 'hoc autem manifestum est in phantasia respectu sensuum externorum; ipsa enim potest illa omnia imaginari: quae possunt illi sentire; differunt autem, quia sensus externi non sentiunt obiectum absens, sed solum praesens, phantasia vero imaginatur etiam absentia: haec tamen differentia non ita accipienda est, ut dicamus sensus sentire sola praesentia, phantasiam vero sola absentia, falsum enim est, sed ut sensus sentiat sola praesentia, phantasia vero et praesentia et absentia: sic enim distinguenda est facultas animae superior ab inferiore, ut possit omnia cognoscere, quae cognoscit inferior, et alia praetera'.

[49] Cf. Ibid. c. 1044 E–1045 A: 'Quoniam igitur ut sensus ad phantasiam, ita phantasia ad intellectum dirigitur, eiusmodi debet esse discrimen intellectus, et phantasia, et sensuum omnium, ut intellectus conoscere illa omnia possit, quae phantasia, et sensu cognoscunt, et alia quoque praeter illa, quoniam igitur phantasia et sensus cognoscunt singularia, debet intellectus quoque singularia cognoscere, et praeterea universalia, quae nec phantasia, nec sensus cognoscit'.

[50] Cf. Ibid. c. 1045 E–1046 A: 'Possumus praeterea sic argumentari: intellectus suam intellectionem cognoscit, omnis autem intellectio est particularis, ergo quando cognoscit se nunc rem hanc intelligere, cognoscit intellectionem particularem'.

The question now is to understand what kind of knowledge this intellectual knowledge of a particular object is. In regard to this problem, Zabarella recalls what Aristotle says in *De anima* III.4, 429 b 10–22 concerning the knowledge of the flesh.[51] Intellectual knowledge of the singular is rough and confused and does not need the intervention of the active intellect, but is exclusively grounded on imagination. However, if we want to understand the essence (i.e. the universal concept) of particulars, the intervention of the active intellect becomes essential.[52]

Being rough and confused, the intellectual knowledge of particulars cannot be considered a scientific knowledge, but simply 'a necessary stage, although transitory, to ascend to the final knowledge of the universal concept'.[53] Knowledge of singular things is necessary and indispensable in acquiring the knowledge of universal concepts and essences.[54] The transition from the intellectual knowledge of the particular to the intellectual knowledge of the universal corresponds to the transition from rough and confused knowledge to perfect and distinct knowledge. Indeed, all knowledge of objects, which Zabarella calls 'actual knowledge', is either confused or distinct: 'omnis nostra actualis cognitio vel confusa est, vel distincta'.[55] The difference between confused and distinct knowledge is that the former case is knowledge 'that something exists', while the latter is knowledge of 'what it is'.[56] Intellectual knowledge of a particular is therefore only confused knowledge of the existence of that particular, and not the knowledge of the universal, of the cause or essence of the particular. Confused knowledge of the particular proceeds from a general concept to the universal concept by means of its definition. Therefore, for instance, when the mind knows a particular horse, at first it knows that it is an animal, then a quadruped and finally a horse, with all the essential properties that pertain to it.[57] Only after this analytical process, writes Zabarella, following Aristotle's statement in the proem of the *Physica*, will the mind acquire a distinct knowledge of the thing.

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[51] Cf. Ibid. c. 1046 E–F: 'mentem nostram ad singulare cognoscendum non egere intellectu agente, sed solo phantasiae ministerio illud cognoscere, tanquam totum quoddam rude atque confusum, hoc enim ab intellectu comprehenditur etiam sine ope intellectus agentis'.

[52] Cf. Ibid. c. 1046 F: 'sed ad intelligendam rei essentiam indigere alio, scilicet intellectu agente confusum illud illuminante; seu (quod idem est) eodem sensu aliter se habente, hoc est, phantasia ab intellectu agente illuminata, nam phantasma ab agente illustratum imprimit in intellectu etiam speciem universalis, et essentiae rei'.

[53] Poppi, *La dottrina della scienza in Giacomo Zabarella*, 111.

[54] Cf. Zabarella, *De rebus naturalibus libri triginta*, c. 1049 F: 'recte igitur constituitur operatio intellectus in cognitione universalium, quia haec est praecipua, et finalis eius operatio, quum cognitio singularium sit potius medium quoddam necessarium, sine quo ad universalium cognitionem pervenire non posset'.

[55] Ibid. c. 1060 D.

[56] Cf. Ibid. c. 1060 E–F: 'rei simplicis cognitionem habemus confusam quando cognoscimus ipsam esse, et ignoramus quid sit; distinctam vero quando etiam quid sit cognoscimus; rem autem complexam confuse cognoscere est ignorata causa nosse solum quod sit, distincte vero est cognoscere propter quid'.

[57] Cf. Ibid. c. 1061 A–B.

Zabarella, however, has not yet explained how it is possible, beginning with the particular, to get from the actual knowledge of the universal to true scientific knowledge as an intellectual habit. In other words, Zabarella has only explained how the cognitive process of one experience works, but not how all the experiences add up to the science. Zabarella solves the problem by distinguishing actual knowledge into original and habitual. Original knowledge is when the mind first apprehends what was previously unknown, while habitual knowledge is when the thing was already known and is recalled by memory for a clearer knowledge of what the mind is actually apprehending from experience.[58] In this way, Zabarella explains how the knowledge of the universal (as an intelligible species) remains in the mind beyond the actual act of intellection—this is the foundation of science. Poppi rightly says that Zabarella 'is dealing with a new subjective disposition, which inheres permanently in the intellect, and not an objective element like the species, which persists outside of the mind'.[59] Undoubtedly, Zabarella emphasizes the subjective aspect of knowledge in the constitution of science, because science is a habit which the mind acquires with the exercise of the intellect, starting from the apprehension of particulars throughout its life. The shift of interest is clear: Zabarella aims to determine the subjective conditions by means of which objective knowledge and science are made possible. However, it would be a mistake to believe that Zabarella confines the problem of subjectivity to the acquired knowledge of the intellect. In fact, if it is true that 'the general concept precedes in knowledge the intellectual knowledge of the specific universal concept',[60] then the capacity to distinguish the differences between things of which the mind has experience pertains to sensation, so that the 'the intellectual order of reason seems to be modelled on the perceptive order of the senses'.[61] Sensation as a judging faculty is able to manifest the distinctive differences of a general confused perception.[62] Zabarella gives sensation a fundamental role in the acquisition of knowledge, not only as the origin of the matter of knowledge

[58] Cf. Ibid. c. 1061 B–D: 'cognitio nostra actualis confusa duplex est, una originalis, altera vero habitualis; rectius enim habitualis appellatur illa, quae fit ex habitu iampridem acquisito, ut quando ego equum actu intelligo, cuius notitiam iampridem in pueritia acquisivi, quam mera aptitudo ad habitus comparandos; intellectus enim postquam contraxit habitus, postest res actu contemplari quando vult; ideo eam actualem cognitionem, quae fit ex habitu, voco in praesentia cognitionem habitualem: sed quando primum concepi animo equum, illa fuit prima origo impressionis illius conceptus, eamque in praesentia appello cognitionem originalem'.

[59] Poppi, *La dottrina della scienza in Giacomo Zabarella*, 107.

[60] Ibid. 117.

[61] Ibid. 118.

[62] Cf. Zabarella, *De rebus naturalibus libri triginta*, c. 1067 B–E: 'pueri primum non distinguunt equum ab asino, neque ab bove; sed eos omnes eodem nomine boves vocant, quia rudem illam animalis figuram, et motum conspicantur, videntque illud commune accidens, quod hi omnes currum trahunt; at particularia lineament figurae singulorum, et particulares motuum conditiones nondum discernunt, hae namque differentiae continent illas, quare maiorem iudicandi vim in sensu requirunt, ut videantur. … [intellectu et sensu] cognoscunt enim non solum patiendo, sed etiam agendo, hoc est, receptam speciem iudicando: vis autem iudicatrix in principio debilis est, nec potest illa statim iudicare, quae plures differentias continent, sed prius iudicat singulas differentias, et per gradus pervenit ad cognitionem perfectam, qua omnes simul differentias comprehendit'.

itself, but also because in conjunction with the intellect it forms general concepts, which after further analysis become universal concepts. Moreover, Zabarella makes clear that intellection is not an operation that forms the confused general concept, but rather it is the process that designates the distinct apprehension of an intelligible species; intellection always works according to induction, which proceeds from particulars. Finally, intellection is not a form of intuition or immediate understanding, as it was for Plato, but simply the act of the intellect. But the intellect for Zabarella is first and foremost the *habitus principiorum*, therefore intellection itself is determined by the acquisition of this intellectual habit. This preliminary examination of the psychology of knowledge is fundamental, because only through its correct comprehension is it possible to understand how the principles of science are discovered, on which Zabarella elaborates all his methodological doctrines.

4.3 The Habit of Principles and the Induction

In his commentary to the *Analytica posteriora* II.19, Zabarella explains how the first principles can be apprehended by means of intellection. In particular, Zabarella shows how this habit is formed through the repetition of the cognitive process which proceeds from particulars to universals. Zabarella makes explicit that as a habit, the 'habitus principiorum non esse in nobis naturaliter insitos, sed ab nobis iam natis acquiri'.[63] Such a statement, Zabarella concedes, may appear to contradict Aristotle's words according to which all disciplines begin from previous knowledge. But Zabarella shows that these two statements are not, in fact, contradictory, for it is true that every discipline begins from previous knowledge, but such knowledge is not of the same kind as that concerning the habit of principles, i.e., the intellect. The knowledge preceding that of the intellect is the sensible knowledge which we have examined in the previous section.[64] Sensible knowledge is a lower form of knowledge and serves intellectual knowledge, as sensation serves the intellect. The task of sensation is to provide the intellect with the prior knowledge that Aristotle designates as typical of every discipline. Meaningfully, Zabarella adds that the method by which the mind acquires prior knowledge, which will be further elaborated by the understanding, is a kind of inductive knowledge. At the end of his commentary, as we shall see, Zabarella takes up the problem of induction; but for now it is noteworthy that there is a sharp distinction between induction, which provides knowledge to the understanding by means of sensation, and intellection, which is the action of the intellect on knowledge provided by induction. It is clear therefore that all intellectual

[63] Zabarella, *Opera logica*, c. 1264 D.

[64] Cf. Ibid. c. 1266 B–C: 'inferior, et ignobilior, et quae respectu horum habituum sit potius serva, et ministra, quam domina: haec autem est facultas sensibilis, cujus cognitio est praevia ipsi acquisitioni habituum primorum principiorum, et ita habitus principiorum acquiruntur in nobis ex praecedente sensuum cognitione, et methodus, qua aquiruntur est inductio'.

knowledge is based on sensible knowledge, and that the validity of the former rests on that of the latter. Furthermore, Zabarella argues that sensible knowledge can provide firm and solid knowledge to the extent that it is particularly developed and perspicacious as a judging faculty.[65] Sensible knowledge provides a kind of certainty that is different from that of intellectual knowledge. Sensible knowledge is accurate and precise (*exquisita*) when, 'cum diligente observatione, et cum magna attentione, proinde cum magna certitudine, quantam dare sensus potest, acquisita fit'.[66] According to Zabarella, diligent and careful observation plays a central role in the constitution of certainty in sensible knowledge. However, Zabarella does not deny that sensible knowledge is less firm and solid than intellectual knowledge, which is the only one that can be called *perfecta*, because it is knowledge of universal concepts, i.e. of the causes of things, while 'sensus non cognoscit nisi quod sit'.[67] The epistemological difference between sensible and intellectual knowledge regarding the certainty of the known thing is that the former knows *that the thing is*, while the latter knows *what it is*. This distinction was connected in the *De ordine intelligendi* to the distinction between confused and distinct knowledge, to which corresponded respectively sensible and intellectual knowledge. Therefore we can conclude that, for Zabarella, sensible knowledge (of an object's existence) is solid and precise (*exquisita*), although confused, while intellectual knowledge (of the object's cause) is perfect and distinct. However, we must keep in mind that, according to Zabarella, intellectual knowledge is grounded on sensible knowledge, therefore the perfection of the intellectual knowledge depends on the certainty of the sensible knowledge, even though the first and supreme causes do not depend on other causes.[68] Ultimately, every cognitive process is based on sensation, which must provide solid knowledge to the intellect, which in turn discovers the first causes by means of resolution or analysis.

Once Zabarella has determined the different degrees of certainty and perfection of sensible and intellectual knowledge, he summarizes the process of transition from one to the other: the mind proceeds from sensation to imagination, from imagination to memory, from memory to the intellect.[69] The long repetition of this process and the retention of images in the memory constitute experience, which is a

[65] Cf. Ibid. c. 1266 D–E: 'obijcere aliquis posset, cognitionem, quae sensu habetur, certissimam videri, et certiorem cognitione mentali, quandoquidem sensus in iudicando proprio objecto non decipitur'.

[66] Ibid. c. 1266 E–F.

[67] Ibid. c. 1266 F–1267 A.

[68] Cf. Ibid. c. 1267 A: 'scientia demonstrativa exquisitior est, quam ea, quae per sensum habetur, et inter plures scientias illa est exquisitior, et perfectior, quae ex prioribus, ac superioribus causis fit: exquisitissima autem omnium ea, quae resolvit rem in causas primas, quae a prioribus causis non pendeant'.

[69] Cf. Ibid. c. 1269 D: 'ex sensu fit imaginatio, et speciei impressio in memoria, ex hac postea fit intellectio: dum enim phantasia idolum in memoria servatum imaginatur, producit in intellectu speciem, quare sicut ab ipsa re movetur sensus, ita movetur phantasia ab sensu, et intellectus ab phantasia'.

collection of individual memories.[70] Experience, in the intellect, generates universal concepts, which are the principles of all arts and sciences.[71]

Zabarella must still face two problems. The first concerns the nature of these universal concepts and the second is to account for the Aristotelian statement that universal concepts exist in the mind. To the first problem, Zabarella answers that 'horum memoriam servans dicitur expertus esse, et ex hac experientia format in intellectu hoc universale … ex ipsa experientia singularium gignitur universale in intellectu'.[72] It is important to pay attention to Zabarella's words in characterizing the formation of the universal concept, which is generated from the several particular cases which the subject has experienced. What is fundamental, and occurs again within a few lines, is that the universal concept is made or generated *in intellectu*, and not *by* the intellect. This reinforces the idea that the universal concept issues by induction, proceeding from sensible to intellectual knowledge, and that intellection is only the act of knowledge of this universal concept, *not* the act that produces it. This analysis also helps to answer the second problem. In *De specibus intelligibilibus* the universal concept as intelligible species was such only at the moment of the intellection. If Aristotle was right that universal concepts exist in the mind, we should conclude either that there is a permanent intellection, or that universal concepts have an existence independent of intellection itself, but this latter position, as we have seen, had already been rejected. Zabarella solves the problem by referring to what Aristotle says in *De anima* III.1. The universal concept exists in the mind in the sense that the cognitive transition from sensible to intellectual knowledge leads to new knowledge.[73] As we have already mentioned, according to Zabarella there is a radical difference between the general concept apprehended by induction and the universal specific concept (*species intelligibiles*) apprehended by intellection. The general inductive concept is a *universale post multa*, while the universal specific concept is a *universale in multis.*[74] The universal *post multa* is drawn

[70] Cf. Ibid. c. 1269 D–E: 'Ex hac facultatum serie colligit Aristoteles fieri ex sensus memoriam, ex memoria vero, quae saepe fiat eiusdem rei, experientiam; quandoquidem multae numero memoriae unam experientiam constituunt'.

[71] Cf. Ibid. c. 1269 E–F: 'memoria plurium singularium eiusdem speciei una experientiam facit, ex qua inquit Aristoteles oriri universale in intellectu, quod artis et scientiae principium est'.

[72] Ibid. c. 1269 F–1270 A, 1270 B.

[73] Cf. Ibid. c. 1270 E–F: 'species rerum in intellectu esse velocis transmutationis, et non fixas. Ego puto quietem hic significare finem illius transitus de una facultate animae ad aliam facultatem, de quo supra meminimus, qui est motus quidam, nam res movet sensum, sensus movet phantasiam, phantasia movet intellectum: universale autem in intellectu dicitur quiescere'.

[74] Cf. Ibid. c. 1272 A–B: 'per universale intelligere id, quod est unum praeter singularia, et repraesentat naturam illam comune, quae in singularibus omnibus una, et eadem est, tale enim est universale in animo ex individuis collectum, quod dicitur universale post multa, de quo nunco sermo est, cui extra animum respondet universale in multis, hoc est natura communis, quae in singularibus una et eadem inest: hoc autem fortasse adiecit Aristoteles, ne crederemus hoc universale esse omnino extra singularia, quale a Platone ponebatur: est enim reipsa in individuis; illud autem, quod est in animo, est eius repraesentativum'.

from the particular elements which are collected in this 'common nature', because they have some similar characteristics and can be classified in a wider set than that constituted by the singular element—that is, they can be grouped into a general concept. This universal has the peculiarity of deriving from sensation, which is a singular act, in that it perceives things individually. By its own nature, sensation tends towards universal concepts, which are apprehended by abstraction depriving the singular thing of its own individual characteristic and revealing the 'common nature'.[75] However, such a 'common nature' does not necessarily designate a universal concept, which is the cause and the essence of the thing, but rather a confused general concept of the mind as a representation of the several particular things. The universal concept *in multis*, instead, is the form that inheres in singular things in themselves, and therefore the real universal concept. Such a *universale in multis* is known not by induction from sensible particulars, but only at the end of the demonstrative process.

Regarding the inductive process which is grounded on sensation and forms the *universale post multa*, Zabarella states that it is the same process that the mind uses to discover first principles.[76] Knowledge of principles is grounded on sensible knowledge of particulars, although, he adds, these principles are not really universal, since the general universal concept is not the same as the specific universal concept. In fact, only 'conclusiones quidem ex principiorum cognitione notae fiunt, principia vero universalia'.[77] Real universal principles are the conclusions of a demonstration; when it is not possible to demonstrate them by already known principles, induction is necessary to discover them.[78] This means, in a general way, that all principles, at least initially, are discovered by induction, because the same conclusions of a demonstration, which serve as principles, are deduced from other principles, which in turn were either conclusions of another demonstration or discovered by induction. Since the reasoning would lead to an infinite regress, and the mind must ground its knowledge on actual first principles, it is clear that all principles are discovered by induction.

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[75] Cf. Ibid. c. 1275 C–D, 1276 C–D: 'ipsum sentiendi actum non esse nisi rei singularis, ut ipse apertae asservit in loco praedicto, sed ipsam sensus naturam ad universale dirigi … potest itaque intellectus per vim abstrahendi, quam habet, separare universale, quod ibi latet, ab conditionibus individuantibus, et ipsum expresse concipere ut universale; hoc autem facit, dum plura singularia similia condita in memoria contemplatur, et inter se comparat: inspecta enim natura communi in qua conveniunt, colligit illud universale, quod vocatur post multa'.

[76] Cf. Ibid. c. 1277 B–C: 'Ex his omnibus tandem Aristoteles colligit, qualis sit haec methodus, qua prima principia cognoscuntur, et inquit eam esse inductionem: ex particularibus enim universale colligere est inductionem facere, et addit esse necessarium, ut principia [*inductione cognoscantur*] quia nulla ratione fieri potest, ut mens nostra cognoscat aliquod universale nisi ab sensu, et ab particularibus ea cognitio ortum duxerit'.

[77] Ibid. c. 1277 C.

[78] Cf. Ibid. c. 1277 C–D: 'quando demonstrari per alia priora principia non possunt, per inductionem cognoscantur oportet, hoc autem est ex seipsis innotescere ut ex notioribus in particulari'.

Zabarella explains that the knowledge of principles is acquired by means of induction beginning from sensible knowledge.[79] Induction, however, should not be understood as a syllogism that demonstrates unknown things by means of prior knowledge, but as a process that notifies the transition of the knowledge of one and the same thing, from sensation to the intellect. Ultimately, induction is the process by which particulars are comprehended under the general universal concept, but properly it does not create new knowledge beyond what the mind has already acquired by sensation. In other words, induction does not employ a proper middle term, as syllogism does, to infer something new from the given premises. The premises discovered by sensation are notified to the intellect differently from how they were presented to the senses, but the content of the knowledge is the same.[80] In a brief but significant remark, Zabarella calls this kind of induction, following Averroes, as demonstrative induction, to distinguish it from dialectical induction, examined by Aristotle in the *Topica*.[81]

Demonstrative induction does not require a complete enumeration because after the observation of a few particular cases the mind grasps the essential connection between the subject and the predicate, which constitutes the universal concept. This is possible because what is predicated essentially (*per se*) in the singular case can always be predicated of all the other members of the same class that is universal (*de omni*).[82] Such an induction, however, is not a real syllogistic demonstration, but, as we have previously said, only a clarification of things already known by sensation. Demonstrative induction, as we shall see in the next paragraph, is considered by Zabarella as one of the two methods of the *resolutio*, which in turn is one of the

[79] Cf. Ibid. c. 1277 D–F: 'principiorum cognitione … non est tamen innata, sed acquisita per inductionem in pueritia, etsi tempus huius inductionis non animadvertimus … Per inductione principia universalia cognoscuntur, quia et sensus hoc modo producit in intellectu ipsum universale; quamvis enim proprie solus intellectus faciat universale, attamen non sine ministerio sensus offerentis particularia, quamobrem modo quodam etiam sensus dicitur facere universale, quatenus praebet inchoamentum et primum initium productionis universalis: dat enim intellectui assumptum inductionis, ex quo universale colligatur'.

[80] Cf. Ibid. c. 1281 D–E: 'inductionem non esse rationem, qua res tanquam ignota ex alia notiore probetur, sed potius esse notificationem rei per seipsam et transitum rei per se notae ab sensu ad intellectum'. On the causality of the 'middle' see Poppi, *La dottrina della scienza in Giacomo Zabarella*, 255–266; Dominique Bouillon, *L'interprétation de Jacques Zabarella le Philosophe. Une étude historique logique et critique sur la règle du moyen terme dans les* Opera logica *(1579)* (Paris, 2009), 364–460.

[81] Cf. Ibid.: 'esse notificationem rei per seipsam et transitum rei per se notae ab sensu ad intellectum; in quo transitu id quoque est summa animadversione dignum, quod in omnibus eiusmodi principijs est essentialis connexus praedicati cum subiecto, quod Averroes saepe dicit de inductione demonstrativa'.

[82] Cf. Ibid. c. 1281 E–F: 'quum enim in materia necessaria inductionem facimus, non enumeramus omnia singularia quia in paucis intellectus incipit conspicari essentialem connexum duorum, ideo neglecta reliquorum individuorum enumeratione statim ex illis paucis colligit universale, necessaria enim est illatio a praedicatione per se ad praedicationem de omni; ideo in quibusdam est ita manifestus essentialis terminorum connexus, ut ex individuis admodum paucis, immo etiam fortasse ex uno colligatur universale'.

two parts of the regressive method. In order to understand the role of induction within the regressive method and its difference from the syllogism, we must carefully examine the nature of induction in general. Zabarella offers a brief but complete account of induction in the *Tabulae logicae*, where he states that induction is a logical instrument proceeding from known particulars to explain unknown things. Furthermore, he adds that there are two kinds of induction to accomplish this task, perfect and imperfect.[83]

Induction is perfect when the mind considers all the particular cases and therefore the conclusion is necessary, so much that induction itself can be reduced to the syllogistic form. It is, however, imperfect, if the mind infers from only several cases, knowing that there are many more of them, which could confute the validity of the conclusion. Perfect induction, however, does not always demand a complete enumeration of the particular cases, but there exists a peculiar kind of perfect induction grounded on the observation of just a few particular cases—this, precisely, is demonstrative induction.[84] In conclusion, according to Zabarella, there are three kinds of induction: (1) dialectical imperfect induction; (2) dialectical perfect induction; (3) demonstrative perfect induction.

Once he has established that induction is the process through which the mind grasps principles, constituted in the intellect as general universal concepts, it is possible for Zabarella to deal with demonstration as an instrument of science, namely, to elaborate his theory of scientific method.

4.4 Scientific Method

Zabarella's methodology has been the subject of many historiographical investigations,[85] aiming to assess its analogy with the methodology of the modern science.

First of all, it is worth emphasizing once again that Zabarella's method is grounded on sensation, which provides all knowledge to the intellect. This is a very

[83] Cf. Ibid. *Tabulae logicae*, 170: 'Nemo est, qui ignoret inductionem esse logicum instrumentum, quo ex particularibus notioribus ostenditur universale ignotius, eamque duplicem esse. Perfectam, quae necessario concludit, quia sumit omnia particularia, ut si supponamus non dari alium individuum hominem praeter hos tres, Petrum, Socratem, & Platonem, haec erit inductio perfecta. Imperfectam, quae non necessario concludit, quia non sumit omnia particularia, ut si supponamus dari alios singulares homines praeter Petrum, Socratem, et Platonem, haec erit inductio imperfecta. Petrus, Socrates, et Plato sunt bipedes, Ergo omnis homo est bipedes'.

[84] Cf. Ibid. 171: 'Fiat autem duobus modis inductio perfecta. (1) Quandoque nominantur sigillatim, et expresse omnia individua, ut si omnium hominum, qui nunc extant, nomina exprimamus et postea colligamus omnem hominem esse bipedem. (2) Quandoque non nominantur omnia expresse, sed aliqua tantum exprimuntur, reliqua vero implicite denotamus brevitatis gratia per dictionem aliquam distributivam, ut dicendo, Petrus est bipes, et Socrates est bipes, et quilibet alius, seu singulus alius homo est bipes, ergo omnis homo est bipes. Talis est inductio Arist. in princip. primi lib. Posteriorum'.

[85] For a general overview on Zabarella's scientific method cf. Heikki Mikkeli, 'Jacopo Zabarella (1533–1589): The Structure and Method of Scientific Knowledge', in Paul R. Blum (ed.), *Philosophers of the Renaissance* (Washington, 2010), 181–191.

important remark because it characterizes essentially the way in which Zabarella conceives method as the process from sensation to what is most knowable by nature, namely the causes of the things and the universal concepts. Without reference to sensation, the Zabarellan method would be reduced to a mere intellectualism and not to a real method of discovery.

Zabarella makes clear his doctrine in his commentary to the proem of Aristotle's *Physica*, distinguishing a real method of learning (*via doctrinae*) from the order of learning (*ordo doctrinae*). Such a distinction, as we shall see in the next chapter, is fundamental to the difference between the method of Zabarella and his followers, and that of Platonic scholars like Francesco Piccolomini,[86] and of Ramists like William Temple. Zabarella states that method is a logical instrument leading to the discovery of something unknown, while order is not an inferential process, but simply arranges knowledge.[87] Furthermore, method follows the syllogistic discourse, so much that syllogism itself can be considered as the method of science, if it deduces from necessary premises. In all his logical treatises, Zabarella emphasizes that the method of science is syllogism, but he never denies the epistemological role of induction as a logical instrument. In fact, as we have seen, perfect induction could be reduced to a syllogism and in particular, demonstrative induction gives to a syllogism the principles on which the demonstration is grounded.

In *De methodis* Zabarella distinguishes the order from method; the former 'arranges', while the latter 'notifies': 'propterea dicunt proprium esse ordinis disponere, methodi autem notificare'.[88] Notification, not by chance, is the proper function that Zabarella assigns to demonstrative induction and it is in this element that the real distinction between method and order lies. Method discovers new knowledge, order does not: 'the utility and aim of method consist in the notification of unknown things, namely in the acquisition of new knowledge, while order does not provide new knowledge, but is limited to a better and clearer articulation of the various concepts of a science'.[89]

In starting from what is more knowable by us, i.e. the input of the senses, Zabarella rejects the common assumption of humanistic logic that it is always necessary to start from what is first in nature. For the humanists, the logical order 'had to imitate the system of nature, in other words, the doctrinal system espoused by a philosopher had to be the copy of the objective system of things, both in their being

[86] Cf. Ragnisco, 'La polemica tra Francesco Piccolomini e Giacomo Zabarella nella Università di Padova', 1226–1252;

[87] Cf. Jacopo Zabarella, *Opera physica* (Verona, 2009), 7: 'Via est processus a noto ad ignotum per discursum syllogisticum; ubi enim et necessaria illatio huius ex hoc per aliquod logicum instrumentum ea vocatur methodus, seu via doctrinae. … enim est via, quia per formam syllogismi a principiis notis ducit nos per necessarium processum ad conclusionem cognitionis ignotae. … Ordo vero non est syllogismus, neque processus illativus unius rei ex alia, et solum est dispositio conveniens omnium partium scientiae'.

[88] Zabarella, *Opera logica*, c. 139 C.

[89] Poppi, *La dottrina della scienza in Giacomo Zabarella*, 172.

and in their formation'.[90] Zabarella, instead, 'kept his eyes fixed more on man, who knows in his own way, than on the absolute objective order'.[91] Zabarella is clearly distinguishing an ontological order from an epistemological order. In the cognitive process the mind cannot proceed from causes, which are primary in nature—or there would not *be* any process, since everything would already be known. The principles of scientific method are not ontological principles or *principia essendi*, but rather *principia cognoscendi*, which make possible the knowledge of things as they appear to the knowing subject.[92] With this detachment of the epistemological level from the ontological level, which we have already seen in the distinction between *primae notiones* and *secundae notiones*, Zabarella lays the foundation for a science completely independent from metaphysics, which considers the being of the things. His science rests on logic and epistemology, whose interest is only in explaining the things that appear to the senses. Zabarella's standpoint defines the shift of philosophical interest in world and man from the first term to the second.[93] Method, as we have already said, is an 'intellectuale instrumentum facies ex notis cognitionem ignoti'[94] and for Zabarella it can be either resolutive (analytic) or compositive (synthetic or demonstrative). Analytic method proceeds from effects to causes,[95] while synthetic method proceeds from first causes to effects.[96] Analytic method is related to synthetic method as sensible knowledge is related to intellectual knowledge. Synthetic method is superior to analytic because its demonstrative power is superior, starting from the knowledge of causes; analytic method 'serves' synthetic method.[97] In particular, synthetic method is superior because its end is not simply the discovery of first principles, but the knowledge of things, i.e. effects, by means of causes. Furthermore, Zabarella adds, if the principles were already known, analytic method would be useless.

In Zabarella's exposition, however, we must not confuse what is superior because it leads to 'perfectam scientiam, quae est rei cognitio per suam causam',[98] with what is more fundamental. The entire logical system of Zabarella is grounded on analytic

[90] Crescini, *Le origini del metodo analitico. Il Cinquecento*, 183.

[91] Ibid.

[92] Cf. Zabarella, *Opera logica*, c. 504 F–505 C.

[93] Cf. Crescini, *Le origini del metodo analitico. Il Cinquecento*, 173.

[94] Zabarella, *Opera logica*, c. 224 F–225 A.

[95] Cf. Ibid. c. 268 D: 'methodus resolutiva est syllogismus ex propositionibus necesariis constans, qui ab rebus posterioribus et effectis notioribus ad priorum et causarum inventionem ducit'.

[96] Cf. Ibid. c. 268 C: 'methodus demonstrativa est syllogismus scientiam pariens ex propositionibus necessarijs, medio carentibus notioribus, et causis conclusionis'.

[97] Cf. Ibid. c. 266 D–E: 'hic fit ut methodus resolutiva sit serva demonstrativae et ad eam dirigatur. Non enim finem talem resolutio habet, quo invento quiescamus, sed ab quo invento exordium compositionis sumamus; principia enim ideo per resolutionem indagamus, ut per ea cognita effectus consequentes demonstremus. Ultimus enim finis et scopus omnium qui in scientiis speculativis versantur est per methodum demonstrativam duci ab principiorum cognitione ad scientiam perfectam effectuum qui ab illis principiis prodeunt'.

[98] Ibid. c. 267 D.

method, whose end is invention and discovery.[99] Synthetic method cannot work without a previous analytic method: it is possible to conceive the latter without the former, but not the opposite. Indeed, even if the principles were already known and the synthetic method were sufficient, these principles were previously discovered by the analytic method or else they were postulated. In this last case, there would not be properly a real scientific knowledge.

Analytic method is therefore the inventive method *par excellence*. As I have said, however, the main inventive method is demonstrative induction. Therefore it would be logical to conclude that demonstrative induction is the analytic method, and Cassirer and many other scholars have interpreted Zabarella's scientific method in this way.[100] However, Zabarella's doctrine of analytic method is much more complex than this. He states that there are two kinds of resolutive method: (1) demonstrative induction, and (2) demonstration from effects (*ab effectu*).[101] Demonstration *ab effectu* is for Zabarella a more effective form of resolution than induction, which is defined as the 'processus ab posterioribus ad priora: quia universale est natura prius particularibus, et habet ratione causae: ideo ab particularibus ad universale progredi, est ab posterioribus ad priora procedere'.[102] Starting from this concept of induction, Zabarella characterizes demonstration *ab effectu* as a demonstration *ab signo*, namely that which Aristotle called demonstration τοῦ ὅτι, in Latin *demonstratio quod* or *quia* or 'what something is'. Furthermore, he states that demonstration *ab effectu* is more effective because it discovers the principles, which are unknown by nature, and which induction is unable to discover.[103] The difference between induction and demonstration *ab effectu* can more easily be understood, 'si intelligatur quidam sit notum, vel ignotum secundum naturam'.[104] The sensible is known by nature (of the mind), as both particular and universal, while unknown by nature is that

[99] Cf. Ibid.

[100] Cf. Alistair C. Crombie, *Augustine to Galileo: The History of Science, A.D. 400–1650* (London, 1952); Id., *Robert Grosseteste and the Origins of Experimental Science 1100–1700* (Oxford, 1953), 299; Harold Skulsky, 'Paduan Epistemology and the Doctrine of the One Mind', *Journal of the History of Philosophy*, 6 (1968), 341–361; Antonio Pérez-Ramos, *Francis Bacon's Idea of Science and the Maker's Knowledge Tradition* (Oxford, 1988), 230–236.

[101] Cf. Zabarella, *Opera logica*, c. 268 F–269 A: 'Methodus autem resolutiva in duas species dividitur efficacitate inter se plurimum discrepantes, altera est demonstratio ab effectu, quae in sui muneris functione est efficacissima, et ea utimur ad eorum, quae valde obscura, et abscondita sunt, inventionem; altera est inductio, quae est multo debilior resolutio, et ad eorum tantummodo inventionem usitata, quae non penitus ignota sunt, et levi egent declaratione'.

[102] Ibid. c. 269 C–D.

[103] Cf. Ibid. c. 269 D–E: 'est autem inter has duas resolutiones magnum discrimen: quia inductione non inveniuntur nisi illa principia, quae sunt nota secundum naturam, et levi egent comprobatione: at demonstratio ab signo est multo efficacior, per eam enim illa principia inveniuntur, quae secundum naturam sunt ignota, ad quorum inventionem inductio est prorsus inutilis'.

[104] Ibid. c. 269 E. We must not confuse this distinction with the distinction between what is most knowable by us and what is most knowable by nature.

which must be demonstrated by a means, which is usually the middle term of the demonstration, and which (being unknown by nature) cannot be known directly by the light of the intellect.[105] Demonstration *ab effectu* is more effective than induction according to Zabarella because it makes the terms of the argument more explicit, using as a middle term what is known by nature and demonstrating one thing by means of another.[106]

Ultimately, induction is a self-referential analytic method, while the demonstration *ab effectu* is an analytic method by reference to something known other than the *demonstrandum*. Thus, demonstration *ab effectu* seems to be superior to induction in effectiveness, and this would be indeed the case, if it were not for the fact that demonstration *ab effectu*, as we shall see, also draws its premises from inductive demonstration.

While analytic method, as we have said, is the necessary but not sufficient condition of acquiring scientific knowledge, most of all because it provides a confused knowledge of a thing's existence, synthetic method demonstrates the cause or essence of the thing. It is the kind of demonstration which Aristotle called τοῦ διότι and which Zabarella, following other logicians, calls demonstration *propter quid*. Unlike other logicians (including his mentor Tomitano), Zabarella argues for an identification of demonstration *propter quid* with *demonstratio potissima* (κύριον ἀποδείξιν).[107] The latter was usually considered demonstration *par excellence* because it gave reasons for both the existence and the cause of a thing, while the former gave reasons only for the cause. However, Zabarella claims, the cause cannot be demonstrated without the existence, and so demonstration *propter quid* cannot be otherwise than *demonstratio potissima*.[108]

Scientific knowledge can be acquired only in the conjunction of the analytic method (the method of invention and discovery) and the synthetic method (the demonstrative method), and in this conjunction lies the entire theory of the *regressus*. First of all, Zabarella is careful to show that *regressus* is not a vicious circle, and this is easy to grasp because the initial knowledge is confused while the final

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[105] Cf. Ibid. c. 269 F–270 A: 'notum secundum naturam illud dicitur, quod sensile est, eiusmodi autem sunt non ea solum, quae singularia sunt, sed ea quoque universalia, quorum singularia sensu percipi possunt; … contra vero ignotum secundum naturam illud dicitur, quod in suis singularibus sensile non est ideo eget alio medio notiore, per quod demonstretur; et quum ipsum proprio lumine non cognoscatur'.

[106] Cf. Ibid. c. 270 C–D: 'his igitur differentijs invicem dissident inductio et demonstratio ab effectu: utraque enim est methodus resolutiva ab rebus posterioribus ad principia progrediens; sed duo principiorum genera nobis offeruntur: alia quidem naturaliter nota sunt: ideo nullo egent instrumento logico, nisi inductione, qua sola notificantur; omnis enim nostra cognitio ab sensu originem ducit, nec potest aliquid ab nobis mente cognosci, quin prius sensu cognitum fuerit: proinde inductione omnia eiusmodi principia nobis innotescunt, nec propterea demonstrari, seu probari dicuntur … inductio autem non probat rem per aliam rem, sed modo quodam eam per se ipsam declarat'.

[107] For the reasons for distinguishing between demonstration *propter quid* and *demonstratio potissima* cf. Poppi, *La dottrina della scienza in Giacomo Zabarella*, 246–247.

[108] Cf. Zabarella, *Opera logica*, c. 460 A–461 D.

knowledge is distinct and perfect.[109] In order to explain the effectiveness of *regressus*, Zabarella gives the following example:

> ubi est generatio, ibi est subiecta materia,
> at in corpore naturali est generatio,
> ergo in corpore naturali est materia.[110]

The major premise ('ubi est generatio…') is discovered by demonstrative induction and therefore provides only a confused knowledge; the minor premise ('at in corpore…') comes from observation. Therefore the conclusion can only be confused. What the demonstration *ab effectu* demonstrates is not the cause itself, but simply that there must be a cause of the effects, perhaps the one we have obscurely recognized; this is the first part of the regressive method.[111] If the first part of the *regressus* reveals only the necessary connection between subject and predicate, we can understand why for Zabarella demonstrative induction, the logical instrument that recognizes immediately the necessary connection between subject and predicate, is one of the two resolutive methods.

In order to acquire knowledge of the effect by means of the distinct knowledge of the cause, and to demonstrate that the cause discovered by the analytic method is the one correctly pertaining to the effect, Zabarella requires a 'mental examination'.[112] Mental examination, or consideration, is constituted by two moments. The first recognizes the *existence* of the effect's cause and prepares for the discovery of that cause's essence or nature, while the second compares the cause (known confusedly) with the effect.[113] If the comparison is successful we can say that the causes and principles that we have discovered initially in a confused way, are the genuine causes and principles of the effects, now known perfectly. This is the last moment of the *regressus* and it coincides with the *demonstratio potissima*.[114]

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[109] Cf. Ibid. c. 481 A–B: 'regressus vero est inter causam et effectum, quando reciprocantur et effectus est nobis notior, quam causa, quum enim semper ab notioribus nobis progrediendum sit, prius ex effectu noto causam ignotam demonstramus, deinde causa cognita ab ea ad effectum demonstrandum regredimur, ut sciamus propter quid est'.

[110] Ibid. c. 485 B.

[111] Cf. Ibid. c. 486 C–D: 'hic itaque est primus processus in regressu, quo solam invenimus inhaerentiam causae in subiecto proposito, non tamen prout illius effectus causa est, sed ut praedicatum quoddam necessarium et inseparabile'.

[112] Ibid. c. 486 F: 'facto itaque primo processu, qui est ab effectu ad causam, antequam ab ea ad effectum retrocedamus, tertium quendam medium latore intercedere necesse est, quo ducamur in cognitionem distinctam illius causae, quae confuse tantum cognita est, hunc aliqui necessarium esse cognoscentes vocarunt negotiationem intellectus, nos mentale ipsius causae examen appellare possumus, seu mentalem considerationem'.

[113] Cf. Ibid. c. 487 A–B: 'Duo sunt, ut ego arbitror, quae nos iuvant ad causam distincte cognoscendam; unum quidem, cognitio quod est, quae nos praeparat ad inveniendum quid sit. Alterum vero, sine quo illud non sufficeret, est comparatio causae inventae cum effectu per quem inventa fuit, non quidem cognoscendo hanc esse causam, et illum esse effectum, sed solum rem hanc cum illa conferendo'.

[114] Cf. William A. Wallace, *The Modeling of Nature: Philosophy of Science and Philosophy of Nature in Synthesis* (Washington, 1996), 302–303.

4.5 Experiential Empiricism

Some conclusions may be drawn from Zabarella's conception of science and of scientific method.

First, logic, as an instrument of science, has as its main task to direct the mind in the knowledge of things. It is therefore an epistemological theory, rather than a theory of argumentation. This marks a shift of interest from the instrument which arranges knowledge to those which discover and provide new knowledge.

Second, logic is grounded on *secundae notiones*, which are a voluntary product of the mind, corresponding a priori to (and grounded in) *primae notiones*. However, truth and falsehood are never in the *primae notiones*, but rather in the *secundae notiones*—in other words, they are in the mind. In this sense, Zabarella establishes an ontological primacy of the *primae notiones* and an epistemological primacy of the *secundae notiones*. Logic, however, deals with the direction of the mind in knowing things with the aim of acquiring perfect science, which, however, remains in the mind, not in the external world. In other words, *that* the world *is*, is a matter of fact, but *how* the world *is*, depends entirely on the correct use of the mind—on logic.[115] Here we have a sharp detachment of logic and epistemology from ontology and metaphysics.

Third, Zabarella emphasizes the central role of the mind and of its function by a reevaluation of sensation, which had previously been conceived as passive and concerning only the object of knowledge; for him, it is an active judging faculty, completely immanent to the mind.[116]

Fourth, all knowledge begins from sensation and nothing innate exists in the mind, except the mind itself and its functions, which, however, are not originally developed, but are acquired with hard work and exercise over the course of time.

Fifth, all knowledge comes from experience, even intellectual knowledge: 'omnis nostra intellectualis cognitio ab inductione et a sensu pendet'.[117] Zabarella's epistemological standpoint can only be described as empiricist.

Sixth, induction is a fundamental element of Zabarella's methodology because it is the sole logical instrument that discovers first principles, which are the foundations of demonstrative argumentation from sensation. Knowledge provided by induction, however, is still confused and generic and it must be clarified and improved by means of the intellect.

Seventh, even if it is true that the intellect and intellection are what enable the final stage of scientific knowledge, because they discover universal concepts and

[115] Cf. Stephen Gaukroger, *Explanatory Structures: Concepts of Explanation in Early Physics and Philosophy* (Atlantic Highlands, 1978), 126; Gaukroger, *The Emergence of a Scientific Culture: Science and the Shaping of Modernity, 1210–1685*, 161–164.

[116] On the originality of Zabarella's doctrine of perception, cf. Leen Spruit, 'Renaissance Views of Active Perception', in Simo Knuuttila and Pekka Kärkkäinen (eds.), *Theories of Perception in Medieval and Early Modern Philosophy* (Dordrecht, 2008), 203–224.

[117] Zabarella, *Opera logica*, c. 890 B.

principles in a distinct and perfect way, such knowledge would not be possible if there were not already sensation and induction. Intellection, which is what actually grasps universal concepts, is superior and worthier because it leads to science, but sensation and induction, though inferior and ancillary, are more fundamental—the original operations on which all science is grounded.

The framework that we have proposed, examining only some elements of Zabarellan logic, leaves no doubt of interpretation. Zabarella's Aristotelianism is empirical and his scientific method cannot be explained without the appeal to experience.[118] Zabarella's Aristotelianism is therefore, using a well-known expression of Alexandre Koyré,[119] followed by Schmitt himself,[120] an *experiential empiricism*, or sensationalism, which exerted little influence on the *experimental empiricism* of modern science.[121] Nonetheless, this conception had a considerable impact on the genesis of the empiricist positions developed during the seventeenth century in the British Isles. In fact, British Aristotelians took these Zabarellan ideas and carried them to an extreme, gradually removing them from their original Aristotelian contexts and developing what would later become the fundamental ideas of 'British empiricism'.

[118] Gilbert, who for a long time combatted Cassirer's thesis of Zabarella's empiricism, has finally admitted, albeit in a footnote, the empirical character of Zabarella's methodology. Cf. Gilbert, *Renaissance Concepts of Method*, 173.

[119] Cf. Alexandre Koyré, *Metaphysics and Measurement. Essays in Scientific Revolution* (London, 1968), 90.

[120] Cf. Charles B. Schmitt, 'Experience and Experiment: A Comparison of Zabarella's View with Galileo's in De Motu', *Studies in the Renaissance*, 16 (1969), 80–138,

[121] For a more complex account of Zabarella's theory of experience, cf. Gabriele Baroncini, *Forme di esperienza e rivoluzione scientifica* (Florence, 1992), 39–62. Baroncini reconstructs three notions of experience in Zabarella: (1) *experientia principium scientiae*, general experience which starts from particulars and leads to universals, that is, a kind of apprehension of the intelligible which coincides with the inductive process of experience to establish the first principles of scientific discourse; (2) *experientia imperfecta*, which deals with the question of 'an sit', making use of observations rather than scientific explanations; (3) *experientia singulare*, which is used to confute past theories or general assertions. In particular, Baroncini locates a quasi-experimental use of the concept of experience in Zabarella's commentary on the *Physica*; see Zabarella, *Opera physica*, 525: 'aegritudo denotatur in facultate discursiva si rejecto testimonio sensus de re sensibile quaerert aliquis rationem dimisso sensu, non enim datur ratio melior sensu de re sensili, immo ipsa quoque demonstratio sumit fundamentum a sensu'.

Chapter 5
Early Aristotelianism Between Humanism and Ramism

5.1 Aristotelianism, Humanism and Scholasticism

Early British Aristotelianism, after the momentous medieval Scholastic systematization of Aristotelian philosophy, was defined by its position against humanistic logic and Ramism. It was not a particularly advanced form of Aristotelianism and chiefly involved commentaries on Aristotelian texts, but it rejected any kind of rhetorical and dialectical logic that did not serve science.

The protagonists of this early period of Aristotelianism were Richard Stanyhurst, Everard Digby and John Case. It is hard to say whether these logicians were acquainted with the development of Paduan and Continental logic. This is because in their logical works they were not inclined to mention Paduan Aristotelians, and because their interpretation of some central Aristotelian issues diverged consistently from those of the Continent. Nonetheless, we can find explicit traces of Paduan Aristotelianism in other works of the time not strictly connected with logic, and we know that Paduan logical doctrines were well known in their intellectual context. If there was a Paduan influence on these Aristotelian scholars, it must have been weak and bland. However, the doctrines of such Aristotelians with their conception of logic as an instrument of science certainly paved the way for a more systematic appropriation of the ideas of Continental Aristotelianism in the following decades.

The first genuine Aristotelian of the period was the Dubliner Richard Stanyhurst, who was educated at Oxford. His most important work is undoubtedly the 1570 *Harmonia seu catena dialectica*, which is according to Schmitt 'an impressive piece of scholarship comparing favourably with the very best work being done on the Continent at the same time'.[1] This work was the first exposition of the Aristotelian logical system available in the British Isles in the sixteenth century.[2]

[1] Schmitt, *John Case and Aristotelianism in Renaissance England*, 43.

[2] Cf. Colm Lennon, *Richard Stanihurst the Dubliner 1547–1618* (Blackrock, 1981), 26–33.

M. Sgarbi, *The Aristotelian Tradition and the Rise of British Empiricism*,
Studies in History and Philosophy of Science 32, DOI 10.1007/978-94-007-4951-1_5,

The *Harmonia* was too early to make use of Zabarella's ideas, and its sources were mostly scholastic and humanistic, as the author reveals in his introduction. However, what most characterizes his work is its copious use of the Greek commentators. This is an absolute novelty in the field of sixteenth-century logic in the British Isles, marking a radical break with humanistic logic, whose ancient sources were only Cicero and Quintilian. Stanyhurst's work was commissioned by Edmund Campion (1540–1581),[3] and it was probably the immediate result of Oxford's *Nova statuta*, since Campion himself taught at St John's. In fact, Stanyhurst's *Harmonia* is a commentary on and exposition of Porphyry's *Isagoge*, the standard introduction to the study of Aristotelian logic.

The study of Porphyrian logic is important according to Stanyhurst because it is propaedeutic to the acquisition of scientific knowledge. Starting only with the constituent blocks of logic, it is possible to establish the entire system of science, and this system is grounded on the primitive and simple terms of necessary argumentation, namely the ten categories and the predicables. In this context, Stanyhurst discusses the problem of scientific method in way much like the Paduan Aristotelians, which is probably the result of reading Giunti's edition of Aristotle. Stanyhurst sharply distinguishes the *ordo naturae* from the *ordo doctrinae*.[4] *Ordo naturae* is the kind of order that immediately explains the dependency between the part and the whole, the effect and the cause, the accident and the subject, and so on. The *ordo doctrinae*, instead, is the order that proceeds from general things to specific things, from known things to unknown things. This preliminary methodological remark, though extemporaneous, is very significant for understanding Stanyhurst's Aristotelian position against Ramist logic, in which *ordo naturae* and *ordo doctrinae* coincided. From this twofold methodological attitude it is possible to make two kinds of description, a *descriptio essentialis* and a *descriptio adventitia*: the former is properly a definition, the latter is a description, which begins from the accidents. It is noteworthy that in his brief methodological *excursus* Stanyhurst states that every scientific argument that seeks causes and universal concepts, namely essences, is a *descriptio essentialis*, which is properly called *demonstratio potissima*, a Scholastic definition; in the context of the investigation of scientific method this seems to refer directly to the Paduan Aristotelian doctrines. The most interesting aspect of Stanyhurst's logic is its final achievement in the interpretation of Porphyry. Stanyhurst strenuously defends the Aristotelian standpoint on the problem of universals, proposing a conceptualistic interpretation to match the methodology I have just mentioned.[5]

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[3] Cf. Stanyhurst, *Harmonia seu catena dialectica in Porphyrianas institutiones*, D1r, 'Elencus autorum quorum testimonijs usi sumus'.

[4] Cf. Ibid. 4: 'Natura itaque ordo est, quo partes totum, causa effectum, subiectum proprium aut accidens, & generatim omne ab quo quicquam dependet, illud quod ab ipso est dependes praecedit. Ordo doctrinae expostulat, ut communiora praecedant minus communia, notiora minus nota. Speciei proprij accidentisque cognitio, earumque rerum tractatio et ad definiendum'.

[5] Cf. Ibid. 210: 'quadruplex est universale, causae, ideae, formae, et intentionis. Universale causae, est causa diversarum rerum singularum producta, quae quidem aeque sub speciebus diversis continetur, et hoc modo Deus et Angeli universalia dicuntur: atque huiusmodi universalium meminit

Ultimately, universals are concepts of the mind which designate a common nature. They are causes and principles of the various singular things. They are ideas, not as separate realities (as in Plato), but as examples to which many singular things can refer. They are the common form of things because they inhere in the specific matter. They are *intentiones* as concepts and the subject of logic. Stanyhurst's Aristotelian standpoint comes quite clearly from Paul of Venice's conceptualistic exposition of the theory of universals,[6] showing that the doctrines of Oxford logic were still being discussed and debated during the 1570s.

Stanyhurst's work succeeds in presenting so important and difficult an issue as the exposition of the elementary blocks of logic; it also refers to the newest publications on the topic, making it a cutting-edge textbook. But because it entirely lacked a theory of reasoning and was too sophisticated for an introductory course on logic, Stanyhurst's textbook was completely useless in class and was seen as a throwback to the medieval commentators of Oxford.

5.2 Digby's Eclectic Aristotelianism and Anti-Ramist Polemic

The first important British Aristotelian of the sixteenth century was Everard Digby, who 'set the tone for the new enthusiasm for Aristotle'.[7] In his two works, the *Theoria analytica* (1579) and the *De duplici methodo libri duo* (1580), Digby aims to defend Aristotelian logic against the Ramist positions circulating in Cambridge.[8] Digby is clearly an Aristotelian scholar, but it is hard to say whether his ideas come from Padua or not, because the Paduans are never mentioned in his two logical

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Aristoteles cum illa cognitu esse difficillima concederet. Universale ideae est quoddam exemplar omnium individuorum, quae eidem Speciei subijciuntur: et hac ratione Plato, hominem universum, equum communem, intelligentias esse voluit, ab individuis suis in orbe signorum separatas ac avulsas. Haec platonica universalia refellit Aristoteles: ideas hoc loco valere iubeamus, nihil enim quam nugae, et quasi inanes cantiones sunt. Universale formae est natura communis ab suis Individuis participata, ut humanitas in singulis hominibus existens. Universale intentionis est conceptus, qui in multis uno modo dici potest: atque huiusmodi universalia significavit Porphyrius, cum posuit tantum quinque voces communes esse, cuiusmodi sunt, genus, species, differentia, proprium et accidens. Cum dicat Aristoteles, universale aut nihil esse, aut rebus singulis posterius, universale post rem significavit. … universalia non esse substantias, vult universalia non esse substantias per se, atque propria vi existentes, quemadmodum male opinatus erat Plato, sed suis rebus singulis inesse'.

[6] On Paul of Venice's Aristotelian conceptualistic idea of the universals cf. Bottin, *Paolo Veneto e il problema degli universali*, 459–468.

[7] Schmitt, *John Case and Aristotelianism in Renaissance England*, 49.

[8] Probably Digby was influenced by Jacques Charpentier's criticism against Ramus, cf. Cesare Vasoli, *La dialettica e la retorica dell'Umanesimo. Invenzione e metodo nella cultura del XV e del XVI secolo* (Milan, 1968), 469–473, 530–535; Mack, *A History of Renaissance Rhetoric 1380–1620*, 154.

writings. Nonetheless, all of Digby's works appeared in the years immediately after the publication of Zabarella's *Opera logica* in 1578, and so it is not possible to exclude a direct influence.

The *Theoria analytica* is the first British work of logic of any originality and complexity after the Oxford scholastic elaborations. It is eminently an Aristotelian work, referring frequently to the Greek Aristotelian commentators, but it does not neglect the Platonic and Neoplatonic sources, which are also mentioned copiously. Indeed, Digby's exposition of the theory of science is a mixture, often confused, of Aristotelian, Scholastic and Platonic doctrines, which makes it hard to define the author's views and his role in the history of logic. One problem is that Digby terminologically confuses analysis with synthesis and often uses the terms 'science' and 'logic' interchangeably.[9] This may be the best evidence that Digby did not read the works of Paduan Aristotelianism. However, in Digby's own writings, regarding these doctrinal confusions, we can also recognize a development of his knowledge of methodological doctrines, which will be more accurate in subsequent works, probably in reaction to his controversy with William Temple.

The most interesting elements and ideas are in the first two books, where Digby presents the general outline of his logical and epistemological thought. Digby summarizes the methodological problem at the beginning of his research in two questions: 'Philosophum differre docere, ut via ab Athenis ad Thebas, et ab Thebis ad Athenas? Aliudque obscurum ad naturam, aliud ad nos … quorum hoc Genesis, illud Analysis?'.[10] These two questions reveal many interesting aspects of Digby's conception of logic. First, when Digby refers to the road from Athens to Thebes and vice versa, he is referring to a well-known example of Aristotle in *Physica* III.3, which concerns the twofold way of method. Digby asks whether the way from Athens, which represents the man's familiar hometown, to Thebes, an unknown town, is the same in both directions. Obviously, Digby is not asking an ontological question. Rather, he is wondering whether the method that proceeds from the known to the unknown is the same as the method that proceeds from the unknown to the known. Digby's answer is quite clear from his following question, that is, there are two distinct methods: (1) the first method proceeds from what is more known to what is less known and this is called genesis or synthesis; (2) the second method proceeds from what is less known to what is more known and this is called analysis. Digby inverts the traditional Aristotelian dichotomy of synthesis and analysis, following Socrates' suggestion in the *Phaedrus*, when the Greek philosopher labels synthesis the composition of singulars to form a whole.[11] Thus Digby calls the process from particulars to universals 'synthesis', while the process from universals to particulars is called 'analysis'. Analysis, after all, is a form of resolution, that is, an operation that divides and separates the compound into simple parts. Digby then

[9] On Digby's confused terminology, cf. Crescini, *Le origini del metodo analitico. Il Cinquecento*, 114–115.

[10] Digby, *Theoria analytica*, 3.

[11] Cf. Ibid. 3–4. Digby is referring to Plato, *Phaedrus*, 268 D.

connects synthesis to the Aristotelian method which proceeds from what is most knowable by us to what is most knowable by nature, and, vice versa, analysis to the process from what is most knowable by nature to what is most knowable by us. It is, however, only in the second book of the *Theoria analytica* that Digby seems to develop a consistent theory of method, which answers his initial questions. Digby states that there is only one perfect method of knowing things, but it is possible only for celestial intelligences and God. The method that the natural philosophers follow is also unique, but it must be considered in a twofold way: one way proceeds from the principles and another way proceeds from the mind.[12] The human mind does not know differently regarding the order of knowledge, but knows differently according to the means (or middle term).[13] Digby's example of the return journey from Athens to Thebes makes clear his methodological positions: the Athenian who goes for the first time to Thebes and then returns home walks on the same way or path, but the walking is twofold. At the beginning, the wayfarer has an obscure knowledge of Thebes and of his journey's route. But then he sees the walls, goes into the town and discovers the institutions, customs, laws, language and way of thinking, and he begins to acquire a clearer knowledge of Thebes from these particulars. Returning home, if he climbed up a mountain, he would see Thebes from above in its totality and recognize all its particular aspects. Of this kind, Digby states, is the process of scientific knowledge: after a preliminary and confused

[12] Cf. Ibid. 91: 'Exemplo Philosophi doctus atque eductus, unam in natura perfectionem principii, unamque methodum statuo. Cuius perfectionem in statu suo quoniam nullius ingenium unquam vel effingere vel imitari poterat, oppositam rationem nostri et naturae sancientes, multiplices excogitaverunt secundum medij, non causae dispositionem, methodo: ipsas tamen in suis terminis oppositas'.

[13] Cf. Ibid. 91–92: 'unius et eiusdem Analysis diversa ratio est, discrepans sicut via ab Athenis ad Thebas, et ab Thebis ad Athenas. Habitans Thebis proficiscitur Athenas, ab Athenis ad Thebas rursum revertitur, una eadeaque semita. Ita et Artista, primo resolvendo apprehendit ulteriorem gradum esse, deinde hoc esse, postremo revertens ad notitiam prioris ex cognitione utrisque demonstrat. Quam quidem institutionem naturae ad nos, nostrique ad naturam immitati sumus, adeo ut contemplationem videntes priorem iudico, et apprehensionem doctrina, et Analysin primam lucem … Adeo ut sicut mens et discursus sese habent in scientia, eiusque principiis discendis, contemplandis, docendis: ita et deductio huius Theoriae sese habebit, ut (quod solet summus methodi solusque magister) demonstrando doceamus demonstrare, et omnis oratio ut moribus consonet. … Haec tria nempe huc redeunt: apprehendo speculando, primum intelligimus esse: hoc primum summum solumque quod quaerimus est principium et confusa praenotitia, qua primo universalia haud aliter atque Thebas querens primo intelligit esse viam, deinde haec Thebas spectare sperat, dein videt muros et propugnacula prominentia proprius accedens, intrans, inhospitans, ediscit noscitque hoc esse Thebas multaque eius esse secreti ora, ut magistratum, mores, leges, fruges, voces, vultusque, λόγως, linguasque. Paucis hic dierum commoratus, si ingeniosus sit, et sicut Ulysses πολύτροπος, rursus exit civitate, altos conscendit montes, quibus civitas circumvallatur: uno aspectu universam circumiacentem regionem intuetur: videt locum unde est egressus, et domum suam: errores adventus sui una videt corrigitque. Hac una visione propriam iam ad Thebas viam et quasi compendiaram digito designat. Non iam confuse hanc novit esse viam ad Thebas, quin directe habet, tenetque atque dexteram suam. Nec mirum cum in altam aetheris claritatem sit evectus, ubi etsi positus sit terminus itineris sui, cognitionis tamen et scientiae methodi est initum'.

research and after trial and error it is possible to know the truth directly.[14] This is in general Digby's theory of method: indeed, there is only one method, but there are two ways to consider it, and the human mind needs both to acquire scientific knowledge. Digby's methodological directions in his *Theoria analytica* are somewhat vague, but they assume a more precise form following his dispute with his Ramist colleague Temple. In his *De duplici methodo libri duo* Digby characterizes method as a twofold process because the *ordo naturae* is different from the *ordo mentis*, since 'what is most knowable by us' differs from 'what is most knowable by nature'.[15] What is 'most knowable by us' comes first in the cognitive process, while what is 'most knowable by nature' comes first in teaching, but only when the teachers already know the subject. However, what is 'most knowable by us' comes from sensation, while what is 'most knowable by nature' is the last thing that the mind knows. The former are particulars; the latter universals.[16]

The cognitive process from what is 'most knowable by us' to what is 'most knowable by nature' is the inventive method or the method of discovery and Digby usually calls it 'analysis'. Analysis can be either ascending or descending: the former proceeds from particulars to universals, while the latter proceeds from universals and explains particulars by means of syllogism.[17] Ascending analysis (or resolution), however, is not a real demonstration because it proceeds from the proximate cause to conclusions, while a real demonstration always infers from universal concepts to first causes.[18] Therefore a scientific demonstration requires the descending part (or composition)—others usually call this part synthesis, although for Digby it remains part of the analytical process. However, he argues, since every scientific demonstration is grounded on universal principles or concepts, it is important to focus on the mental act which grasps them, i.e., the act of apprehension;

[14] Cf. Ibid. 92: 'post confusam hanc inquisitionem primi, iam voti compotes facti, respicimus viam per quam ascendimus tanquam per multiplices multorum artificum methodos, errores et imperfectionem nostram videntes, quae per vagam cogitamus posita, eius lucis beneficio videt illam non modo viam qua huc est elata, verum et proximam et directam'.

[15] Cf. Digby, *De duplici methodo libri duo*, b. 1, ch. 16: 'non est idem ordo naturae et nostri: non idem notius nobis et simpliciter. … Non est ergo unica methodus, quia lucis, et tenebrarum; mentis, et sensus; nostri, et naturae; descendendi, et ascendendi; progrediendi, regrediendi; texendi, retexendi methodus non est unica'.

[16] Cf. Ibid. b. 1, ch. 19: 'Priora autem et notiora sunt bifariam. Non enim idem prius natura, et ad nos prius; neque notius, et nobis notius. Dico autem ad nos quidem priora et notiora, viciniora sensui, sempliciter vero priora et notiora, remotiora. Sunt vero remotissima quidem, universalia maxime; vicinissima autem, singularia'.

[17] Cf. Ibid. b. 1, ch. 26: 'Logici, progressionem a particulare ad universale, appellant ascensum: a superiore ad inferius, descensum. … Sive enim ab universalibus, simul demonstrantes, resolvamus; sive a toto ad partes integras: sive a fine ad media: tamen (etsi diversa ratione et modo) descendimus a confuso ad distincta, quod quidem eo respectu quo est, confusum est universale et superius in eo genere resolvendi, etsi non positive et absolute'.

[18] Cf. Ibid. b. 1, ch. 27: 'Analysin facit, qui a quaestione procedit per proximam causam, ab hac, ad tertiam; perpetuo causam aliam ex alia retexendo, donec ad primam fit denentum. Demonstrat vero, qui a causa prima descendit per proximam, reliquasque inferiores, donec quaestionem suo lumine illustret'.

otherwise the mind would proceed from what is less knowable and more obscure (i.e. the universal concept), inferring incorrectly and drawing false conclusions.[19]

In order to acquire new knowledge and to discover, the mind always proceeds from apprehension of the universal concepts grounded on sensation, making possible the knowledge of the things that are more 'knowable by us'. Sensation, as active judging and discerning faculty, lies at the foundation of the method of discovery and is the beginning of all knowledge. From sensation the mind acquires experience, many experiences constitute memory, and memory makes possible scientific knowledge. It is essentially an ascending method from sensation to the intellect.[20] Scientific knowledge, however, is acquired only by combining the ascending and the descending part of method in the *regressus* or *methodus mixta*.[21]

Digby thus distinguishes the *methodus inveniendi* from the *methodus essendi* and shifts his attention solely to the method of discovery, that is, to sensation and the apprehension of universals. In this way, he considers reality from a subjective point of view, by contrast to the Ramist position, which considered things in themselves, according to its assumption that what is 'most knowable by us' is the same as 'what is most knowable by nature'.[22] With this identification, Ramist logic neglected the importance of the empirical side of the theory of method, i.e. sensation; but this was for Digby a constituent element in the cognitive process of acquiring knowledge, so much that he calls its entire logical system 'analysis' or *theoria analytica*, because it is only by means of analysis that mind acquires new knowledge.[23]

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[19] Cf. Ibid. b. 1, ch. 30: 'Quo universalior, eo nobis confusior. Incipienti, confusio maximum est incommodum. Itaque ad discendum accedentes, magnum nobiscum plerunque apportamus malum; a distinctis enim discere incipientes, eodem momento prae universali mentis apprehensione, ad primam nos erigimus'.

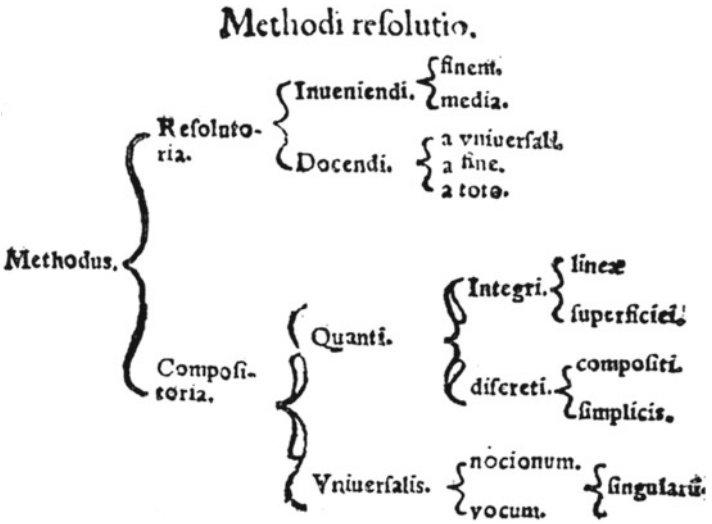
[20] Cf. Ibid. b. 1, ch. 36: 'Sensus est initium notitiae nobis prioris.… Quem quidem primae abstractionis notitiaeque esse initium […] Si nullum in nobis naturale est principium iudicandi, neque artificiose quicquam poterimus invenire; sin tale inveniatur in natura, in arte utique confirmabitur. Assero omnes habere naturalia iudicia … ex multis sensibus, fieri experientiam: experientiis, memoriam, memoriis, scientiam. … actio prima ab obiecto ad sensum, per hunc ad intellectum ascendit'.

[21] Cf. Ibid. b. 1, ch. 51: 'Omnis enim via scientifica, vel est progressio perfectionis ad nos, vel informatio nostri ad perfectionem. Quare cum altera sit alteri obscura, et altera processui alterius impedimento; qualis est illa methodus, quae ex pugnanti utriusque discrimine constat? Cuius una affectio alteri est inutilis, eius progressio, partim est regressus; eius claritas, partim obscuritas; eius Concordia a partim est discors'. Digby seems very much indebted to the Paduan Aristotelians in considering sensation as an active judging faculty and regressus as the true scientific method.

[22] Cf. Temple, *Admonitio de unica Rami methodo reiectis Caeteris retinenda*, 70: 'statuendum quae natura notiora sunt, eadem ipsa esse nobis notiora'.

[23] The thesis of the priority of the resolution of the analytic method was sustained also by the Paduan physician Girolamo Capivacci (1523–1586) in his *Opusculus de differentiis doctrinarum logicis, philosophis, atque medicis pernecessarium* (Padua, 1562), 127r–143r, which probably was Digby's source of this idea. Cf. Vasoli, 'Su alcuni problemi e discussioni logiche del Cinquecento italiano', 302–307. One piece of evidence that Capivacci was a source of Digby is the fact that both deal with resolution using the example of going back home after a journey. Capivacci states that resolution is 'vocabulum sumptum per translationem ab his qui post peregrinationem in patriam revertuntur, nam ad proprios lares, ab externis regionibus reditus resolutio vocatur', cf. Capivacci, *Opusculus*, 118v. Digby's example of the journey from Athens to Thebes and return as a resolutive procees is a clear example of Capivacci's methodology.

At the end of his *De duplici methodo libri duo*, Digby summaries his position on the analysis:



Digby's theory of method was not peacefully accepted in the academic world and already in 1580 Temple wrote his *Admonitio de unica P. Rami methodo* against his colleague at Cambridge. Temple's work helps us to understand better Digby's standpoint on methodology.

Temple responded rhetorically to Digby's exposition,[24] without directly criticizing any specific doctrine, but stirring up controversy based on logical fallacies.[25] In fact, Digby's doctrines do not differ radically from those of Temple, because in his *Theoria analytica* Digby recognizes the importance of the second part of the method, that is, the cognitive process from universals to particulars, more commonly called synthesis.

However, Digby and Temple differ in one specific point which is essential to the empiricist tradition—the problem of whether the theory of method includes the cognitive process from sensation and sensible knowledge to the intellect and the formation of the universal concepts, namely, the inductive process.

[24] Cf. Temple, *Admonitio de unica Rami methodo reiectis Caeteris retinenda*, 55: 'alia methodus initium ducit a luce, alia orditur a tenebris; alia a mente, a sensu alia; alia a nobis, alia a natura; alia descendit, alia ascendit; alia progreditur, alia regreditur; alia texit, alia retexit'.

[25] Cf. Ibid. 56: 'quae tuum ingenium (analytice methodorum architecte) tam foecundae et adipales Musae obsederunt, cum ista cudebantur? Ut methodus pro rerum disponendarum notitia et lumine conformetur, ut ab universalibus quae et ratione naturae suae et nobis sunt notissima inchoetur, ut descendat, progrediatur, et ordinem apta collocatione texat. … Quid de methodo regrediendi et a singularibus sensus perceptis ad generalia ascendendi dicam? Quid de retexendi ratione?'. Jardine rightly emphasizes Temple's 'scurrilous comment', cf. Lisa Jardine, *Francis Bacon. Discovery and the Art of Discourse* (Cambridge, 1974), 64.

Temple, a faithful Ramist, is opposed to this inclusion, while Digby, a loyal Aristotelian, is in favour.[26]

The problem emerges because Temple does not accept the distinction between what is 'most knowable by us' and what is 'most knowable by nature'. Temple's criticism is fierce, but more in its sarcastic tone than in the real effectiveness of his objections.[27] Temple disagrees with Digby and the other Aristotelians, sneering at the notion that qualities are different for us and for nature: it is hardly plausible, he argues, that what is healthy for us is not also healthy for nature, or that a colour which is bright for nature should be dark for us. Analogously, what is 'most knowable by us' must be what is 'most knowable by nature' and vice versa: 'statuendumque quae natura notiora sunt, eadem ipsa esse nobis notiora'.[28] Defending this position, as Crescini points out, implies devaluing the empirical moment in the constitution of knowledge.[29] Nevertheless Temple concedes that, if the learner fails to understand what is 'most knowable by nature', he can begin from what is 'most knowable by him', introducing *de facto* the distinction between *nobis notiora* and *natura notiora.*[30] Moreover, Temple admits also that experience and sensation are at the beginning of all scientific knowledge, but despite this concession, according

[26] Lisa Jardine's evaluation of Digby's theory of induction is a little hasty, Cf. Jardine, *Francis Bacon. Discovery and the Art of Discourse*, 59: 'In the writings of Digby, a professed Aristotelian with mystical Platonist sympathies, these tendecies are carried to an extreme. The acquisition of knowledge by induction is completely ignored, and all possible contexts for discussion of method are scrambled together in glorious confusion'. On the contrary, as I have previously shown and as I will emphasize later, Digby considers the inductive moment from the sensible objects to the universal concepts as the initial moment of his theory of method for the acquisition of new knowledge.

[27] Cf. Temple, *Admonitio de unica Rami methodo reiectis Caeteris retinenda*, 68–69: 'Notius itaque ut placet Aristoteli, duplici ratione distinguitur: aliud est notius nobis, aliud notius natura. Dico Everarde notioris partitionem istam esse ab organicae disciplinae magistro potius somniatam, quam cogitata institutam ratione et judicio. Etenim in ea modus notitiae cum homine cui res nota sit perinscite comparatur. Quid si artifex medicinae in rerum salubrium distributione diceret, alias esse hominibus salubriores, alias vero natura: annon risum prudenter intelligentibus commoveret? Si musicus e duobus sonis propositis illum acutiorem nobis, hunc natura acutiorem esse contenderet, annon Musicum istum planae derelictum a Musis esse diceres? Dic jam Digbeie hunc sonum esse natura acutissimum, sed nobis ne acutum quidem; Dic hunc colorem esse natura splendidissimum, sed nobis valde obscurum et tenebricosum videri; Dic errasse Aristotelem, cum differit id esse absolute et natura bonum, quod viro bono tale sit; id absolute salubre, quod hominibus corpore bene affectis salubre sit; et id similiter natura et absolute notum, quod nobis mente eleganter compositis notum existat'.

[28] Ibid. 70.

[29] Cf. Ibid. 70: 'Vin' in arte constituenda ut a specialissimis ad generalissima progrediamur? Eae enim tuo judicio nobis sunt notissimae. At si rebus specialissimis singulares et sensu perceptas comprehendis, ab iis artem exordiri vis quae nullam in artem excepta Astronomia cadunt'.

[30] Cf. Ibid. 66: 'Quod si discentis industriam generalium obscuritas retardaverit, est ea non modo facili interpretandi genere minuenda, sed etiam familiarissimis et illustrissimis exemplis dissipanda'.

to Temple, there is only one method.[31] Ultimately, Temple believes that all knowledge comes from sensation, but that this is not the same as saying that sensation plays a role in the method and arrangement of knowledge.[32] Sensation and induction are, according to Temple, preparatory to method but not included in it.[33] Temple denies the presence of any subjective or empirical aspect in science, arguing instead for the objectivity of knowledge; minds know nature as it actually is, and not as it presents itself to the knowing subject. If it is true, then, that 'Temple insists on the sovereignty of induction in the discovery of knowledge',[34] it is also true that, for him, the discovery and acquisition of new knowledge is not part of scientific method. This Ramist position is radically different from the conceptual elaborations of the Aristotelians and those of the first reformers of Aristotelian logic, such as Bacon, who included induction in scientific method. Moreover, Temple's view is common not only among Ramists but also among Platonists, who aim to preserve at all costs the *ordo naturae*, which alone can be known perfectly. Temple like the other Ramists favours the ontological approach at the expense of the epistemological one.

The polemic nature of Temple's work, and his rather weak arguments, induced Digby to respond in print after only a month. In his *Responsio*, Digby argues that his dispute with Temple concerns the correct interpretation of Aristotle's words; these, he claims, had been completely misinterpreted by the Ramists, who threatened to corrupt students all over Europe by teaching the existence of only one method. In particular Digby charges Temple with ignorance of Aristotelian philosophy, for otherwise he would never have supported the Ramist cause.

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[31] Cf. Ibid. 72–73: 'Verum remitto istud tibi: sit sensus principium, sit mens etiam principium scientiae et cognitionis acquirendae. Quid tum? An hinc duplex methodus existet? Hujus tam frigidae consequentiae judicium quis ita stupidae mentis est aliquando ut probet? Agnosco a sensuum observatione et rerum inductione omnem cognitionem defluisse. At vero res singulae, postquam subsidio sensuum et mentis lumine cognitae fuerint, si volumus ipsa ordine aliquo devinciri, sunt illae quidem unica Rami a generalibus methodo digerendae. Aliud est sensus mentisque benificio ad rem intelligendam pervenire: aliud res intellectas methodo disponere. Neque si acquirendae cognitionis via in multiplici genere sita sit, id circo rerum jam cognitarum dispositio in varias ac repugnantes species distinguetur. Quod si rationem parandae scientiae quae per sensum efficitur, methodum appellas, et idem de mentis ad rem cognoscendam actione statuis: duas hercle praeclaras methodos constituis: quarum utraque tantum abest a veritate methodi, quantum abesse videmus aut vanitatem contorti sophismatis a laude sapientiae, aut Everardi analyticae theoriam ab ornamentis excultissimae disciplinae'.

[32] Cf. Ibid. 75: 'omnes enim disciplinae, postquam naturae per sensum observatio acessisset, ex accurata specialium inductione per subalterna a generalissimum ascendendo effloruerunt'.

[33] Cf. Temple, *Pro Mildapetti de unica methodo*, 63 'Fieri non potest ut universalia percipiantur nisi per inductionem. Ergo … Neque enim ex universalibus scientia absque inductione, neque per inductionem sine vi sentiendi. Ergo … Aristoteles quem prius contexuit soritem, eundem deorsum versus retexit. Scientia (inquit) non existit absque universali nec universale efficitur sine inductione, nec inductio efformatur nisi accesserit sensus. Quamdiu nos inductione ista eludes? Quamdiu in scientiae investigandae praecepto delirabis, de inveniendis per inductionem generalibus confitemur: unica tamen est rerum generalium, quae inductione specialium constitutae sunt, ordine collocandarum methodus'.

[34] Jardine, *Francis Bacon. Discovery and the Art of Discourse*, 64.

Digby shows point by point that, according to Aristotle, there are two methods. First, he emphasizes that Aristotle's logic is constituted by simple terms or mental concepts, and that truth or falsehood derive from the composition or division of these terms in the mind. In composing and dividing terms, the mind forms propositions, on which is grounded the syllogism, by means of which scientific knowledge is possible. Thus, syllogism is dependent on simple terms, which are inner signs of the mind deriving from sensible particulars: all intellectual knowledge therefore depends on sensible knowledge.[35] If this reconstruction of Aristotle's logic is correct—and it is correct—then, according to Digby, it is impossible that there is only one method, as the Ramists claim. Indeed, what kind of knowledge could be organized before sensation? There must be necessarily two methods, one that acquires knowledge and one that arranges it. The objects most knowable absolutely (*simpliciter*) are the universal concepts, but those most knowable by man are those that come from sensation.[36] The entire method of invention or of discovery is characterized by the transition from sensible to intellectual knowledge.[37] Of course this method is not sufficient for scientific knowledge. In fact, the earliest intellectual knowledge is still confused and obscure; correct arrangement is necessary to transform imperfect knowledge into clear and perfect knowledge.

In support of his interpretation, Digby lists and comments on many passages of Aristotle, in which there is evidence of a twofold aspect of method such as *Ethica nicomachea* VI.3, *Physica* I.1 and III.3, *De coelo* I.2., *De anima* II.2. and III.6, and finally *Metaphysica* I.1–7. In particular, Digby comments on three passages which seem relevant to the confutation of the Ramist position. The first passage is *Metaphysica* II.1, in which Aristotle states that the difficulty of knowing things lies in the mind and not in reality itself. Therefore knowledge is subjectively conditioned by the knowing mind, and not by reality; reality is known not in itself but according to the organization of knowledge in the mind. In the second passage, *Metaphysica* II.2, Aristotle states that he who learns is different from he who already

[35] Cf. Everard Digby, *Admonitioni F. Mildapetti Navareni de unica Rami methodo retinenda, responsio* (London, 1580), 4v-5r: 'Cognitio intellectiva conclusionum fit ex praeexistenti cognitione intellectiva principiorum et cognitio intellectiva principiorum fit ex praeexistenti cognitione terminorum; cognitio vero intellectiva terminorum fit ex praeexistenti cognitione sensitiva interiori; sed cognitio sentitiva interior fit ex sensitiva cognitione exteriori; cognitio vero exterior sensitiva non fit ex praeexistenti cognitione'.

[36] Cf. Ibid. 4v: 'dico autem ad nos quidem priora et notiora viciniora sensui, simpliciter vero priora et notiora remoti ora sunt vero remotissima universalia maxime vicinissima autem singularia et opponuntur haec inter sese'.

[37] Cf. Ibid. 6r: 'Fieri non potest ut universalia percipiantur nisi per inductionem. … Neque enim ex universalibus scientia absque inductione, neque per inductionem, sine vi sentiendi … quapropter a singularibus ad universalia ascendere oportet … insito autem animalibus sensi in quibusdam formae sensibilis mansio fit, in quibusdam non fit. In quibus autem nos fit hijsce praeter ipsum sentire aut omnis cognitio nulla, aut eorum circa quae formae mansio non fit nulla … ex sensu igitur fit memoria, et memoria experientia nascitur, ab experientia notitia fit. … Neque igitur determinati habitus sunt, neque ab alijs ad cognoscendum magis aptis habitibus, sed a sensu fiunt … necesse est igitur ut ex hijs patet, ipsa prima inductione cognoscere; sic enim et sensus efficit ipsum universale in nobis'.

knows.[38] Therefore, the learner and the learned know reality very differently. However, the passage that seems to support Digby's thesis better is *De partibus animalium* I.1, in which Aristotle states that, on a given subject of investigation, it is possible to acquire scientific knowledge or to have experience alone.[39] This means that the mind knows things not according to the *ordo naturae*, but from its own standpoint and according to the purpose of its research.

In 1581 Temple replied to Digby's charge, commenting directly, passage by passage, on the Aristotelian texts alleged to support twofold method, and interpreting them from the Ramist standpoint. But here again, Temple does not give good reasons in favour of his position, but supports his thesis with rhetorical arguments alone.

Temple's interpretation diverges from Digby's on two fundamental aspects of the Aristotelian theory of knowledge. First, according to Temple, an object cannot be correctly investigated from different perspectives: there is only one correct 'method', strictly speaking. Second, it is possible to deal with scientific method only after acquiring the first principles on which the demonstration is grounded. Supporting these two assumptions, which are evidently not Aristotelian, Temple entirely renounces the subjective side of knowledge, both from the perspective of the knowing subject, and from that of the known object. Temple considers the knowing subject always capable of acquiring scientific knowledge independently of his mental development, that is, of the development of his intellectual habits. The object, instead, is considered only in relation to the scientific perspective, while all other points of view are improper or insignificant, and so to be rejected.

Digby never answered Temple because the Ramist had raised no new objections, but simply reasserted the existence of only one method. The two positions were irreconcilable, because they began from different assumptions. So who won? According to the Ramist Nathaniel Baxter, Digby was the winner. Indeed, in his *Quaestiones et responsiones in P. Rami dialecticam*, Baxter admits the existence of two methods, perfect and imperfect. Perfect method is grounded on firm axioms from which the mind deduces necessary conclusions. It proceeds from universals to particulars. It is the method of science and of the intellect, and corresponds to the order with which things are arranged in the memory. This perfect method is the Aristotelian synthesis. Imperfect method, instead, proceeds from particulars to

[38] Cf. Ibid. 7v: 'Tria adhuc restant eximia Aristotelis testimonia … Primus extat I. ca. lib. 2. Metaph. in hunc modum: cum vero difficultas duobus sit modis, fortasse causa eius non rebus sed nobis ipsis inest. … Secundus extat ca. 2. lib. 2. Metaph. item ipsum scire perimunt qui ita dicunt: non enim possibile est scire antequam ad individua deveniatur, et ipsum cognoscere non est'.

[39] Cf. Ibid. 7v-8r, 'Tertius ac ultimus est insignis locus Aristotelis, quem Ramus et Ramistae omnes sacra venerant ignorantia. Is continetur ca.I. lib. I. de partib. Animal: quem, locum si leges, facile intelliges Ramum Ramistasque hic ratiocinari a termino secundum quid ad terminum simpliciter. Nihilominus hic docet philosophus quam unicam methodum: imo nihil apertius affirmat, quam methodum scientias docendi esse duplicem, idque hijs verbis. In omni contemplandi genere, omnique tum nobiliori tum ignobiliori docendi via et ratione, duos esse habitus constat, quorum alterum scientiam rei appellasse, alterum quasi peritiam quandam bene est. Hic expressae duas nominat docendi vias, duos earum habitus ac initia contraria. Ergo non est unica methodus secundum Aristotelem'.

general propositions and corresponds to Aristotelian analysis.[40] To save the Ramist doctrine, Baxter characterizes analysis as an imperfect method, but in fact he acknowledges the existence of two distinct methods.

Well beyond being an academic dispute, the controversy between Digby and Temple shows that the Aristotelians were more interested in the method of discovery than in the method of organizing knowledge, and that their particular interest was in the subjectivity of the cognitive process and in sensation as the first source of knowledge.[41] Both authors, however, fail to consider the application of their respective methods of knowledge, their treatments remaining completely theoretical. In this sense the controversy between Temple and Digby must be inscribed within the tradition of the humanistic attempts to provide a new systematization of knowledge. Their discussions were extremely important on the one hand for the reformers of knowledge and pedagogues like Bacon, Johannes Amos Comenius (1592–1670), and Joachim Hübner (1610–1666), and on the other for the Continental systematic philosophers such as Keckermann, so much that they had also enjoyed several German editions of their works.[42] However, the real problems of early empiricists and experimental philosophers were removed from the schoolroom and from the academic disputes, in the everyday praxis of discovering new knowledge and in reading the great book of nature, a step made possible by the dissemination of the Paduan doctrines on scientific method, in which the theoretical considerations of nature were applied to concrete and specific cases. The controversy, however, had the merit of setting the tone for every following treatment of the question of scientific method, as Case's works reveal.

5.3 John Case and the Early Dissemination of Paduan Aristotelianism

The debate between Digby and Temple had a wide resonance in British logic, and marked the shift of interest away from humanist rhetoric and dialectics and from Ramist logic, towards the Aristotelian methodology. It is not wrong to say that from

[40] Cf. Nathaniel Baxter, *In Petri Rami dialecticam quaestiones et responsiones* (Frankfurt, 1588), 88; 'Methodus est dianoia variorum axiomatum, pro suae naturae claritate praepositorum, unde omnium inter se convenientia iudicatur memoriaque comprehenditur. … *Quaest*. Quotuplex est methodus? *Res.* Duplex: 1. Perfecta; 2. Imperfecta. *Quaest*. Quid est perfecta *Res.* Qua utimur, quoties perspicue res docenda est. Itaque disponetur ex homogeneis axiomatis, primo loco absoluta notione primum, secundi secundum, tertio tertium, et sic deinceps, … *Quaest*. Quomodo progreditur? *Res.* Ab universalibus ad singularia perpetuo progreditur … *Quaest*. Cur a generalibus ad specialia in docendo semper descendendum est? *Res.* Quia illa est via scientiae et intelligentiae. Deinde qui hoc ordine, memoriae succurritur. Ordo enim est memoriae pater'.

[41] Cf. Riccardo Pozzo, 'Ramus and Other Renaissance Philosophers on Subjectivity', *Topoi*, 22 (2003), 5–13; Riccardo Pozzo, *Adversus Ramistas. Kontroversen über die Natur der Logik am Ende der Renaissance* (Basel, 2012).

[42] Cf. Howard Hotson, 'The Ramist Roots of Comenian Pansophia', in Steven J. Reid and Emma A. Watson (eds.), *Ramus, Pedagogy and the Liberal Arts: Ramism in Britain and the Wider World* (Farnham, 2011), 227–250.

this controversy Aristotelianism acquired new vigour in the British Isles, and that the texts of the Continental Aristotelians such as Zabarella became widespread and popular. Indeed, the Ramist standpoint was never explicitly defended from the methodological point of view. Tellingly, the Ramist Thomas Spencer, attempting in 1628 to reconcile his docrtrine with Aristotelian logic, claimed that Aristotle 'did never meane to make *Method*, one member of his Art, distinct from the rest: seeing therefore we have nothing to say touching *Method*'.[43] The problem was simply glossed over. The Ramists' embarrassment in dealing with the problem of method, and their clumsy self-defence, are clear signs that Aristotelianism was spreading and taking root in the British Isles, and that Ramism was in decline. This is most evident in the works of John Case, 'the most important English Aristotelian of the Renaissance period'.[44]

Following Digby, Case makes the empirical part of the cognitive process the central point of his scientific method, in his *Summa veterum interpretum in universam dialecticam Aristotelis*, published in 1584.[45]

Before examining Case's doctrine of method, it is important to emphasize that his logical perspective is conceptualist and instrumentalist, very similar to Zabarella's conception of logic.

Case's instrumentalism is evident from his definition of logic as an instrument of science which works on the *secundae intentiones* by means of definitions, divisions and demonstrations.[46] In being applied to science, logic can be either *utens* concerning the *modus sciendi*, or *docens* when the science of which it is the instrument deals with a particular issue. According to Case, like Zabarella, the subject of logic is twofold: from the point of view of the matter, the subject is the *ens rationis*; from the formal point of view the subject is the probable argument. Unlike Zabarella and following instead the Ramist position, Case divides logic into two parts, invention and judgment,[47] This partition, however, does not represent a real appropriation of the Ramist doctrine, and plays little role in his logical system.

Besides logical instrumentalism, we can find also a conceptualist position in Case's work, in particular in his response to the problem of universals. Universal concepts are simple, finite second intentions, produced by the intellect in relation to things, and can be predicated univocally of other things.[48] Thus to the question of whether universal concepts are things, simple words (*flatus vocis*) or concepts, Case

[43] Thomas Spencer, *The Art of Logick, delivered in the Precepts of Aristotle and Ramus* (London, 1628), 311.

[44] Charles B. Schmitt, 'John Case on Art and Nature', *Annals of Science*, 33 (1976), 543–559, esp. 543.

[45] The work was published in 1592 and in 1598. I quote from the 1598 edition.

[46] Cf. Case, *Summa veterum interpretum in universam dialecticam Aristotelis*, 2: 'Est ergo *Dialectica ars artium*, et *scientia scientiarum*: quippe inservit reliquis scientiis, ut aiunt, ad manum, nam probandi in monibus subministra modum. Hinc etiam definitur, *scientia acute definiendi, accurate dividendi, elaborate demonstrandi*: sunt enim, definitio, divisio, demonstratio, instrumenta dialectices, quibus omnem propositam quaestionem ad vivum discutit'.

[47] Cf. Ibid. 6.

[48] Cf. Ibid. 28: 'simplex, non complexa; finita, non infinita; secundae intentionis, non primae; vi intellectus rebus accomodata, quae potest de pluribus univoce praedicari'.

does not hesitate to sustain that they are not mere words or *intentiones*, but always designate something very precise of which the mind can have scientific knowledge.[49] For Case, then, universal concepts are of a different kind depending on the disciplines to which they pertain: (1) metaphysical universals are only in the mind; (2) mathematical universals are products of the mind and separated from real things; (3) physical universals are in the things themselves and are principles of things; (4) logical universals have a particular status, referring both to things and to words.[50] A logical universal is always a mental concept which designates a thing and which exists as a form in the thing itself constituting it, or as a sign in the word to signify things: 'est enim universale Dialecticum in (1) re, ut subiecto: sic ens reale ut homo; (2) voce, ut in signo, sic ens rationis, ut species dicitur'.[51] The concept is always comprised of a material part, defined by the *ens reale* to which it refers, and a formal part, the *intentio*, pertaining to the mind. Logic deals with concepts as *intentiones*, and it is from the combination or division of *secundae intentiones* that truth and falsehood, scientific discourse and demonstration, are made possible. In Case, therefore, there is a correspondence between the thing and its concept, but the knowledge of the thing depends entirely on the *secundae intentiones* and on the operation of the intellect. Like Zabarella, Case establishes an ontological primacy of the thing and an epistemological primacy of the concept. This is why Case's logical doctrine can be defined as conceptualist.

Case's methodological doctrine can also be defined as conceptualist, although in a peculiar way. He is interested in the problem of how mental concepts as universals can signify particulars as well as general things, and in which of the *ordines* they signify. According to Case, the order of things is twofold. There is an order of nature that proceeds from simple things, universal concepts, and causes, which are initially very confused in the mind, to singular things, compounds and effects, which are generally 'most knowable by us'. This order proceeds from the genus to include the species and specific differences. Then there is the order of learning which, by contrast, proceeds from differences to genus. This order begins with particulars, effects and compounds, and leads to the knowledge and discovery of simple things, universal concepts and causes.[52] Concepts have a twofold relation to the order: '(1) intellectus confusi et sic universale est nobis notius,

[49] Cf. Ibid. 30: 'universale non esse meram vocem, aut intentionem, sed aliquid rei in se continere: (1) quia coniungitur cum rebus singulis sine ope intellectus; (2) naturam cohaerentem habet; (3) de eo est scientia; (4) ex eo nascitur demonstratio'.

[50] Cf. Ibid.: 'Universalia dicuntur vel Metaphysica, quae sunt in sola mente, ut Deus, rerumque divinarum Ideae; Mathematica, quae vi mentis a rebus eliciuntur, et separantur, ita tamen, ut rebus possint accomodari, ut figurae Geometricae; physica, quae sunt res ipsae, rerumque principia: ut materia, forma, elementa; Dialectica quae sunt conceptus partim rerum, quoad constitutionem, partim vocum, quoad significationem'.

[51] Ibid. 29 [31].

[52] Cf. Ibid. 36: 'Ordo rerum est duplex: (1) naturae, qui procedit a simplicioribus ad composita, ab universalibus ad singula, a confusis ad distincta, a causis ad effecta, et hic est generis; (2) disciplinae, qui procedit a compositis ad simplicia, a singulis ad universalia, a distinctis ad confusa, ab effectis ad principia, et hic est speciei respectu differentiae'.

I. Physicorum; (2) intellectus distincti, et sic universale est prius (natura ordine) re singulari: et sic Genus est prius sua specie'.[53] For Case, logic should deal with concepts according to the *ordo naturae*, because only the genus provides a real meaning to things. But, being a mental concept, the genus must be grasped beforehand by the intellect. Therefore it is important to examine the process of the formation of the genus as a universal concept, because only the universal concept signifies reality, and, by means of reasoning and demonstration, can lead to scientific knowledge. Therefore, concepts signify things, but to signify things they must have a relation with them, and such a relation is defined by the mental process of the generation of the concept from particulars. Case characterizes the operation of the apprehension of the concept from particulars as the transition from sensible knowledge (*cognitio sensitiva*) to intellectual knowledge (*cognitio intellectiva*). Sensible knowledge can be either external, when the objects affect the senses, or internal, when the objects affect the common sense.[54] Intellectual knowledge, meanwhile, can be either complex, when the principles originate in the light of the active intellect or the conclusions issue from the perception of principles, or simple, when the mind directly knows by means of the senses the intelligible species of the object.[55] However, intellectual knowledge does not have an epistemological autonomy; that is, there is no pure intellectual knowledge, but rather it is always grounded on sensible knowledge. This is for two reasons: first, because the intellectual knowledge directly receives species from the senses, and second, because, intellectual knowledge indirectly abstracts the species from the senses, by means of the light and acumen of the intellect.[56] However, intellectual knowledge is necessary for the acquisition of science, so much that all scientific knowledge, since it is based on intellectual knowledge, is ultimately grounded on sensible knowledge. Moreover, Case adds, scientific knowledge is always discursive knowledge, that is by demonstration. He claims that no intuitive knowledge is possible while the mind is attached to the body.[57] Against this, Case sustains that the mind knows perfectly through (bodily) sensation, and new knowledge may be acquired only by means of it. In addition, Case denies that knowledge is a

[53] Ibid.

[54] Cf. Ibid. 120: 'cognitio sensitiva, quae est, aut (1) exterior, in externis obiectis, quae feriunt externum sensum; (2) aut interior, in visis, quae pulsant commune sensum'.

[55] Cf. Ibid.: 'Cognitio intellectiva complexa et haec est aut (1) principiorum, quae nascitur ex lumine intellectus agentis, (2) aut conclusionum quae oritur ex perceptione principiorum. Incomplexa, quae est scientia terminorum, rerum que simplicium, orta ex antecedenti cognitione sensus per species ad se transmissas ac splendore mentis illustratas'.

[56] Cf. Ibid.: 'Omnis intellectiva cognitio, sive complexa, sive incomplexa sit, oritur a sensu, vel (1) directe recipiendo species, ut in obiectis rerum corporearum, quae vi sua pulsant moventque sensum; (2) indirecte per lucem et acumen intellectus agentis, qui ex corporeis formis a sensu ad se translatas saepe res incorporeas percipit'.

[57] Cf. Ibid. 120–121: '*Duplex est scientia (1) intuitiva, quae hic non intelligitur; (2) discursiva, quae dependet a sensu.* … Intellectus separatus seipsum intelligit sine medio, sed coniunctus corpori hoc usum non facit sine phantasmate. Aliud est responsum quod magis placet: quod in modo intelligendi. Intellectus ipse qui est in homine intelligendi principium hoc loco recipiatur'.

kind of memory or reminiscence.[58] Without sensible knowledge a real scientific knowledge would be impossible. In this way, sensation becomes the foundation for the entire scientific method and in particular for the method of discovering its first principles.[59]

For Case the real problem is to determine whether all first principles come from sensation by means of induction, or whether there is another method to discover them. He concludes that the *principia cognoscendi*, which are common, evident, and known *per se*, may be discovered by means of intellection, which is distinct from the inductive process. Induction and intellection are two distinct processes for discovering the principles and they differ in the way that sensation is related to the understanding. Sensible knowledge is related to intellectual knowledge by means of the operation of the apprehension (or the faculty of conceiving) and of judgment (or the faculty of discerning).[60] For Case it is evident that if all knowledge comes from sensation, the process of discovering the first principles is induction. However, although all knowledge comes from sensation, this does not mean that the intellect is sterile or does not offer any contribution. Indeed, the intellect has a natural light which can easily illuminate and assent to principles without any mediation of induction. These principles, known *per se*, include 'the whole is greater than the part' or 'if we add an equal to two equals, they will remain equals'. They are grasped directly by the intellect as valid and correct, and are hard to demonstrate by induction. Case is not denying the value of the inductive process for the discovery of principles, but rather arguing that some principles must be laboriously discovered by induction, through many comparisons and experiences, while others may be apprehended directly by the intellect.[61]

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[58] Cf. Ibid. 121: 'Iam quoniam constat nos aliquid perfecte scire, proxime quaeritur, an contingat nos aliquid de novo scire: ad quod respondeo, animam humanam in hoc differre ab intelligentia separata, quia haec scientiam habet per formas innatas sibi … illa vero non per formas habet, sed per multiplicem potentiam, qua docilis redditur ad formas speciesque rerum percipiendas. Hinc patet, nostram scientiam non esse praeteritorum memoriam et reminiscientiam, sed quondam elaboratam notitiam de novo acquisitam per species a sensibus transfusas, et ab intellectu receptas, discussas et comparatas'. The issue was debated at the time, as evidenced by the manuscript *BD*, Ms. *Rawl*. D. 273, and was related to the early dissemination of the Platonic texts in Britain. It became an anti-Platonic cliché of the British empiricist Aristotelians.

[59] Cf. Ibid. 128: 'Praeterea cum scientia sit habitus conclusionis, cumque ignotis principiis, nulla conclusionis habetur notitia, cum denique ipsa principia cognosci non possint, nisi per sensum, memoriam, et experientiam … sequitur sublato sensu tolli etiam scientiam'.

[60] Cf. Ibid. 134: 'Hic etiam spectat illud, quod in intellectu humano duo spectentur, apprehensio et iudicium: per illam concipit, per hoc discernit: ad illam omnia obiecta sensuum deferuntur, per hoc delata an vera an falsa sint discutiuntur. Intellectu iam dependente, quaestio est, ain' in potentissimis illis principiis cognitionis maxime notis, sit mentis per inductionem ad sensum reciprocatio. Una est probabilis opinio quod universalia haec cognitionis axiomata non omnino cognoscantur, nisi per gradus quosdam inductionis'.

[61] Cf. Ibid. 134–135: 'Verum etsi primaria a sensibus derivetur omnis animi nostri cognitio, non est tamen adeo sterilis quin ex formis apprehensis per intellectum alias eliciat, illisque si verae sint assensum suum praebeat. Ut enim in gemma splendor, ita in mente lumen quoddam innatum est, quo illustrata facile credit et assentitur principiis, idque nullo inductionis medio instructa ac informata. Nam quamvis proxima atrium principia inductione egent, remota tamen, … luce quadam

The entire cognitive process of the principles is therefore characterized by four operations of the mind: (1) apprehension, which grasps from sensation the species of objects; (2) judgment, which discerns among the perceived objects; (3) sagacity, or the capacity to perceive immediately, without induction, the principles of knowledge; (4) the order of study or teaching, which infers from the induction of particulars to general concepts.[62]

For Case, intellection does not properly discover any new principles, but recognizes immediately from sensation the necessary relation between the subject and the predicate which constitute the principles, and assents to them. Case does not argue that scientific or intellectual knowledge is in some way intuitive, but rather that there are some self-evident truths grasped immediately by the intellect. It is always from sensation and induction that the first principles of knowledge are discovered. The human mind can never avoid the hard work of experience, which is based on sensation. If for Zabarella intellection was the act of apprehending the intelligible species in the moment in which particular experiences became universal concepts, for Case intellection is a kind of induction, which the Paduan logician called demonstrative induction, immediately conceiving the necessary connections among the various elements of experience. Unlike Zabarella, Case seems to sustain that non-demonstrative induction could also discover the first principles of knowledge.

In his *Lapis philosophicus*, where the debt to Zabarella's comments on *Physica* I.1 is explicit, Case affirms once again that scientific knowledge is always discursive and never intuitive.[63] In particular, he makes clear that discursive knowledge can either be perfect, following demonstration, or imperfect, following abstraction, thus identifying induction as a process of abstraction from particulars to produce general concepts and principles. According to Case, induction, or at least the process of apprehending general concepts, is a part of the resolutive method, which characterizes the *ordo disciplinae* and proceeds from effects to causes. Scientific method, however, also needs to work back from causes to effects, that is, the compositive

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insita ipsius intellectus percipiuntur. Verum attende: non simpliciter nos negare hoc loco inductione posse et haec probari principia, sed distinctione adhibita, per intellectum absolute, per inductionem comparate hoc fieri constituimus; insitam enim nobis principiorum notitiam cum Aristotele docemus quoad intellectum, qui suo ipsius lumine reflexo percipit: acquisitam etiam illam ipsam docemus quoad ordinis progressum, quoniam omnem cognitionem a sensu et obiecto eruit'.

[62] Cf. Ibid. 135: 'In cognitione principiorum per intellectum considerantur: (1) apprehensio, quae est a sensibus et speciebus rerum collecta cognitio; (2) iudicium, quod est quaedam discretio rerum perceptarum; (3) Proprium et innatum lumen, quod est naturalis quaedam sagacitas dexteritasque cito percipiendi, et sic sine inductione rerum singularium principia cognosci dicuntur; (4) ordo disciplinae, qui est a rebus singulis inductione probatis, ad communissima quaedam progressio'.

[63] Cf. Case, *Lapis philosophicus*, 36: 'Si quis hoc loco dubitet, an haec notitia universalium, de qua iam agitur, sit intuitiva an discursiva: respondeo discursivam esse, quae vulgo abstractiva dicitur. Est autem discursive cognitio duplex; aut perfecta per demonstrationem, aut imperfecta per abstractionem, unde primus animi in rebus conceptus nascitur; haec quidem, non illa, intelligi debet'.

method, according to the *ordo naturae*.[64] Nonetheless, Case, unlike Zabarella, ignores this compositive method, concentrating solely on the *ordo disciplinae* or *mentalis*. The reason is clear from Case's words: what is important is sensation and observation, from which all knowledge derives, even if its beginning is confused and obscure.[65]

In Case, by comparison to Digby and Temple, the empirical process of knowledge assumes much greater importance than its systematic arrangement and organization, as his *Lapis philosophicus* shows. Case does not consider any Ramist argument against the double method or the subjectivity of knowledge, which is evidence that Aristotelianism had already won the struggle. Case is thus the first British Aristotelian to support an instrumental, conceptualistic and empiricist conception of logic and scientific methodology, a position further accentuated with the wider circulation of the works of the Paduan Aristotelians from the last two decades of the sixteenth century. In Case we can find doctrines very similar and analogous to those of Zabarella, by which he was influenced, while still maintaining autonomy and originality.

[64] Cf. Ibid. 34: 'Modus sciendi distinguitur a Philosopho in Analyticis, ut sit vel a priore per causas, qui ordo naturae; vel a posteriore per effecta, qui ordo doctrinae dicitur: huc etiam spectat illa distinctio de sciendi modo, per resolutionem a fine, per compositionem a causa. … Modus ille primus, per resolutionem a fine, ordo doctrinae vulgo resolutivum dicitur, per quem progredimur a fine confuse apprehensio, eundem resolvendo in sua principia, tandem accuratius cognita; modus per compositionem a causa, vulgo ordo doctrinae compositivus dictus, ex adverso alteri respondet, quippe incipit a principiis (sed attende) confuse etiam cognitis, et pergit componendo, donec ad finem distincte cognitum pervenerit'.

[65] Cf. Ibid. 38: 'Observatio de hisco omnibus modis cognitionis haec est necessaria, quod omnia a quibus incipiamus scire, sint illa quidem primo intuitu confusa, et sub modo universali a nobis concepta, sint illa fines, causae, definita, vel divisa, quae resolutione, compositione, definitione et divisione fiant tandem certiora'.

Chapter 6
The Influence of Paduan Aristotelianism and the Genesis of the British School

6.1 Griffith Powell and Paduan Aristotelianism

The last two decades of the sixteenth century in the British Isles saw the dissemination of the works of Paduan Aristotelianism, marking the definitive defeat of Ramist logic which had enjoyed a brief but spectacular success, although it continued to be taught into the next century.

British Aristotelian logicians of the late sixteenth century were characterized by: (1) a great expertise in commenting on and interpreting the Aristotelian texts by means of philological instruments; (2) reference to Zabarella's exegesis, often in a simplified form; (3) emphasis on the empirical process of knowledge; (4) a lack of originality in dealing with all parts of logic, even those related to the theory of scientific method.

The most important Aristotelian scholar of the period was Griffith Powell, who within a few years, published two important commentaries on the Aristotelian logic: the *Analysis analyticorum posteriorum sive librorum Aristotelis de Demonstratione* (1594, reprinted in 1631), and the *Analysis libri Aristotelis De sophisticis elenchis* (1598, reprinted in 1664). Even if both works are 'high-level discussions, based on the Greek texts, of the two relevant Aristotelian works and make use of some of the best commentaries available',[1] it is the commentary on the *Analytica posteriora* which outlines his empiricist Aristotelianism and shows Zabarella's influence. In this commentary Powell focuses on some particular aspects of the Aristotelian doctrines, highlighting an empiricist emphasis on the importance of sensation and induction as instruments of science in the definition of logic.

According to Powell, all knowledge is knowledge of causes, by means of which the mind properly knows particulars. If science seeks causes and principles, these are not what is 'most knowable by us', but what is 'most knowable by nature'. What is 'most knowable by us', by contrast, is what comes from the senses, that is, sensations, which are always particular.

[1] Schmitt, *John Case and Aristotelianism in Renaissance England*, 36.

M. Sgarbi, *The Aristotelian Tradition and the Rise of British Empiricism*, Studies in History and Philosophy of Science 32, DOI 10.1007/978-94-007-4951-1_6,

The Aristotelian question, rephrased in the language of Zabarella's logic, is: how can we acquire knowledge of first principles and causes from sensations, that is, from what is most knowable to us as human beings? It is apparent, Powell argues, that we have no innate knowledge of first principles in our mind. Rather, the mind acquires knowledge of them after a laborious cognitive process which forms a habit, and so becomes able to grasp them quickly. Powell describes these workings of the mind as a process of transition from sensible to intelligible knowledge. He states explicitly that there is no knowledge prior to sensible knowledge, for it is only through the senses that we acquire knowledge. Sensation does not passively receive the matter of knowledge from experience, but is an active faculty in perceiving sensible things. This activity is possible only for some animals and it consists in the abstraction of sensible species from corporeal things. If sensible species remain in the memory, the memory of many particulars enables the mind to form general concepts. What is important for Powell is that the memory of experience is possible only through sensation, and it is only through experience that general concepts remain in the mind. Ultimately, Powell supports the idea that the entire cognitive process is grounded on sensation.[2] This process, which operates in the mind, together with sensation and understanding, is called induction[3]; and it is the true and only way to know the first universal principles and causes by means of the intellect or *habitus principiorum.*[4]

Powell's commentary recalls Zabarella's standpoint, but simplifies his theories, considering sensation as the central issue of the doctrine of method for the discovery and acquisition of scientific knowledge, and limiting his discussion to the theory of syllogism. Powell's work thus represents a decisive step towards an empirical approach to scientific method, but his brief account of logic and his interests in the humanist theory of argumentation did not make him a key reference for the next generation of logicians. Furthermore his works were mainly commentaries, which were popular only among specialists, rather than successful textbooks among students and scholars like those of Giulio Pace, who can be considered the real pedagogue of late sixteenth- and early seventeenth-century England.

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[2] Cf. Powell, *Analysis analyticorum posteriorum sive librorum Aristotelis de demonstratione*, 338–339: 'Et haec nullam habent cognitionem praeter cognitionem sensus, quam in ipso sentiendi actu tantum acquirunt. Nam nihil cognoscunt, nisi cum sentient, cum illa rei etiam absentis cognitionem habeant. Deinde animalia, quae memoriam habent, non unius sunt generis. Nam quaedam rationem, quae similes rerum sensilium conceptus inter se componit, et universale ex illis colligit habent: ut homo quaedam non habent: ut caetera bruta animantia. Haec cognitionem tantum singularem: ille etiam universalem habet: Unde in homine ex sensu, sive ex sensatione sit memoria: ex memoria saepe rei eiusdem (non numero sed specie) facta sit experientia: siquidem multae memoriae numero unam experientiam constituunt: ex experientis, sive ex omni universali quiescente in anima, nimirum uno praeter multa, quod in omnibus est unus et idem, sit artis et scientiae principium: artis si pertineat ad generationem; scientiae, si pertineat ad id quod est, sive quod iam existit'.

[3] Cf. Ibid. 340: 'methodus … qua principia cognoscuntur, est inductio, quia adminiculo ipsius sensus cognoscuntur, qui una cum intellectu universale in anima efficit'.

[4] Cf. Ibid.: 'habitus principiorum dicitur *intelligentia* sive *intellectus*'.

6.2 Giulio Pace in the British Isles

The diffusion of Paduan Aristotelianism reached its peak with the dissemination of the works of Giulio Pace. His editions of Aristotle became the standard for a careful study and reading of the Stagirite, and his textbooks were officially adopted and used in the university at least until the 1620s.

In his *Institutiones logicae* Pace summarizes the entirety of Zabarellan logic, and even expands on some aspects concerning the problem of the scientific method. The work was published for the first time in Sedan in 1595, but found greater success with its 1597 Cambridge reprint.

According to Pace, logic is an 'ars ratiocinandi, ut discernatur verum a falso', whose end is science.[5] Logic is therefore an instrument of science that helps to determine truth and falsehood regarding the logical subject under consideration. The subjects of logic are the *notiones*,[6] which are in general mental concepts; however, like Zabarella, Pace distinguishes between *primae* and *secundae notiones* (or *intentiones*).[7] *Primae notiones* always refer to natural things, while *secundae notiones*, grounded on the *primae*, refer only to the mind that conceives them. It is important to emphasize once again that this logical standpoint reiterates the view that logic deals firstly with concepts, whose validity and truth lie entirely and completely in the mind. Pace also adds that the *primae notiones* are the subject of the philosopher's investigation, while the logician deals with them only as the foundation of *secundae notiones*, which, instead, are the proper subject of logic. *Primae notiones* which concern logic are particularly the categories.[8]

As we have already said, like Zabarella, Pace held that logic deals with the *secundae notiones* and with the operation of the mind upon them. The first and most important operation of the mind is *interpretatio*, by which the mind composes complex arguments as in a syllogism.[9] Indeed, *interpretatio* is the constitutive element of all logical instruments, from mere *oratio* through *enunciatio* up to the syllogism. It is defined as: 'vox articulata ex instituto sensa animi significans'.[10] The fact

[5] Pace, *Institutiones logicae*, 3r.

[6] Cf. Ibid. 3r: '*notiones* vocantur, conceptus animi nostri, quicquid enim intelligimus seu mente concipimus, id a philosophis et logicis *notio*, vel *intentio* nominatur'.

[7] Cf. Ibid.: 'Logicae partes duae sunt: una de primis notionibus; altera de secundis notionibus … Primae notiones sunt, quibus aliquid respondet in rerum natura … Secundae autem notiones sunt, quae primis attribuuntur per intellectum reipsa illis non insunt'.

[8] Cf. Ibid. 3r–3v: 'Primae notiones exquisitae tractantur a philosopho; quatenus a logico, quatenus scilicet sunt fundamentum secundarum ad Logicam pertinentium. Porro primae notiones referuntur omnes ad decem classes, quae vocantur Categoriae: de quibus deinceps dicemus, quibusdam prius praemunitis, quorum cognitio ad categorias intelligendas est necessaria'.

[9] Cf. Ibid. 12v: 'A primis notionibus transgrediamur ad secundas; quales sunt syllogismi, in quibus … dixi Logicam versari; et interpretationes ex quibus syllogismos componemus. Primum igitur de interpretatione, postea de sillogismo dicendum est'.

[10] Cf. Ibid. 12v–13r: 'Articulata dicitur: quoniam habet articulos syllabarum, quae non reperiuntur in sibilo, et canis latratu, et similibus vocibus. Ex instituto dicitur, Graecae κατὰ συνθήκἶων, quod non est a natura sed hominum aribitrio positum'.

that *interpretatio* is an articulated word meaningful by institution, i.e. signifying by convention, marks the epistemological primacy of the mind over the world. It is the mind that provides meanings to the things of the world; these have no meaning in themselves. The epistemological primacy, or rather the hermeneutical primacy of the mind and of logic over the ontological level of reality is indisputable according to Pace; this is clear, as we shall see, from his doctrine of scientific method, which forms the end of the logic as he has already indicated at the beginning of the *Institutiones*.

For Pace, like all the other Aristotelians, science is demonstrative science, that is, the end of the demonstration is scientific knowledge. Science can be of two kinds, partial or total. Partial science leads to just one conclusion on one particular fact or event, while total science involves more.[11] Pace is particularly interested in partial science because in a broad sense it constitutes total science. The partial science is of three kinds: τοῦ διότι, τοῦ ὅτι and τοῦ διότι καὶ τοῦ ὅτι.[12]

Perfect knowledge is τοῦ διότι καὶ τοῦ ὅτι, which knows things and explains the effects through the proper cause, while science τοῦ διότι taken individually is abstract knowledge of the cause without the effect, and knowledge τοῦ ὅτι is improperly science because it knows only the existence of the thing. Knowledge τοῦ ὅτι can be (1) sensible knowledge; (2) knowledge of the first principles; (3) knowledge of the remote cause; (4) knowledge from the effects.[13]

Pace, like Zabarella, includes sensible knowledge and knowledge of first principles as part of knowledge τοῦ ὅτι; this is knowledge which is confused and tentative, not yet demonstrated, and providing only the beginning of science. Nonetheless, Pace considers this kind of knowledge as indispensable, preliminary and preparatory to scientific knowledge.

Partial science aims to answer five 'quaestiones' in particular: 'quid nomen significet', 'an res sit', 'quid sit', 'qualis res sit', and 'cur res talis sit'.[14] In general, however, science is more perfect when it knows the *cur sit* and the *quod sit*, that is, knowledge τοῦ διότι καὶ τοῦ ὅτι, and it is more precise the more it abstracts from sensible knowledge.[15]

Pace states that science has a particular affinity with opinion, sagacity, wisdom, art, prudence, intellect and reasoning. But it also has essential differences from

[11] Cf. Ibid. 70r–70v.

[12] Cf. Ibid. 70v–71r: 'Aut est τοῦ διότι, id est, cur sit; aut τοῦ ὅτι, id est, quod sit; aut simul τοῦ διότι καὶ τοῦ ὅτι. Scientia τοῦ διότι καὶ τοῦ ὅτι est cognitio rei per proximam eius causam cum scilicet eam illius rei causam esse scimus. … Scientia τοῦ ὅτι est, cum rem cognoscimus alia quacumque ratione, quam per causam proximam. … Scientia τοῦ διότι sine cognitione τοῦ ὅτι, quando cognoscimus causam in abstracto nec eam applicamus subiecto'.

[13] Cf. Ibid.: 'Prima est cognitio sensitiva … Secunda est cognitio primorum principiorum: velut omne totum esse maius suas parte, et si ab aequalibus aequalia demantur, residua fore aequalia, atque haec proprie dicitur intelligentia. Tertia est cognitio per causam remota … Quarta est cognitio per effectum'.

[14] Ibid. 71r–71v.

[15] Cf. Ibid. 72v–73r: 'Perfectior est scientia, quae simul complectitur cur sit et quod sit … Scientia eo est exquisitior et prior, quo magis abstrahit a subiecto sensili'.

each. It differs from opinion because the former knows the elements that inhere essentially and necessarily to the subject of investigation, while opinion has a contingent knowledge of the thing. For instance, science knows whether a thing is mobile or not, while opinion knows only whether it is currently in motion. Sagacity or diligence (*solertia*) differs from science because it is the faculty of the mind, and in particular of the intellect by means of which it is easier to conjecture the cause, whereas science knows perfectly the cause of an effect. Moreover, intellect is not science, because it concerns the knowledge of the first principles of science. Nor is science reasoning, because the latter is the capacity of the mind to proceed from an unknown thing and, by means of demonstration, to acquire scientific knowledge. Finally science differs from wisdom, because wisdom involves the knowledge of first principles and of the conclusions of a given demonstration.[16]

Once the habits necessary for scientific knowledge have been established, Pace examines the workings of its proper instrument, namely, demonstration. The validity and truth of a demonstration lies in its principles, which, in order to be principles of science, must have seven characteristics: (1) they must be true; (2) they must be immediate and indemonstrable; (3) they must be cause of the conclusions; (4) they must be prior to the conclusions; (5) they must be more knowable by nature than conclusions; (6) they must be necessary; (7) they must be specific to the subject of demonstration.[17]

The first principles are the foundations of scientific method, which corresponds for Pace to the *ordo doctrinae*. There are three constituent elements of the method: (1) the subject; (2) that which is sought; (3) the means (or middle term) through which knowledge is acquired. According to the arrangement of the subject there are seven methods. The first is distributive and proceeds from the genus to the species. The second is inductive or collective and proceeds from particulars to universals; this is the same method as the notification of universal concepts and principles. The third method is partitive and proceeds from the compound to its components. The fourth is connective and proceeds from the components to the compound. The fifth method is resolutive and proceeds from the whole to its essential parts. The sixth is compositive and proceeds from the essential parts to the whole. The seventh is adjunctive and proceeds by adding parts to parts.

[16] Cf. Ibid. 73v–74r: ‘sagacitas, quam alii solertiam appellant, est animae humanae, id est intellectus, vis et facultas, per quam facile coniicitur causa seu medium pariens scientiam … intelligentia est cognitio principiorum; quemadmodum scientia est cognitio conclusionis; sapientia vero est habitus constans ex intelligentia et scientia. Dianoea est progressus intellectus a notis ad ignota vel animae facultas per quam ita progreditur et progredendo scientiam acquirit’.

[17] Cf. Ibid. 75r–76r: ‘I. Sunt vera. II. Sunt immediata et indemonstrabilia, quod intelligendum est de primis principiis. III. Sunt causae conclusionis, id est, causae cur conclusio sit vera et cur a nobis cognoscatur. IV. Sunt priora conclusione, id est, et prius sunt, et prius a nobis cognoscuntur. V. Sunt notiora conclusione; quoniam sunt causae cur cognoscatur conclusio. Intellige autem esse priora et notiora secundum naturam, non secundum nos. VI. Sunt maxime necessaria. VII. Principia sunt propria seu syngenea, id est, sumpta ex natura rei qua de agitur, non eterogenea, nec communia’.

If the seven methods constitute the arrangement of the subject, there is only one method of investigation or research—the inquisitive method.[18] Meanwhile, there are four methods according to the typology of the means. The first is demonstrative and proceeds from the proximate cause to the effect. The second is quasi-demonstrative and proceeds from the remote cause to the effect or from the effect to the cause. The third is dialectical and proceeds neither from the cause nor from the effect, but following a probable means (or middle term) to reach the conclusion. Finally, the fourth method is cumulative, connecting many reasons and causes together to form a means. Therefore, according to Pace, there are twelve methods in total.[19] All of these have two main features in common: (1) they proceed from known to unknown; (2) they determine the subject and the order of science.[20]

In conclusion, according to Pace, there is only one method for discovery and invention: all methods proceed from known to unknown and science must be constituted around its subject, answering the five 'quaestiones' and discovering the 'medii' that finally solve the scientific problem under investigation.[21]

The textbook *Logicae rudimenta* was published in London in 1612 on the basis of the German edition of 1601. By contrast to the *Institutiones*, the *Rudimenta* is a work of a few pages, lacking any reference to the doctrine of scientific method. But the *Rudimenta* carries to extreme the conceptual and mental nature of logic. To define the nature of logic, Pace begins with an examination of the three operations of the mind: (1) intelligence (or apprehension); (2) judgment, which composes and divides; (3) reasoning.[22]

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[18] Cf. Ibid. 79r–81r.

[19] Cf. Ibid. 82r.: 'duodecim igitur sunt methodi: quarum, septem ad subiectum pertinent, distributiva, collectiva, partitiva, coagmentativa, resolutiva, compositiva, adiunctiva; una quaestiones spectat, inquisitiva; quatuor ad medium respiciunt: demonstrativa, quasi demonstrativa, dialectica et cumulativa'.

[20] Cf. Ibid. 82r–82v: 'I. In omnibus methodis progrediendum esse a notioribus ad ignotiora. Notiora intellige, quae ad sequentia notificando valent: alioqui saepe contingit, ut obscuriora primo loco doceantur. … II. Quamlibet scientiam et artem ita extrui: ut primo constituatur subiectum in quo versatur … deinde ordine de eo explicentur quinque illae quaestiones supra propositae, quid nomen significet, an sit, quid sit, quale sit, et cur tale sit. Quamquam si quid horum adeo manifestum sit ut expositione egere non videatur, eius declaratio potest ac solet in scientiis praetermitti … In his autem omnibus enarrandis et confirmandis adhibetur, methodus demonstrativa, vel quasi demonstrativa, vel dialectica, vel ex his methodis plures simul, prout rei subiectae natura requirit. His absolutis, transgredi oportet ad quaestionem quotuplex sit, atque afferenda subiecti divisio, speciesque eius eadem ratione explicandae. Nam cuiuscumque scientiae capita methodo distributiva ab universalibus ad particularia progrediente constituuntur: hiuc vero methodo reliquae methodi accedunt'.

[21] For a general overview of Pace's *Institutiones logicae* cf. Cesare Vasoli, 'Scienza, dimostrazione e metodo in un maestro aristotelico dell'età di Galileo: Giulio Pace da Beriga, logico e giurista', in Id., *Profezia e ragione. Studi sulla cultura del Cinquecento e del Seicento* (Naples, 1974), 649–777, esp. 703–735.

[22] Cf. Pace, *Logicae rudimenta*, 1–2: 'Tres sunt intellectus nostri operationes: simplex intelligentia, compositio vel divisio, et ratiocinatio. Simplex intelligentia dicitur cum rem aliquam solam et per se non cum alia coniunctam, mente concipimus.… Divisio nominatur, cum rem a re separatam intelligimus quasi ei non attribuatur; … Ratiocinatio vocatur, cum aliquid per aliud probamus'.

Thus logic becomes the instrument able to direct the mind in acquiring a real knowledge according to its three main operations, which characterize the partition of logic itself.[23] Also in the *Rudimenta*, Pace grounds logic on 'dictio', which in the *Institutiones* was called 'interpretatio', as is quite clear from its definition.[24] Logic is therefore grounded on the capacity of the mind to signify things.

Pace's conceptualism is quite evident also in his *In Porphyrii Isagogen et Aristotelis Organum commentarius analyticus*, which appeared in 1597.[25] According to Pace, the logician must deal only with *secundae notiones*, but he must not ignore their foundations, namely the *primae notiones*, although these should be considered not as things that actually exist in nature, but as subjects of predication.[26]

Secundae notiones are first of all *interpretationes*, as primitive and simple elements of logical argumentation.[27] The meaning of the *interpretationes*, as in the *Institutiones* and the *Commentarius*, depends completely on the mind, and not, as for Plato and the Platonists, on the thing. Once again, Pace reaffirms the epistemological primacy of the mind over the ontology of the things.

The empirical perspective of Pace's logic and its dependence on Zabarella is most evident in the chapters devoted to science in the commentary to the *Analytica posteriora*. Pace states that every demonstration proceeds by composition, although the principles are discovered by resolution.[28] These two aspects of Aristotelian logic, i.e. composition and resolution, define the partition of logic, which is constituted by

[23] Cf. Ibid. 2: 'Logica est ars rationalis, id est, dirigens operationes nostri intellectus, ut verae sint, et omni vitio careant, id circo tres sunt Logicae partes. Tribus illis intellectus operationibus proportione respondentes. Prima pars est de dictionibus, secunda de enunciationibus, quae ex dictionibus conficiuntur tertia de syllogismis, qui ex enunciationibus extruuntur'.

[24] Cf. Ibid.: 'dictio est vox significans rem aliquam ex instituto: cuius vocis nulla pars seorsum accepta, aliquid significat'.

[25] Cf. Pace, *In Porphyrii Isagogen et Aristotelis Organum commentarius analyticus*, 26: 'Per omnes considerari possunt duobus modis: nempe ut sunt et ut intelliguntur. … Quoniam igitur res prius sunt, quam a nobis intelligantur: id circo prior illa rerum intelligentia et consideratio, vocatur prima notio, seu prima intentio: posterior autem appellatur secunda notio, seu secunda intentio. … Ac primae quidem notiones sunt res consideratae prout sunt; secundae autem notiones sunt res consideratae, non ut sunt, sed tantum ut a nobis intelliguntur. Unde apparet, primas notiones secundarum esse fundamenta quibus secundae nituntur. Cum igitur logicus versetur in secundis notionibus, cuiusmodi sunt subiectum attributum, propositio, syllogismus, demonstratio, definitio, et caetera quae in logica tractantur: certe non debet ignorare fundamentum secundis notionibus substratum, id est primas notiones'.

[26] Cf. Ibid.: 'Quod animadvertens Aristoteles, initio Organi logici posuit hunc librum Categoriarum, quo explicat nobis res omnes non tam ut sunt in rerum natura, quam ut sunt categoriae, id est, sub ratione attribuendi et subiiciendi: proinde quatenus sunt fundamenta secundarum notionum'.

[27] Cf. Ibid. 59: 'Cum autem syllogismi partes aut sint simplices, ut nomina et verba; aut ex his simplicibus compositae, ut propositiones sive enunciationes: utraeque appellatione intepretationis continentur. Interpretatio namque est vox, quae anima sensa et per ea res ipsas ex instituto significat. Ex instituto sunt quae Graeci dicunt κατὰ συνθήκιω: ut rerum vocabula, quae non sunt a natura constituta, ut sentit Cratylus apud Platonem, sed arbitrio hominum imposita'.

[28] Cf. Ibid. 111: 'Observa ex Zabarella in primum cap. I. lib. Poster. demonstrationem non esse resolutionem, sed potius compositionem, quam resolutio praecedit. Principia namque per resolutionem invenimus: deinde, iis inventis, extruimus demonstrationem'.

two parts which Pace calls invention and judgment, following in this case the Ramist perspective.[29]

Invention characterizes the theoretical part of science, while judgment characterizes the practical part. The two parts, however, differ also in the kind of knowledge that they acquire. Indeed, invention only notifies the intellect on what has been perceived by sensation, providing not a scientific knowledge, but a confused universal knowledge of singular things coming from the senses.[30] This is because, for Pace, following Zabarella's interpretation, *scire* differs from *cognoscere.*[31]

Science is the demonstrative knowledge that proceeds from causes, but to cognize in general pertains as much to the senses as to the intellect. In cognitive process the mind does not always proceed from first causes and principles and does not always deduce necessarily by means of syllogism. Moreover, for instance, sensible knowledge is always the knowledge of singular things, even if they are notified to the intellect in their universality (albeit still confused). Science, instead, is always the knowledge of perfect universal concepts.[32] The transition from sensible knowledge to science is the specific subject of the commentary on Aristotle's *Analytica Posteriora* II.19. At first, Pace emphasizes that the notion of innate knowledge is absurd, and this is true most of all of the knowledge of the principles, which comes from sensation.[33] The cognitive process by which the mind acquires principles is

[29] Cf. Ibid. 166: 'Quod ut clarius intelligatur; et methodus huius libri I. Primorum appareat; nec minus intelligatur, quam inepte a multis disputetur de ordine harum duarum logicae partium, quarum altera est de inventione, altera de dispositione: notandum est primo naturam et vim syllogismorum esse cognoscendam, deinde ad usum traducendam. Prior igitur pars est theorica, quam hactenus Aristoteles docuit; posterior est practica; et quidem bipartita; quia duplex est syllogismorum usus; aut enim ipsi syllogismos invenimus, et extruimus; aut de syllogismis quos alij extruxerunt, ex praeceptis artis iudicamus, et confuse conceptos, in figura set modo resolvimus; vel certa forma digestos, in aliam formam convertimus. Prior praxeos inscribitur de inventione; posterior de iudicio, vel resolutione, vel dispositione'.

[30] Cf. Ibid. 272.

[31] Cf. Ibid. 274: 'Quidam putant Aristotelem consulto uti verbo scire dicitur, quatenus acquiritur, scientia vero, quatenus est habitus iam acquisitus: ab Aristotele autem hic non consideratur ut habitus, sed ut per demonstrationem in nobis gignitur. … In definitione pro genere sumitur cognoscere. Nam proprie loquendo, cognoscere latius patet, quam scire: quia cognoscimus etia per sensum, scimus tantum per intellectum: immo scientia proprie dicitur ea sola, quae per demonstrationem acquiritur'.

[32] Cf. Ibid. 319: 'Probaturus scientiam demonstrativam non acquiri per sensum, initio praemunit discrimen quoddam inter sensum, id est, facultatem sentiendi, et sentire, id est, ipsum actum sentiendi. Discrimen in eo consistit: quod sensus est rei universalis; actu autem sentimus res singulares. Exempli gratia, obiectum aspectus est color simpliciter, non hic, vel ille color: nos tamen non videmus colorem simpliciter, sed hunc, vel illum colorem. Ait sciamus. Accipit proprie verbum sciendi, ut significet scientiam per demonstrationem. Ait, rei talis, id est, rei universalis. Ait, non huius alicuius, id est, non rei singularis. … Scientia demonstrativa est cognitio rei universalis; atqui per sensum non habetur cognitio rei universalis, ergo per sensum non habetur cognitio demonstrativa'.

[33] Cf. Ibid. 346: 'Primo probat cognitionem primorum principiorum nobis non inesse natura, ita ut in infantia lateat. Nam si hoc esset, sequeretur hoc absurdum, infantes habere cognitionem exquisitiorem demonstratione, id est, scientia demonstrativa, et nihilominus eos latere quod tam exquisite scirent. … Secundo cum ait: si vero eos probat cognitionem principiorum a nobis non acquiri, quia si acquireretur principia discernuntur ex antecedente cognitione, sed consequens est falsum et impossibile, quia haec sunt prima principia; ergo falsum etiam est id, ex quo sequitur'.

induction.[34] Inductive knowledge, however, concerns only the first part of logic, i.e. invention, which, as we have said, provides only a confused and obscure knowledge, and only through a correct arrangement, by means of composition, can the mind acquire scientific knowledge.

Ultimately, Pace differs from Zabarella only in his admission of a plurality of methods, though there is only one method of discovery and invention. However, thanks to the propaedeutic simplicity of his works, Pace spread the doctrine of Paduan Aristotelianism to most of the universities by the end of the sixteenth century, providing the common ground for a generation of scholars.

6.3 British Aristotelians on the Continent

Paduan Aristotelian doctrines also had some impact on the British Aristotelians who emigrated to France, Holland and Belgium, such as Mark Duncan.

In his *Institutiones logicae*, published in 1612, Duncan was one of the first to accept the suggestions of Melanchthon and Keckermann of making 'thema', theme, the subject of logic.[35] The theme can be divided into simple and complex, and into *primae* or *secundae notiones*. *Secundae notiones* are the specific subject of logic, and the instruments for acquiring new knowledge, speaking truth and falsehood, and reasoning. Whereas *primae notiones* originate from the direct intuition of things, *secundae notiones* are a voluntary product of the mind.[36] Duncan's work, however, is devoid of any originality and its importance is due mainly to the fact that Burgersdijk considered it a model for his own logic.

Duncan is not the only Scottish logician who emigrated to the Continent and who showed influences of Paduan Aristotelianism. In fact, Pace's dissemination of Zabarella's ideas is evident also in Balfour's *Commentarius in organum Aristotelicum*, printed in 1615 but dated 1616. It is true that Balfour taught predominantly in France and that his works were not published in the British Isles; however, the author was educated and lived in St Andrews just at the moment when the works of Zabarella and Pace became popular. Thus the work can be considered a typical product of its time and intellectual milieu.

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[34] Cf. Ibid. 349: 'quomodo cognitio principiorum constituatur, haec neque connata est, neque acquiritur ex antecedente cognitione intellectiva, sed per inductionem quandam comparatur: dum ex multis particularibus, quae a sensu suggeruntur, intellectus colligit universale. Fit enim ex sensu memoria; ex memoria fit experientia; ex hac universale'.

[35] Cf. Riccardo Pozzo, 'Thema', in *Historisches Wörterbuch der Philosophie* (Basel, 1998), vol. 10, c. 42700–42705.

[36] Cf. Duncan, *Institutionis logicae libri quinque*, 25: 'Quoniam autem thematum logicae tractandorum instrumenta sunt notiones secundae, et thematum simplicium atque complexorum constitutiones et diversitates absque notionibus secundis commonstrari nequeunt, antequam progredior tenendum est, notionum quae in animo humano sunt alias esse primas, alias secundas. Notio prima est quam animus efformat cum res ipsas intuetur. Notio secunda est quam efformat cum acquisitas rerum notiones et voces illis significandis impositas intuetur. … Sunt notiones secundae, quia colliguntur ex consideratione nostrarum de rebus notionum et vocabulorum illis significandis institutorum'.

The peculiarity of this commentary, unlike that of Pace, is that it presents one of the first combinations of Zabarellan logic with Jesuit metaphysics, in particular that of Suárez, as the epistle to the reader testifies.[37] This combination was becoming typical in the Protestant countries; Scottish logicians adopted it before others, thanks to their strict relationships with the Continent.

Zabarella's influence is immediately recognizable in the third *quaestio* where Balfour asks: namely, which kind of habit is logic? He devotes an entire paragraph to explaining the Paduan's opinion.[38]

Balfour sustains, like Zabarella, an instrumental conception of logic, which is a real habit of the mind. Moreover, Balfour states that the subject of science is composed of two parts, a material part, which is the *res considerata*, and a formal part, which is *modus considerandi*.[39] Since several sciences share the same subject, 'ut rectae explicat Zabarella lib. I. de natura Logicae, cap. 15',[40] what distinguishes them is *modus considerandi*, because 'dicere materiam subiectam Logicae esse res omnes, de quibus viam, et ordine disputari potest'.[41] After these preliminary observations, Balfour establishes that the subject of logic is *ens rationis*.[42] *Entia rationis* are mental concepts, and those specific concepts on which logic operates are the *secundae intentiones*.[43] The

[37] Cf. Robert Balfour, *Commentarius in organum Aristotelicum* (Bordeaux, 1618), B1r–3v.

[38] Cf. Ibid. 33–34: '*Excutitur Zabarellae opinio*. Verum Zabarella cap. 8. lib. prioris de natura Logicae, negat Logicam artem esse, aut vere et proprie quicquam efficere. Efficere, inquit, ea proprie dicimur, quae extra edimus. Nam Aristoteles cap. I. lib. 2. Physicorum, dicit artem esse principium operandi in alio, et eo maxime discrimine artem a natura separat, quod natura sit principium operationis receptae in eo ipso, in quo ea in est, quam interpretes immanentem vocant: ars vero principium operationis receptae in alio, quam transeuntem dicunt. Nec diffiteor Aristotelem idem dicere cap. I. lib. 2. de Generatione animalium. Iam vero nihil Logica facit extra animum, sed in ipso animo operat, et in eo syllogismos efficit, ideo eius operatio immanens est, immo vere ac proprie immanens, quia in Logici mente manent syllogismi, in qua Logica ipsa inest. Cum igitur Logica sit principium internum, ars externum, Logica non erit ars. Haec ratio Zabarellam ipsum decepit, et alios per multos: et sola eum coegit dicere non omnes habitus in eo cap. 3. lib. 6. Ethicorum, ab Aristotele enumeratos, sed solos principales, Logicam vero non esse principalem, sed instrumentalem habitum et propterea sub nullo eorum quinque contineri'.

[39] Cf. Ibid. 44: 'observa in omni subiecto scientiae duas quasi partes spectari, quarum altera materiae, altera quasi formae rationem habet. Nam res considerata quasi materia est; sed modus considerandi rationem habet formae'.

[40] Ibid. 44.

[41] Ibid. 46.

[42] Cf. Ibid. 47: 'Ens itaque rationis, a ratione nomen habet, eo quod ad rationem, hoc est, ad mentem, sive intellectum nostrum, aliquam comparationem habeat: non quod a mente, reali aliqua effectione fiat, ut sunt quae arte efficiuntur: nec quod in mente tanquam in subiecto inhaereat, ut sunt disciplinae et scientiae, sed quod rem consequatur, ut menti et rationi nostrae objcitur. … Quicquid, inquit, existit in rerum natura actu, ens rei est: quod autem consequitur rem, ut objcitur intellectui ac rationi, ens est rationis'.

[43] Cf. Ibid. 48: 'Porro cum mens nostra prius conferatur in res ipsas, quam in earum cum rebus alijs comparationes; ideo rerum ipsarum conceptus dicuntur in scholis Logicorum, intentiones primae; sed conceptus eorum, quae ijs ab intellectu tribuuntur, intentiones secundae: nempe quia mens nostra primum faciem suam intendit in rem ipsam, ut est; secundo vero loco, in ea, quae illi conveniunt, ut intelligitur. Et vocabula, quibus primi conceptus significantur, vocantur nomina intentionis primae: illa vero, quibus significantur conceptus secundi, nomina secundae intentionis'.

difference between *primae* and *secundae intentiones* is that the meaning of the latter depends entirely on the mind, while that of the former depends on the things from which they are conceived.[44] *Secundae intentiones* or *entia rationis* are the subject of logic. Balfour's conceptualism is evident when he states that a logician deals only with the form of things by means of concepts and that the form is what signifies things.[45]

Logic therefore deals with *secundae intentiones*, which are the subject of the three main operations of the mind: (1) *comprehensio*; (2) *coniunctio* and *divisio*; (3) *ratiocinatio*. In particular it is interesting that Balfour identifies the operation of the *comprehensio* with perception—'comprehensio, quae nihil aliud est, quam rerum ut sunt, et suis distinguuntur classibus, perceptio'[46]—in a similar way that Locke in his *Essay* deals with the first operation of the mind. Balfour specifies also that perception does not provide a true knowledge of the thing, but simply gives some general information on it. From this first operation of the mind proceeds the entire cognitive process. All knowledge comes from sensible things, which are always understood in the mind by means of concepts that are images of the things themselves.[47]

Balfour adds that these mental images of real things are conveyed by means of words. Words are therefore signs of mental concepts and not of things.[48] Further, Balfour makes clear that these words do not depend on the things which they designate, but rather on the mind which generates them: 'voces itaque et scripta non sunt a natura, sed ex hominum instituto'.[49] It is easy to see also in this case the precursor of some Lockian doctrine on language[50]; however, according to Balfour, following Aristotle's doctrines in *De interpretatione*, there is always a correspondence between word, concept and thing. This threefold correspondence is possible only through the inductive process that notifies to the intellect the general concepts apprehended from particulars by means of sensation.[51]

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[44] Cf. Ibid.: 'Ad huius igitur evidentiam considerandum est, quod nomina primae intentionis sunt, quae rebus imposita absolute, mediante conceptione, qua fertur intellectus super rem ipsam, in se, ut homo, lapis; nomina vero secundae intentionis sunt, quae imponuntur rebus, non secundum quod in se sunt, sed secundum quod subsunt intentioni, quam intellectus de ijs facit, ut genus, ut species, ut attributum, et alia'.

[45] Cf. Ibid. 365–366: 'logicus vero eadem spectat formaliter, hoc est, ut res ipsas significant, per medios conceptus. Nam vera vocum forma est earum significatio; siquidem ab ea determinationem et speciem suam habent'.

[46] Ibid. 364.

[47] Cf. Ibid. 366: 'Nam primum omnium, res sensibus nostris occurrunt, quas cum animo comprehendimus, earum conceptus, hoc est notiones quasi imagines, in animo formamus'.

[48] Cf. Ibid. 366: 'deinde animi nostri sensa, hoc est quae de rebus concipimus et cogitamus, per voces exprimimus; aut si longe absunt, nec voces nostras capere possunt, quibus cogitate atque sensa comunicare volumus, voces nostras literis et scriptis indicamus. Sunt ergo notae vocum; voces notae sunt et signa conceptuum: conceptus denique sunt quasi efformatae imagines rerum'.

[49] Ibid. 367.

[50] Cf. E. Jennifer Ashworth, 'Do Words Signify Ideas or Things? The Scholastic Sources of Locke's Theory of Language', *Journal of the History of Philosophy*, 19 (1981), 299–326; Dawson, *Locke, Language and Early-Modern Philosophy*, 185–209.

[51] Cf. Ibid. 713: 'per inductionem comparari, dum ex multis singularibus, quae a sensu suggeruntur, intellectus colligit universalem quandam et communem notionem. Fit enim ex sensu memoria; ex memoria fit experientia; et ex hac tandem universi generis confirmatio'.

Induction is the process of formation of the knowledge of the first principles, which 'neque innatam nobis esse, neque acquiriri per antecedentem ulla cognitionem intellectivam'; the ability to acquire them is a habit with its foundation in sensation: 'habitus principiorum a sensu originem habet'.[52] Balfour vigorously asserts that knowledge of first principles is acquired in no way other than through the senses.[53]

Balfour's position therefore reflects the new British Aristotelianism at the turn of the seventeenth century, which was influenced by the Paduan Aristotelian tradition.

6.4 Flavell's Methodological Aristotelianism

The influence of Paduan Aristotelianism and in particular of Zabarella's logic lasted at least until the mid-seventeenth century, as is evident from Flavell's *Tractatus de demonstratione methodicus et polemicus*, published posthumously for the first time in 1619 and subsequently in 1624 and 1651.[54] The final edition also contains a *Disputatio in libros Topicorum Aristotelis seu de discursu probabili*, which, given the heterogeneity of the arguments and the various sources mentioned, is probably not a work by Flavell. The popularity of this textbook was so great that according to Anthony à Wood—the official historian of Oxford University—it 'hath been taken into the hands of all juniors'.[55] Schmitt has noted that in Flavell's treatise 'as in Powell's works, there is a good deal of discussion of the Greek text of Aristotle' and that 'Zabarella once again is the major author, and there is a strong interest in typically Zabarellan problems'.[56] Flavell, however, simplifies the Zabarellan doctrines and emphasizes the empirical side of scientific method.

Probably following Case, Flavell distinguishes two sources of knowledge: (1) sensation, which knows things by means of the senses and which comes first, and (2) the intellect, which grasps concepts.[57] Flavell is one of the first Birtish Aristotelians to challenge the doctrine of innatism. Against the Platonists, Flavell argues that there are no innate ideas or principles in the mind, but, on the contrary, all knowledge comes from sensation, and by this means the mind continuously acquires new knowledge, leading to the acquisition of the habit of science.

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[52] Ibid. 713.

[53] Cf. Ibid. 714: 'non alia ratione cognosci posse principia, quam inductione: nam nihil aliud esse potest profecta hoc modo a sensibus notitia, quam inductio: huic vero, non alium esse habitum, quo principia cognoscuntur, quam intelligentiam'.

[54] Flavell's textbook was edited by Alexander Huish (1595–1668).

[55] Anthony à Wood, *Athenae Oxonienses an Exact History of all the Writers and Bishops who have had their Education in the University of Oxford* (London, 1817), vol. 2, 207.

[56] Schmitt, *John Case and Aristotelianism in Renaissance England*, 36.

[57] Cf. Flavell, *Tractatus de demonstratione methodicus et polemicus*, b. 2, 13: 'Duplex est cognitio, *sensitiva*, quae est notitia sensus, omnem intellectivam antecedens; praecognitionem *praeparantem* dicunt; *intellectiva*, quae etiam vel *terminorum*: hanc *dirigentem* vocant; vel *praemissarum*, quam *agentem* seu efficientem vulgo appellant'.

Sensation is therefore the first instrument of scientific knowledge.[58] Without sensation and sensible knowledge, science would be impossible for three reasons. First, because all scientific knowledge comes from the conclusions of demonstrations, which depend on the cognition of principles, grounded in turn on induction from sensation. Therefore no conclusions would be possible without sensible knowledge from sensation. Second, because all intellectual knowledge, as Aristotle says, comes from previous knowledge, which itself cannot be intellectual knowledge, otherwise there would be a vicious circle. The knowledge which precedes intellectual knowledge is sensible knowledge. Last, according to Flavell, there is nothing in the intellect that was not first in the senses, and so all intellectual knowledge comes from sensation.[59] Flavell establishes explicitly that without sensation, science would be impossible because (1) intellectual knowledge needs the confirmation of the senses; and (2) the mind cannot judge things such as colours, odours and so on, without the senses; the intellectual object always comes from senses. In both cases they provide obscure knowledge or clear and distinct ideas.[60]

Sensation provides the matter of knowledge to induction, which is the process of the formation of universal concepts and principles, through which mind reasons. All arts and sciences are thus grounded on experience and induction, from which the mind, after many observations, generates the first principles.[61] Flavell adds that induction cannot infer directly from a singular observation to a general conclusion, because the mind gives its assent to principles and universal concepts only after the

[58] Cf. Ibid. b. 2, 107–108: 'Ubi non statuimus media omnia conducentia, vel conditiones omnes necessarias ad acquirendam scientiam pertractare, sed unum illud medium principale, cujus etiam explicationem instituit *Arist. I Post. 134*'.

[59] Cf. Ibid. b. 2, 108–109: '*Primam*, omnis scientia conclusionis, quae habetur per demonstrationem, dependet a cognitione principiorum, quae ut supra asseruimus, habetur per inductionem: atqui inductio ex singularibus notis sumitur, et nota haec esse nisi per sensum non possunt. *Secundo*, *omnis cognitio intellectiva oritur ex praecedente cognitione*: non autem ex praecedente cognitione *intellectiva* (ita enim daretur processus in infinitum) ergo praecedente *sensitiva*. *Tertio*, *nihil est in intellectu, quod non prius fuit in sensu*'. Cf. Paul F. Cranefield, 'On the Origin of the Phrase Nihil est in intellectu quod non prius fuerit in sensu', *Journal of the History of Medicine and Allied Sciences*, 25 (1970), 77–80.

[60] Cf. Ibid. b. 2, 109: 'Quod ad *alterum* spectat, de hoc vel illo sensu deficiente, et de objecto hujus vel illius sensus, res est aeque dilucida. Nam *primo*, cum confirmatum sit, sine sensu prorsus non esse scientiam, et cum res ista ab uno tantum sensu percipi posit, necesse est sublato uno illo sensu tolli universam ejus rei scientiam. *Secundo*, caecus non potest dijudicare de coloribus, surdus de sonis, et sic de ceteris: ergo neque eosdem perfecte cognoscunt'.

[61] Cf. Ibid. b. 2, 48: '*Fieri non potest, ut universalia percipiantur, nisi per inductionem*: per universalia propositiones universales intelligit, quas inductione vel *immediate*, vel saltem *mediate* vult cognosci. Et 1 *Metaph*. *cap*. 1. *Per experientiam ars et scientia hominibus proveniunt.* Et 2. *Post. Tex. 106*. *Necesse est ipsa prima* (nempe principia) *inductione cognoscere*. Et apertissime, 1. *Prior. ca*p. 30 § 3. *Quocirca cuiusque, principia tradere experientiae est: ex gr. Astrologica experientia Astrologiae principia suppeditat: sumptis enim et longo usu observatis iis quae apparent, tum demum inventae sunt Astrologorum demonstrationes: quod idem in qualicunque alia sive arte, sive scientia eodem modo se habet*'.

experience of many observations and experiments.[62] These last two instruments became in Flavell's theory of scientific method central ways of acquiring scientific knowledge—an issue that, as we shall see, will be carried to extremes by Harvey's experimental philosophy.[63]

Principles are conclusions of intellectual knowledge. Flavell emphasizes that the knowledge of the principles cannot be reduced to a mere apprehension from experience, as one might expect, but always involves experiments and judgments to test its correctness.[64] For Flavell, like Zabarella, induction is not a process from the unknown to the known, for in itself induction is not properly an inventive method, but a process that notifies to the intellect the universal aspect of what is apprehended by sensation, which would be otherwise obscure and unknown.[65] Induction, however, plays an essential and ancillary role in scientific method, which is for Flavell, like Zabarella, the *regressus*. *Regressus* is constituted by two processes. The first process, *ab effectu*, proceeds from effects to causes. The second examines the effects from the causes and this is the demonstration *propter quid*. In particular, *regressus* is constituted by three steps: (1) a confused knowledge of the effects from which the

[62] Cf. Ibid. b. 2, 48–49: 'Hoc ratione etiam dilucide constat: quia cum naturaliter non fiat transitus ab uno *extremo* in alterum, nisi per *medium*; fieri non potest, ut homines consueto naturae modo assentiantur principiis, antequam eorum habeant experientiam in plaerisque singularibus. Nam inter judicium unius singularis propositionis, et judicium universalis principii, medium est experimentum. Etenim judicium *singularis* propositionis uni tantum singulari addictum est: judicium vero universalis ad infinita diffunditur: at *experimentum* nec est unius tantum rei singularis, nec omnium, sed quorundam'. In early modern Aristotelian philosophy, the categories of 'experience' and 'experiment' were generally interchangeable and the boundaries between the two concepts were rather blurred: both emphasize 'the importance of sense experience in the creation of reliable knowledge of the world'. Cf. Peter Dear, 'The Meanings of Experience', in Kathrine Park and Lorraine Daston (eds.), *The Cambridge History of Science. Volume 3. Early Modern Science* (Cambridge, 2008), 106.

[63] Noteworthy, the third edition of Flavell's *Tractactus* was published in 1651, the same year of Harvey's *Exercitations de generatione animalium*. Harvey uses a similar terminology and resumes some arguments from Flavell's work, which was probably one of his major sources for the anatomist's theory of method.

[64] Cf. Ibid. b. 2, 49: '*Secundo*, omnis cognitio intellectualis a sensitiva originem ducit; *nihilque est in intellectu, quod non prius fuerit in sensu*: hoc est, quod non fuerit sensu perceptum, vel *per se*, ut *colores*; vel *per suas partes*, ut *mons aureus*, et *caetera quae fingimus*; vel *per sua effecta*, ut *Deus Opt. Max*. et *substantiae separatae*, et *virtutes rerum naturalium nostris sensibus occultae*; vel *per aliquid sibi simile*, ut *absentes* et *defuncti per depictas eorum imagines*; vel *per opposita*, ut *aspera*, *per levia*, *tenebrae per lumen*; vel *per sua fundamenta*, ut *secundae intentiones per res substratas seu denominatas*; vel *aliquo alio modo*. Ergo principiorum omnium, etiam primorum, assensus non ex nuda apprehensione terminorum, sed ex alia sensitiva cognitione emanabit'.

[65] Cf. Ibid. b. 2, 51: 'Inductio enim non est ratio, qua una res tanquam ignota ex alia notiori elicitur: sed notificatio potius rei per seipsam, et transitus rei per se notae a sensu ad intellectum. Universale enim a singulari non reipsa distinguitur, sed formaliter. Et quia eadem res notio est, ut singularis, quam ut universalis (quoniam sensilis dicitur, ut singularis, non ut universalis) ideo inductio est processus ab eodem ad idem, ab eodem ad rationem, qua evidentius, ad idem eo modo quo latentius est et obscurius: quod optime docetur a Zabarella lib.3. de Metho. cap. 19. et in com. ad finem 2. Post. Text 106'.

mind acquires a confused knowledge of the causes; (2) a mental examination, which compares the causes with the effects and thus acquires a distinct knowledge of the causes; (3) perfect demonstration (*demonstratio potissima*), which, by means of the distinct knowledge of causes, acquires a scientific knowledge of the effects.[66] Following Zabarella, Flavell states explicitly that scientific knowledge is demonstrative and acquired through the *regressus*, but, like all the other British Aristotelians influenced by the Paduan tradition, he emphasizes the role of induction, which involves multiple sensations, observations, experiments and judgments. Schmitt has observed in Powell and Flavell a radical change in the field of logic, a shift from dialectic to epistemology. They must have understood that 'Zabarella's work on scientific demonstration, growing out of the *Posterior Analytics*, must be the basis for any high-level discussion of method along traditional Aristotelian lines'.[67] Flavell's discussion was more systematic than Powell's, and more concerned with the epistemological issues of empiricism, giving an overview of the most important logical topics of the next three or four decades in the British Isles, such as the problem of innatism, the origin of sensation, the role of observations and experiments and the systematization of knowledge.

In the earliest years of the seventeenth century there were still authors of humanistic logic like Argall with his *Ad artem dialecticam introductio brevis et perspicua*, published in 1605. But even these humanists began to be influenced by Continental developments in logic, such as those of the Coimbra, Keckermann, Scheibler, Smiglecki, Du Trieu and Burgersdijk, whose works became popular in the British Isles thanks to English editions.

[66] Cf. Ibid. b. 2, 138: 'Regressus vero, definiente eodem Zabarella, est reciprocata quaedam demonstrandi ratio, qua postquam causam ignotam ex effectu noto demonstravimus, maiorem simpliciter convertimus, et minorem loco conclusionis possimus, et conclusionem loco minoris; et ita eundem effectum per eandem causam demonstramus, ut sciamus propter quid sit … Requiruntur porro ad regressum tria: primo, notitia confusa effectus, qua ducimur in cognitionem confusam causae; secundo mentis diligens examinatio, qua causam illam cum effectu, et effectum cum causa comparamus, donec tandem notitiam distinctam ipsius causae adipiscamur; tertio, demonstratio potissima, qua per distinctam causae notitiam, perfectam etiam effectus scientiam acquirimus'.

[67] Schmitt, *John Case and Aristotelianism in Renaissance England*, 36.

Chapter 7
Continental Aristotelians in the British Isles

7.1 German Aristotelianism

During the first half of the seventeenth century the syncretic and systematic works of the German logicians such as Bartholomäus Keckermann, Christoph Scheibler and Johann Stier were very successful in the British Isles. The first syncretic author to have some popularity in British universities was Keckermann, whose *Gymnasium logicum* is an abridgement of his *Systema logicae*. Keckermann's work shows no particular innovation in the field of logic, but is rather a compromise between Ramism and Zabarellism in the matter of systematization of knowledge.[1] It is a striking example of how logic was used at the time to solve theological controversies, to which the textbooks constantly refer.[2] Nonetheless, as I have shown in the previous chapters, Keckermann's works were very popular and well-studied in the university courses. In logic, his real success was not so much the *Gymnasium logicum* as the *Praecognitorum logicorum tractatus tres* (1599), and the *Systema logicae* (1600), later included in the *Systema systematum*.[3] This is particularly striking because these textbooks lacked English editions and they seem to have exerted more influence than the *Gymnasium logicum*: as we shall see, these works were the source of inspiration for many Aristotelian seventeenth-century logical textbooks such as those of Airay and Coke.

[1] Probably more correctly Mack argues that 'in logic Keckermann is one of the northern European Protestants who has turned away from Ramus towards a full reinstatement of Aristotle', cf. Mack, *A History of Renaissance Rhetoric 1380–1620*, 192.

[2] Cf. Gilbert, *Renaissance Concepts of Method*, 213–220; Ulrich G. Leinsle, *Das Ding und die Methode. Methodische Konstitution und Gegenstand der frühen protestantischen Metaphysik* (Augsburg, 1985), 275–276; Joseph S. Freedman, 'The Career and Writings of Barholomew Keckermann', *Proceedings of the American Philosophical Society*, 141 (1997), 305–364. For general overview on German Eclectic Aristotelianism cf. Howard Hotson, *Commonplace Learning: Ramism and Its German Ramifications, 1543–1630* (Oxford, 2007).

[3] Cf. Bartholomäus Keckermann, *Praecognitorum logicorum tractatus tres* (Hanau, 1599); Bartholomäus Keckermann, *Systema logicae* (Hanau, 1600); Bartholomäus Keckermann, *Systema Systematum* (Hanau, 1613).

M. Sgarbi, *The Aristotelian Tradition and the Rise of British Empiricism*,
Studies in History and Philosophy of Science 32, DOI 10.1007/978-94-007-4951-1_7,

It is no wonder that Keckermann's *Praecognita* and *Systema* were quite popular in the British Isles,[4] for, they perfectly cover the topics of the 'systema logicum', which was the first part of teaching of the courses of logic, for instance in Cambridge. Nor is it surprising that these two works were not directly adopted by lecturers in their courses and that they were often summarized in other logical companions; in fact, Keckermann's writings were rather complex and abstruse, full of references to secondary literature, in particular to Zabarella, which were not adapted for the level of instruction of university students. However, since they had exerted a considerable impact on the developments of the British Aristotelian tradition, it is necessary to consider some of their most important doctrines.

Keckermann's logic is built upon his theory of knowledge. In all cognition, three elements are necessary: (1) the object to be known; (2) a faculty that can grasp the object; (3) a disposition to grasp it in order and without error.[5] The first two elements are found in nature, while the third must be acquired. To acquire such a disposition requires a directive discipline, which does not deal with things directly, rather it instructs the mind on the operations of an ordered cognition.[6] There are two kinds of directive discipline, one that helps the cognition of things, and one that signifies and expresses things. In the latter category are included grammar, rhetorics and poetics, while in the former is properly only logic. Indeed, only logic directs the mind for a perfect cognition of things.[7] Thus for Keckermann logic is a mental art, and not properly an instrument as Zabarella sustains: the art of ordering and directing the human intellect in its operation of cognition of things.[8] Logic serves this task because the human intellect is naturally deficient and weak after the Fall, and may access only a limited portion of knowledge. It can err in the apprehension of things, in knowing them obscurely and without order.[9] Logic helps to explain things, to

[4] Cf. Hotson, *Commonplace Learning: Ramism and Its German Ramifications, 1543–1630*, 160.

[5] Cf. Keckermann, *Systema systematum*, 1: '1. Id quod cognoscendum est sive objectum. 2. Potentia naturalis intelligendi fluens ab anima rationali. 3. Dispositio certa, per quam illa naturalis potentia in actum ordinate et sine errore deducatur'.

[6] Cf. Ibid. 2: 'Quae non tractant res ipsas cognoscendas, nec Hominis intellectum rebus ipsis informant et perficiunt; sed eius operationem aliquam tantum praeparant certis normis et instrumentis dirigunt et ordinant'.

[7] Cf. Ibid.: 'Duae praecipue. Primo quidem intellectio sive cogitatio de rebus; post cogitationum significatio, quae sit locutione et scriptione … *Quae disciplinae dirigunt significationem cogitationum?* Grammatica, Rhetorica, Poetica. *Quae vero intellectionem sive cogitationes?* Sola illa divina magistra logica … ab intellectu seu ratione (nam haec aequipollent) dicta, quia dirigit istam excellentissimam hominis operationem et bene ordinat ne aberret'.

[8] Cf. Ibid. 3: 'Est ars humani intellectus operationes sive Hominis cogitationes ordinandi et dirigendi in rerum cognitione'.

[9] Cf. Ibid. 69: 'Anima quidem ipsa et essentia hominis post lapsum mansit, sed interim facultatem mansit, non intelligendi et cogitandi absolute sed recte et ordinate de rebus praesertim gravioribus cogitandi, atque adeo tres magnos velut morbos et defectus contraxit, quibus laborat circa rerum, atque adeo etiam eius, quod in rebus est, veri apprehensionem, quorum primus est aberratio a re apprehendenda; altera est, obscuritas, cum saepe res quidem comprehendit, sed interim naturas eius interiores, harumque notas seu verba quasi per nebulam conspicit; tertius, est confusio, et ἀταξία, quod nimirum res non apprehendit et cognoscit eo ordine, quo debebat: hisce tantis defectibus mentis nostrae dum per praecepta sua medetur logica, dicitur eam dirigere in cognitione rerum'. This passage, as we shall see, appears also in Airay's textbook.

prove obscure points and to order knowledge.[10] In cognition, the proper object of the intellect are universals; however, every universal cognition is preceded by sense experience, which is more knowable by the mind. Logic allows a cognition not of external things, but of the subject and its act of knowing, because following St Augustine's maxim, 'omne meum scire est per logicam'.[11] Furthermore, *contra* Plato, the intellect does not know intuitively, but discursively and following a particular order, proceeding from something already known to something unknown.[12]

There are three particular objects of knowledge: (1) infinite things, which are not in nature; (2) things that are in nature and are determined by particular circumstances and determinations; (3) things that are in nature, but considered in its universality. Only the latter kind of object is that of logic, which is called, following Melanchthon, the theme. The theme can be considered either simple, that is a simple being, or complex. The former is the object of the first part of logic, while the latter is the object of the second and third parts of logic.[13] Logic is thus divided into three parts: (1) the first deals with simple thoughts; (2) the second one deals with complex concepts; (3) the third part concerns the discourse.[14]

Keckermann's subsequent treatment of logic strictly follows that of Zabarella. A striking example is the part devoted to induction. Induction is an inference that proceeds from particulars to general conclusions, which is, for Keckermann, the same as the process of sensation. No wonder, therefore, if Keckermann treats 'sensation' and 'induction' as synonyms. However, while sensation concerns particulars, induction concerns the notification of the universals that occur in the particulars. Like Zabarella, Keckermann does not attribute to induction the possibility of discovering new knowledge on its own; rather, its task is to notify the intellect of what is grasped by sensation. Nonetheless, induction is the instrument without which universals are unknowable. Therefore induction, like sensation, is fundamental for the construction of a system of knowledge.[15]

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[10] Cf. Ibid. :'Tres defectus rationis humane simulque logicae artis tres praecipui effectus et officia: 1. explicare. 2. probare. 3. ordinare. Finis logicae vere adaequatus'.

[11] Cf. Ibid. 6: 'Per logicam non solum scimus, sed etiam scimus reflexive, id est scimus nos scire'.

[12] Cf. Ibid. 4: 'Quod sua natura magis feratur ad objecta universalia, id est ratione certi temporis, loci, contingentiae, voluntatis, et aliarum circumstantiarum indeterminata, quam ad restricta illa et determinata, quae vocatur singularia, et quae sensuum magis sunt obiecta … Quod idem non intelligat per se ipsum, sed ab uno progrediatur ad aliud … Quod egeat obiecto finito et sibi proportionato, cui commensuretur inter agendum'.

[13] Cf. Ibid. 5: 'Triplex rerum partitio … Res aliae sunt infinitae … Res in natura positae considerantur dupliciter: primo, indeterminate sine ullo respectu et restrictione ad certum locum, et tempus, et alias circumstantias, ut homo; post determinate ad certas circumstantias, ut Petrus. … Res interdum considerantur absolute per se et sic dicuntur entia simplicia, ut homo; interdum ut coordinatae inter sese, ut homo animal; et sic dicuntur complexa. Circa illas versatur prima pars logicae, circa has secunda et tertia'.

[14] Cf. Ibid. 68: 'Praecepta eius dividuuntur in tres partes, ex quibus prima, directrix conceptus, seu cogitationis simplicia; altera, conceptus complexi; tertia, discursus'.

[15] Cf. Ibid. 255: '*Inductio principalis est, cum ex pluriuso singularibus vel particularibus elicitur generalis conclusio* … Cum enim sensus noster procedat a singularibus ad generalia, atque adeo intellectui notificentur universalia per singularia in sensus incurrentia, ideo inductio instrumentum notificandi est aptissimum … Hinc Zabar. Lib. 3. De meth. cap. 19. statuit inductionem non tam probare quam declarare … Impossibile est universalia contemplari sine inductione'.

The idea of induction as a specific logical inference presents some peculiarities. First of all, according to induction, what concerns some particulars concerns all the particulars in general. Moreover, since the particulars can be infinite in number, it is sufficient to prove just some of them and to add the clause that it is not possible to find any contradictory example.[16] However, for Keckermann, as for Zabarella, induction is not the proper instrument to direct knowledge, which is possible only through demonstration and regressus.

All knowledge, however, must be structured by method, which does not direct the mind in cognition of things, but rather orders what is already known.[17] In this Keckermann seems to be following the Ramist position in particular, stating also that the process of method must imitate the process and order of natural things, proceeding from what is known *a priori* and more knowable by nature to what is known *a posteriori*.[18] Keckermann does not include method in invention, since it is only a pedagogical instrument. In the same sense must be understood Keckermann's distinction between synthesis and analysis with the preference of the former over the latter. Particularly interesting is Keckermann's examination of analysis which is the only part of method to be treated at length in the *Gymnasium logicum* as well. It is also of utmost importance because it may have exerted some influence on Hobbes' constructivism. According to Keckermann a correct resolution is possible only by means of the cognition of the process of construction of a thing.[19] Therefore every analysis consists first in the cognition of things and second in the cognition of how this thing has been constructed.[20] Only by knowing how a thing is constructed is it possible to know its real constitution, which would remain otherwise totally unknown. Keckermann, however, especially in the *Gymnasium logicum*, applies this idea of analysis only to theological arguments.

Scheibler's work, which was widely approved among British academics, also shows a commingling of Ramism and Zabarellism, like Keckermann's writings. His *Opus logicum*, published for the first time in Marburg in 1634, collects a series of works on logic, such as the *Introductio logicae* (1613), and stands as a comprehensive compendium of his logical thought.[21]

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[16] Cf. Ibid. 255–256: 'Inductio constans ex propositionibus particularibus potest omnia particularia adducere … Cum singularia sint infinita, sufficit praecipua adduxisse, addita formula solenni, *nec potest dari dissimile exemplum*'.

[17] Cf. Ibid. 308: '*Fuit directrix discursus illativi; superest directrix discursus ordinativi, qui est actus mentis seu intellectus humani ab una parte doctrinae ad aliam procedentis, eas inter se conferendo et connectendo, adminiculo praeceptorum methodi*'.

[18] Cf. Ibid. 309: 'Processus methodi imitetur processum et ordinem naturalem rerum, progredendo a natura prioribus et notioribus ad posteriora'. Later, this consideration on method will be followed by Coke.

[19] Cf. Keckermann, *Gymnasium logicum*, 115: '*Omnia resolutio intelligitur ex constructione: nam quibus artificiis quidlibet construitur, isdem etiam resolvitur*'.

[20] Cf. Ibid.: '*Omnis analysis consistit in duobus: primo, in cognitione rei vel operis resolvendi; secundo, in ex pensione modi sive artificii, quo opus illud constructum est*'.

[21] Cf. Christoph Scheibler, *Opus logicum quattuor partibus universum huius artis sistema comprehendens ut sunt I. Introductio logicae II. Topica, de argumentis sive locis dialecticis. III. De propositionibus, sive axiomatibus. IV. De syllogismis et methodis* (Marburg, 1634). The citations are taken from the *Opera philosophica* which contains the *Opus logicum* (Frankfurt-Giessen, 1654–1658).

Scheibler's general definition of logic as the art of arguing well on all matters is essentially Ramist.[22] Logic is an art, in the broad sense, that is, a discipline whose end is useful to man.[23] It deals with being in a general sense, as well as not being.[24] Its aim is twofold, intrinsic and extrinsic. The intrinsic aim of logic is to argue well and teach the modes of argumentation. Its extrinsic aim is universal knowledge. Indeed, logic's general end is to argue well in order to know the truth.[25]

Scheibler's conception of method is indeed completely Zabarellan, beginning with his idea of induction. Induction is according to Scheibler a kind of syllogism, and in particular a kind of enthymeme.[26] It concerns particulars as well as universals, because the particular can be thought of as that which is less universal.[27] Specifically, Scheibler defines induction as a particular kind of syllogism or enthymeme in which the parts are taken together to infer a whole. In order to acquire perfect knowledge, induction should enumerate all the particular cases, although Scheibler is well aware that this is not always possible, and this is why inductive knowledge is less distinct than demonstrative knowledge. However, induction can also be demonstrative, when the connection between subject and predicate or singular and universal is clear.[28]

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[22] Cf. Scheibler, *Opus logicum*, 45: 'Dialectica est ars bene disserendi de quovis Ente'.

[23] Cf. Ibid. 46: 'sine dubio logica ars est, sicut omnes disciplinae philosophicae. Et hanc solam significationem ferae sequuntur Ramei, quando logicam artem dicunt. Definiunt enim eam sic, ut quamvis doctrinam tendentem ad finem in vita humana utilem, dicant artem. Quia tamen admodum laxa et vaga et impropria etiam est ista appellatio secundum hunc sensum, ut fatetur Zabarella *l. de. nat. Log. c. 2*'.

[24] Cf. Ibid. 59: '*Omnis ens in universalissima sua latitudine est objectum adaequatum logicae*. Haec propositio proximae accedit ad sententiam Rami, aut fortasse eadem est cum sententia ipsius. Nam etsi ille non-ens dicat etiam esse objectum logicae, tamen si ens universalissimae sumatur, non-ens sub ente comprehendi potest, ut patebit ex distinctione entis'.

[25] Cf. Ibid. 70: '1. Finis internus logicae est bene disserere, sive tradere modum bene disserendi. 2. Finis externus est verum cognoscere in quovis ente. 3. Finis externus et internus simul indicantur si dicamus finem logicae esse bene disserendo cognoscere veritatem'.

[26] Cf. Ibid. 749: 'Inductionem esse syllogismum … inductionem omnino esse enthymema … Confer Zabarellam *l. 3. de method. cap. 3*'.

[27] Cf. Ibid.: 'Aristoteles medium inductionis dicit esse rem singularem … hoc est progressionem a singularibus ad universale. … Demonstrationem esse universalium, sed inductionem … particularium. Haec in re praemittendum est: singulare bifariam sumi. Aliquando singulare est idem, quod individuum. Haec vulgaris est acceptio. Deinde singulare aliquando idem est, quod minus universale. … Facilius definiri singulare, quam universale, ubi singulare est idem quod minus universale, interprete Zabarella *in comm. ad 2. Post. t. 82 fol. 1217 … Inductio non semper fit per singularia, hoc est, individua, sed sit etiam per singularia, hoc est, minus universalia, adeoque fit per utraque*. Sic igitur omnis inductio hactenus est a singulari, hoc sensu, quod inductio semper incoetur ab aliquo restrictiori et terminetur ad aliquid isto universalius, vel amplius. Confer Zabarellam *2. post. cap. 2. text. 13*'.

[28] Cf. Ibid. 710: 'Inductio est syllogismus vel (propinquius) enthymema in quo ex partibus simul sumptis vel collectis totum infertur. … Inductio debet enumerare omnes partes. Caeterum omnes illae partes non semper enumerantur distinctae sed aliquando implicitae et confusae. … in inductione demonstrativa non esse necesse, percorrere omnia singularia, sed satis esse, si cognoscatur passionem istam aliquibus individuis inesse per se. Tum igitur necessario colligetur, id universale vel toti etiam convenire, quia quod singularibus per se convenit, id etiam ante convenit naturae communi. Idem docet Zabarella *l. 3. de method. cap. 14*'.

Demonstration, by contrast, is a particular form of syllogism, which from true premises deduces necessarily true conclusions. There are two kinds of demonstration, both equally valid: the demonstration τοῦ ὅτι, or *quia*, which proceeds from the effects to a general and confused knowledge of the causes, and the demonstration τοῦ δίοτι, or *propter quid*, which proceeds from the specific knowledge of the causes to the particular effects. The peculiarity of demonstration is that it proceeds from what is known by the mind to something unknown, characterized by the transition from confused to distinct knowledge.[29] Demonstration is thus the specific instrument of method. In fact, following Zabarella, Scheibler defines method as an intellectual instrument which infers from something known to something unknown, and which corresponds to the syllogism.[30] Method therefore proceeds from what is 'most knowable by us' to what is least knowable or unknown. Scheibler remarks that 'known' can be understood in three distinct ways: (1) that which contains the means to arrive at something unknown, such premises for the conclusions; (2) that which is necessary for the knowledge of something else, such as the genus for the species; (3) everything which is presupposed by the mind and that is useful for knowledge.[31] That which is most knowable is the particular, rather than the universal, and it is from particulars that the mind acquires new knowledge. However, the first objects of knowledge of the mind are those universals apprehended by sensation, which are generic and vague; by means of method, they become more specific and definite, including all the particulars which they govern.[32]

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[29] Cf. Ibid. 773: 'demonstratio est ex notioribus nobis, quia est instrumentum intellectus, ad acquirendam notitiam alicujus prius incogniti. Ad notitiam autem rei incognitae non possumus devenire, nisi ex iis, quae prius nobis cognita fuerunt … Ordines istos notioris, opponi, in cognitione confusa, sed in cognitione distincta coincidunt. Ibi nempe, quod est notius nobis, est etiam notius natura. Vide Zabarellam *I. post ad t. 12 fol. 665*'.

[30] Cf. Ibid. 799: 'Methodus significat processum in quo ex unius cognitione ducimur in cognitionem alterius. Unde methodus reperitur in qualibet particula ordinatae tractationis, cui processus syllogisticus a causa ad effectum, vel ab effectu ad causam inest. Ad hunc ergo modum methodus vere nihil aliud est, quam syllogismus et definitio methodi a definitione syllogismi non differt. … Zabarella *l. 3 de method. cap. 2.* Methodum sic definit: *methodus est intellectuale instrumentum, faciens ex notis cognitionem ignoti*'.

[31] Cf. Ibid. 804: '*Methodus procedit a facilioribus cognitu, et nobis notioribus ad difficiliora et ignotiora*. … Igitur observandum est: notius aliquid alio dici trifariam: 1. Quia fit vel contineat medium concludendi aliquid, de alio ignotiori. Ita praemissae notiores sunt conclusiones; 2. Quia fit necessarium ad aliud cognoscendum. Quomodo genus est notius specie, quia eo cognito, jam dum aliqua speciei pars cognita est. 3. Denique notius dicitur quasi discerem quod nihil horum praestat, est tamen utile ad alium cognoscendum, ut ejus notitia in mente presupposita, intellectus facilior fit et promptior, ad apprehendenda et dijudicanda alia, quomodo doctrina de visu notior est doctrina sensuum aliorum'.

[32] Cf. Ibid. 804–805: 'Notius nobis, aliquando specialiter sumi, per ordinem intellectum nostrum prorsus rudem et imperitum, quomodo singularia sunt notiora nobis quam universalia. Proinde notius nobis, in praesenti ita non accipitur. Methodus enim non progreditur a singularibus ad universalia, sed a maxime universalibus ad minus universalia et dehinc ad singularia. Igitur aliter notius nobis intelligitur secundum distinctam cognitionem, quomodo id dicitur notius nobis, quod nobis distinctam rerum cognitionem venantibus facilius est cognitu'.

Following Zabarella, and against Ramus, Scheibler states that there are two methods: synthesis and analysis.[33] Synthetic or compositive method proceeds from components to compound, from the parts to the whole. It proceeds from what is a priori 'most knowable by nature' to what is a posteriori 'most knowable to us', that is from the causes to the effects, from what is more general to what is less general.[34] However, it is wrong to use only synthetic method, because for some disciplines, like physics, the analytic method is also necessary.[35] Analytic method decomposes the whole into its parts and proceeds from the effects to the causes.[36]

Scheibler's textbook is a syncretistic and systematic work, which had the merit of disseminating Zabarella's methodology in Protestant areas, but it made no new contributions in logic. Scheibler was more a metaphysician than a logician and his logical work was too complex to be suitable for teaching, but it was nonetheless a constant reference for professional academics, in particular those in close association with the German Protestant world.

Another important seventeenth-century German Aristotelian was Joachim Jungius (1587–1657), who published his *Logica Hamburgensis* in 1638.[37] The work underwent several editions in 1641, 1657, 1672, taking its final form only in 1681.[38] Jungius' *Logica* never became a textbook in British universities, but, as Stephen Clucas has demonstrated, it exerted some influence on Hartlib's circle.[39] Jungius' work is the perfect example of how Zabarellan ideas on scientific method were transformed into a new kind of empiricism.[40]

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[33] Cf. Ibid. 808: 'Methodus non est unica … methodus est duplex: alia synthetica alia analytica'.

[34] Cf. Ibid.: 'Latinis dicitur methodus *compositiva*, quia videlicet ista progreditur a componentibus ad compositum, hoc est, a partibus ad totum … Est nempe ista methodus, quae procedit a natura prioribus ad posteriora, nempe a causis ad effectum, a magis universalibus ad minus universalia, a componentibus ad compositum, atque adeo a partibus ad totum'.

[35] Cf. Ibid. 804–805: 'Unde qui generale methodi requisitum ponunt *progredi a simplicioribus ad composita etc.* non recte procedunt, cum hoc ipsum soli methodo syntheticae et non etiam analyticae conveniat. Servavitque istam methodum Aristoteles in Physicis'.

[36] Cf. Ibid. 805: 'Dicitur autem methodus *analytica* … quod est resolvere. Unde Latinis vocatur methodus *resolvens* et *resolutiva*, sic dicta, quia progreditur a toto, resolvendo illud in partes, vel quia incipit a fine vel effectu, et illum resolvit in causas prodeuntes ipsum'.

[37] Cf. Joachim Jungius, *Logica Hamburgensis* (Hamburg, 1638).

[38] Quotations from Jungius' text are from Rudolf W. Meyer's critical edition cf. Joachim Jungius, *Logica Hamburgensis* (Hamburg, 1957). The number of pages refer to 1681 edition.

[39] Cf. Clucas, 'In Search of "the True Logick": Methodological Eclecticism among the "Baconian Reformers"', 68–70.

[40] Jungius received his medical degree in 1619 from Padua, where he became acquainted with Zabarella's logic. He probably studied Zabarella's doctrines at Helmstedt, which at the time was a stronghold of Aristotelianism. On Zabarella's influence on Jungius cf. Rudolf W. Meyer, 'Vorwort des Herausgebers', in Jungius, *Logica Hamburgensis*, XV-XVII; Daniel A. Di Liscia, 'Operosum Negotium: Jungius' Doxoskopische Betrachtung es Aristotelismus von Zabarella', in Piaia, *La presenza dell'aristotelismo padovano nella filosofia della prima modernità*, 215–255. On Jungius' empiricism cf. Christoph Meinel, 'Joachim Jungius (1587–1657): empirisme et réforme scientifique au seuil de l'époque moderne', *Archives internationales d'historie des sciences*, 37 (1987), 297–315.

Jungius' logical standpoint is extremely clear already from his definition of logic as the art of directing the operations of the mind in distinguishing truth and falsehood.[41]

These operations are the *notio*, the *enunciatio* and the *dianoea*. The *notio* is the first operation by means of which the mind represents the image of a thing. Representing means to conceive, apprehend and think a notion in the mind, which stands for a thing.[42] A notion in the mind does not always represent a real existing thing, but it can be purely mental. This does not mean that the notion is false, but that it is only a cogitation.[43] The second operation of the mind is the enunciation, which is a composition of notions through which the mind distinguishes truth from falsehood.[44] The third operation of the mind is the combination of several enunciations, which constitutes a discourse.[45] Following Zabarella's definition, Jungius explains that logic is a mental and organic habit that discerns what is true from what is false, i.e. it is an instrument for scientific knowledge.

Like Zabarella, Jungius distinguishes two parts of logic: (1) general logic teaches the most universal precepts for reasoning correctly; (2) special logic is apodictic, when it concerns demonstrations, or dialectic, when it deals with probable arguments.[46]

It is the apodictic part of logic that arouses interest and especially shows Jungius' Zabarellan heritage. *De logica apodictica*, which constitutes the fourth book of the *Logica Hamburgensis*, is probably a re-elaboration of an earlier *quaestio* entitled *Apodictica Zabarellae*, which is now unfortunately lost.[47]

Apodictic logic deals with demonstration that leads to science, and this is the reason why Jungius also calls this part *epistemonica*.[48] In a general sense, science is every intellectual cognition, both necessary and probable. In a narrow sense, science

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[41] Cf. Jungius, *Logica Hamburgensis*, 1: '*Logica* est ars mentis nostrae operationes dirigens ad verum a falso discernendum'.

[42] Cf. Ibid.: 'Tres autem sunt mentis nostrae operationes *Notio sive Conceptus*, *Enuntiatio*, *et Dianoea sive Discursus*. *Notio* est prima intellectus nostri operatio, qua ceu imagine rem aliquam exprimimus: sive *Notio* est simulacrum, (ὁμοίωμα) quo res in mente repraesentatur. Ideo rem ipsam *concipere*, *apprehendere*, *cogitare* dicimur, ubi Notionem ejus concipimus aut efformamus, ut dum ita cogitamus, *homo*, *equus*, *rosa*, *quercus*, *homo pulcher*, *equus celer*, *flos purpureus*'.

[43] Cf. Ibid. 2: 'Notio quidem rebus, quae vere existunt, repraesentandis praecipue destinatur, quod si tamen Notioni alicui res in rerum natura non respondeat, non ob id falsa redditur ipsa Notio, ut si cogitem *campos Elisios*, *Centaurum*, *Purgatorium*, falsa non est haec mea cogitatio'.

[44] Cf. Ibid. 1: '*Enunciatio* est secunda mentis operatio ex Notionibus ita composita, ut verum aut falsum in ea exoriatur'.

[45] Cf. Ibid. 2: '*Dianoea* est tertia mentis operatio ex Enuntiationibus ita constituta, ut verum aliquid ex alio vero colligatur'.

[46] Cf. Ibid. 4: 'Oritur hinc genuina Logices partitio. Dividitur enim Logica in partem *generalem et specialem. Pars generalis est*, quae Verum in genere sibi habet propositum, hoc est, quae ea Praecepta tradit, quae Veri tam necessarij quam probabilis dijudicationi communiter inserviunt … *Specialis logica* Verum in specie spectat, estque duplex *Apodictica et Dialectica*'.

[47] Cf. Martin Vogel, *Historia vitae et mortis Joachimi Jungii* (Strasburg, 1658), 268.

[48] Cf. Jungius, *Logica Hamburgensis*, 273: 'Ex *Specialis Logicae* partibus dignitate antecedit ea, quae in *Vero necessario*, sive in *Vero proprie dicto* versatur, hoc est, quae per *Apodixin*, sive demonstrationem ad *scientiam* nos deducit, ideoque et *Apodictica*, et *Epistemonica* merito appellatur'.

is fourfold: (1) from singulars of singulars; (2) from singulars of universals; (3) from universals of universals; (4) from universals of particulars.[49] The first is called *experientia singularis*, which is a particular enunciation of the mind on a specific concrete thing known by sensation.[50] The second is an *experientia universalis*, which consists in a general enunciation that the mind makes from several singular experiences collected by induction.[51] The third is science strictly speaking because it provides general valid conclusions for every case taken into consideration.[52] The science from universals of particulars is called *scientia particularis* and provides general conclusions for particular cases.[53] The true forms of science are those two that concern universal objects and are based on demonstration.[54]

In general, demonstration is every kind of proof or confirmation of things by means of a legitimate inference. In particular there are two kinds of inference: (1) scientific induction, which proceeds from particulars to universals; (2) demonstration properly speaking, which proceeds from universals to universals in a form of syllogism. These inferences characterize the scientific method, which concerns not only necessary things (such as mathematical things and natural causes), but also contingent things (such as human actions and physical events), even if it always draws necessary conclusions.[55] Therefore, Jungius points out, scientific method is a process from what is known to what is unknown.[56]

According to Jungius, scientific method rests on definitions and experience. Definition is a mental proposition that serves induction and demonstration in

[49] Cf. Ibid. 273–274: '*Scientia late sumpta* intelligitur de quamvis cognitione intellectus enunciativa; sive ea *certa*, sive *dubia* sit, sive *necessaria*, sive *probabilis*. … Ea *quadruplex* est: vel enim est *ex singularibus de singularibus*; vel *ex singularibus de universalibus*; vel *ex universalibus de universalibus*; vel *ex universalibus de singularibus*'.

[50] Cf. Ibid. 274: 'Quae *ex singularibus de singularibus est*, *Experientia singularis*, ἐμπειρία ἡ καθ'ἕκαστον, dicitur, et est enuntiatio singularis, quam intellectus format, dum rem singularem vel immediate, vel mediante sensu cognoscit, ut dum animadvertit'.

[51] Cf. Ibid.: 'Scientia quae *ex singularibus de universalibus* habetur, *Experientia universalis*, ἐμπειρία ἡ καθ'ὅλου, item *Scientia empirica* dicitur, estque Enuntiatio universalis ex pluriuso singularibus experientijs per inductionem collecta'.

[52] Cf. Ibid. 274–275: 'Ea quae *ex universalibus de universalibus* est cognitio*, Scientia* est *stricte dicta*, conclusio scilicet ex universalibus experientijs, sive immediate, sive mediate, nusquam interrupta cohaerentium Dianoearum serie, collecta'.

[53] Cf. Ibid. 275: 'Cognitio *ex universalibus de singularibus* est, quae ex scientia stricte dicta singularem sub ea comprehensam infert, et *Scientia particularis*, aut *propria*, ἐπιστήμη κατὰ μέρος ἤ καθ'ἕκαστον, ἤ οἰκεία appellatur'.

[54] Cf. Ibid.: '*Experientia universalis, et Scientia stricte dicta* interdum communi *Scientiae universalis* ἐπιστήμης τῆς καθόλου appellatione comprehenduntur'.

[55] Cf. Ibid. 276: 'Complectitur itaque tum *Inductionem Scientialem*, quae a singularibus sumptionibus ad universalem; tum *Demonstrationem stricte dictam*, quae ab universalibus sumptionibus ad universalem conclusionem procedit'.

[56] Cf. Ibid. 280: '*Methodus scientifica* est dianoeticus a notioribus propositionibus ad ignotam aliquam universalem propositionem processus: Estque vel *Inductio scientialis*, vel *Demonstratio*'.

determining knowledge.[57] In general, experience is the process of gathering knowledge and deals in particular with the apprehension of sensible objects, which are called *phaenomena*. Experimentation is exactly the process of revealing these *phaenomena* which appear to the mind by sensation, and this is the reason why many logicians, according to Jungius, confuse experience with sensation.[58] But experience concerns also the intellectual cognition of particular things apprehended by perception, and in this case it is called actual experience. Actual experience generates empirical theorems and propositions, which are the foundations of scientific demonstration.[59]

Jungius—as I have just shown—distinguishes a singular experience from a universal experience, which is in turn divided into an external experience, an internal experience and in a middle experience. External experience is based on the external senses and perception; internal experience is acquired by the intellect's act of reflection on its objects and operations; middle experience has its basis in the reflection but operates on sensible things.[60]

Jungius points out that there is also a common experience which arises from observation. Observation stands for experience in two ways: for the acquisition of experience and for experience itself. In the first sense, observation properly speaking is an ordered series of sensations from which it is possible to draw some conclusions. In the second sense, it concerns the intellect when it takes as true that which has been acquired by observation, and it is specifically called *experientia-per-observationem*.[61]

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[57] Cf. Ibid. 283: 'Definitio proinde *extrinsecus tantum Inductioni et Demonstrationi inservit*, *si mentalem orationem spectes*, quatenus scilicet utrique terminum distinctum hoc est notionem distinctam suppeditat'.

[58] Cf. Ibid. 291: '*Experientia* interdum pro *sensili accidente* accipitur, hoc est pro actione, passione, mutatione, eventu circa rem, quam exploramus, experimur, et sensui subjicimus. Dicitur alis *Experimentum* πεῖρα item *Phaenomenon*, hoc est aliquid sensibus apparens. Secundo *experientia* sumitur pro *sensione* ipsa, sive *sensitiva perceptione ipsius Phaenomeni*'.

[59] Cf. Ibid. 291–292: 'Tertio *cognitionem intellectus enuntiativam* significat, ex rerum singularium perceptione ortam, sive ex cognitione aliqua praesentanea, hoc est objectum suum praesens ut praesens apprehendente. Dicitur etiam *actualis experientia*. Hoc loco de *actuali experientia* agendum quae operatio est intellectus secunda*, vide licet* enuntiatio*, et respectu scientificae Methodi* Propositio*.* Dicitur etiam *Propositio empirica*, item *Theorema empiricum*'.

[60] Cf. Ibid. 292: 'Experientia haec duplex est, alia *singularis*, alia *universalis*, sicuti capite primo jam explicatum. Utraque cursus est triplex, *externa*, *interna et media*. *Externa* est, quae externorum sensuum *perceptioni* superstruitur. *Interna* est, quae *reflexioni* intellectus innititur, qua nimirum ipse operationes suas, ceu praesentanea quamdam cognitione sive animadvertit, sive suo modo sentit. *Media* est, cujus fundamentum est *reflexio*, qua *sensus* ipsi, praesertim interni, actiones et passiones suas sibi praesentes sentiunt, vel etiam qua *intellectus* sensuum functiones percipit'.

[61] Cf. Ibid. 293–294: 'Experientia porro alia *vulgaris* est, alia *per Observationem orta*. … *Observatio* τήρεσις dupliciter accipitur, primum *pro acquisitione experientiae*; secundo *pro experientia* ipsa. *Observatio priori modo*, hoc est, *proprie sumpta* est ordinata series sensionum certo consilio instituta sciendi gratia; … *Observatio posteriori modo* intellecta est experientia sive enuntiatio, quam intellectus format observationi proprie dictae fidem habens, ac proinde rectius *Experientia-per-observationem* dicitur'.

Experience can be also confused or distinct. Confused experience is when the mind does not clearly distinguish one thing from another, or when two different things are taken together. It can be confused in two ways: according to the part, when it is not distinguishable from other parts, or according to the accident, when it is considered as an essential element of a given thing.[62]

Distinct experience, instead, is when the mind clearly apprehends all parts and distinguishes all accidents. The work of diligent observation can generate distinct experience, and the collection of ordered observations is called *historia scientialis*, which is the ground of every serious investigation in the natural sciences.[63] For elaborating a scientific history, according to Jungius it is necessary to divide and arrange properly the various experiences from the universal to its parts. Such division follows different criteria, such as the division by subject, by accident, by efficient cause, by effect, by transient matter, by permanent matter, or by objects as they are acquired (either by sensation or by reflection).[64]

Once the experience is well arranged, the mind can apply two instruments in order to discover scientific knowledge, namely scientific induction and demonstration.

In general, Jungius defines induction as an inference that proceeds from specific particulars to general conclusions.[65] Induction can be either primary or secondary. Primary induction is when it proceeds from singulars to universals, while secondary induction proceeds from special universals to general universals.[66] Primary induction is always incomplete because the mind cannot deal with all the infinite particular cases and it must be considered valid until a counter-example is found.[67] Secondary induction, instead, can be either complete or incomplete. It is complete if and only if all the special universals are comprehended by general universals.[68]

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[62] Cf. Ibid. 294: 'Confusa ἐμπειρία συγκεχυμένη est, in qua ut unum quid accipiuntur, quae sunt diversa. Estque vel *partium ratione confusa*, vel *accidentium respectu*'.

[63] Cf. Ibid. 295–296: '*Experientia distincta* ἐμπειρία διωρισμένη, est in qua et unicuique parti suum tribuitur, et id, quod per accidens evenit, ab eo, quod per se est, distinguitur. … Caeterum si plures experientiae sive vulgares sive per observationem comparatae literis consignentur, *Historia scientialis* dicitur'.

[64] Cf. Ibid. 297: 'Inter *Experientias* peculiarem considerationem requirunt illae, quae *Divisionis* appellatione a reliquis discernuntur. *Divisa proprie dicta* est, quae totum universale in partes subjectas dividit, ideoque singularibus accommodari nequit'.

[65] Cf. Ibid. 237: 'Pertractata *Syllogismi* doctrinae, superest ex simplicibus argumentationibus *Inductio* ἐπαγογή, quae est argumentatio, quae ex pluriuso strictioribus propositionibus latior aliqua colligitur conclusio'.

[66] Cf. Ibid. 237–238: 'Est autem *inductio* duplex, alia *primaria*, alia *secundaria*. *Inductio primaria* est, quae ex singularibus Enuntiationibus universalem Enuntiationem colligit … *Inductio secundaria* est, quae ex universalibus specialibus sumptionibus universalem generalem conclusionem colligit'.

[67] Cf. Ibid. 238: '*Inductio primaria* semper *incompleta* est, cum singularia numero infinita sint, infinita autem intellectus hominis transire non valeat; firma tamen habetur, quamdiu *exemplum contrarium* afferri nequit'.

[68] Cf. Ibid. 239–240: '*Inductio secundaria* alia est *completa*, alia *incompleta. Completa* est, quae omnes speciales sub generali comprehensas in Antecedente sumit … *Inductio secundaria incompleta* est, quae non omnes speciales sub generali comprehensas in Antecedente sumit, sive in cujus Antecedente non sumuntur omnia specialia subjecta sub Conclusionis subjecto comprehensa'.

Induction can deal with true and necessary things or with only probable things.[69] Scientific induction concerns only some necessary things, those apprehended by experience. In fact, Jungius points out that scientific induction is always based on experience either acquired by sensation or by reflection (through the intellect) or by prior cognition and it must be distinguished from demonstrative induction, which is based on things taken as true and necessary by demonstration.[70] In this sense, Jungius criticizes Zabarella's assimilation of scientific induction with demonstrative induction.[71] For simplicity, therefore, Jungius prefers to call his conception of induction a 'scientific-empirical induction'.[72]

Jungius specifies that scientific induction proceeds successively and slowly by the various degrees from the lowest species, through the lowest genus, to the highest genus, considering the various instances, rather than proceeding directly and swiftly from singulars to universals.[73] Jungius' attempt to reform the Aristotelian and Zabarellan view of induction is—as we shall see—very similar to that of Bacon in the *Novum Organum*. No wonder that the English Baconian reformers recognized the German logician as an authority in this field of studies, and there is no doubt that he influenced the genesis of experimental philosophy, thanks to the wide dissemination of his ideas in extra-academic circles.[74]

In 1647 the Aristotelian Stier published in Cambridge his *Praecepta doctrinae logicae, ethicae, physicae, metaphysicae*. His conception of logic comes directly from Zabarella. Stier defines logic as an intellectual instrumental habit of the mind, which makes discourses and distinguishes truth from the falsehood.[75] The subject of logic is twofold: (1) the subject *inhaesionis*, which is the human mind; (2) the

[69] Cf. Ibid. 312–313: 'Quid Inductio sit, prout *ad verum tam necessarium quam probabile indifferenter* se habet, libro tertio est explicatum: Hic de ea est agendum, quae in vero necessario occupata, ideo *scientialis* sive *epistemonica* cognominatur'.

[70] Cf. Ibid. 313: 'Habet autem et hoc praeterea peculiare haec Inductio, quod sumptionibus constat *soli experientiae innixis*, hoc est vel per sensum, vel per animadversionem intellectus reflexivam, vel per inductionem aliam priorem cognitis. Si enim sumptiones Inductionis alicujus necessario verae per demonstrationem innotuerint, ham non *scientialis* aut *epistemonica*, sed *apodictica* sive *demontrativa Inductio* dicitur'.

[71] Cf. Ibid.: 'Zabarella *scientialem et demonstrativam Inductionem*, ut aequipollentia usurpat: verum nos ea, quae reipsa discrepant, appellationibus quoque distinguenda ducimus'.

[72] Cf. Ibid. 343: 'Quam supra cum Zabarella *inductionem scientialem* nominavi, eam hic uberioris distinctionis gratiam *scientialem empiricam* appello: ut *Scientialis inductio vel empirica* sit, vel *apodictica*'.

[73] Cf. Ibid. 318: 'Inductio scientifica fiat *successive et gradatim*, hoc est, non a singularibus statim ad superiora genera ascendatur, sed primum ad infimas species, et ab his porro ad genera infima, atque ita pedetentim ad superiora'.

[74] For a complete account of Jungius' theory of induction and his influence on the Baconian reformers see Stephen Clucas, 'Scientia and Inductio Scientifica in the Logica Hamburgensis of Joachim Jungius', in Tom Sorell, John G.A. Rogers and Jill Kraye (eds.), Scientia *in Early Modern Philosophy: Seventeenth-Century Thinkers on Demonstrative Knowledge from Initial Principles* (Dordrecht, 2010), 52–70.

[75] Cf. Stier, *Praecepta doctrinae logicae* …, 1: 'Logica est habitus intellectualis instrumentalis mentis nostrae discursum informans, ut ipsa verum a falso accurate discernere possit'.

subject *operationis* or *obiectum*, which are all things represented as *secundae notiones*. In all things the mind distinguishes a material part or *res considerata* and a formal part, based on the *res considerata*, called the *secunda notio* or *modus considerandi*.[76] Not only do Stier's views of the nature and subject of logic come from Zabarella, but also his theory of method. Method is the logical instrument for acquiring knowledge of things.[77] However, he observes, method is in particular the demonstrative and inferential process by means of which the mind acquires a perfect and distinct knowledge of things, while order is properly the process of arranging knowledge. Specifically, method can be either synthetic, corresponding to demonstration δίοτι, or analytic, corresponding to demonstration ὅτι.[78] Order, by contrast, is properly defined as an instrumental habit that arranges knowledge for a better cognition of things.[79]

German Aristotelianism had a wide dissemination in the British Isles because of its eclecticism, which made possible the gradual passage from Ramism to Aristotelianism.[80] However, at least in the British Isles, it did not contribute to the formation and development of a native school.

7.2 Logical Jesuit School

It is commonly held that the Jesuits in the seventeenth century contributed decisively only to the development of metaphysics. But this is a false image, for they played a fundamental role also in the development of logic. In the British Isles the Jesuits had the greatest impact of all the Continental Aristotelians: their works were studied in strictly Protestant universities, even where anti-Catholic and anti-scholastic polemic was very strong.

We can evaluate the impact of the Jesuit commentaries in the British Isles by examining the *Brevissimum totius Conimbricensis logicae compendium* (London, 1627),[81] a summary of the much larger *Commentarii collegii Conimbricensis in universam dialecticam* (1606). The composition of the textbook offers a general

[76] Cf. Ibid.: '*Subjectum* quod est vel 1) *inhaesionis*, quod est intellectus humanus, cui Logica subjective inest; 2) *operationis* sive *objectum*, quod sunt res omnes quatenus notionibus secundis substant. *Res omnes* sunt materiale seu res considerata: *quatenus substant notionibus secundis* est Formale, seu modus considerandi'.

[77] Cf. Ibid. 30: 'methodus est instrumentum logicum ad rerum cognitionem facilius assequendam utile'.

[78] Cf. Ibid.: '*cum illatione*, seu methodus proprie sic dicta, quae est ipsa demonstratio, estque vel *synthetica*, quae demonstratio δίοτι; *analytica*, quae demonstratio ὅτι'.

[79] Cf. Ibid.: 'Ordo est habitus intellectus instrumentalis, quo res in disciplinis pertractandas ante vel post collocamus, ob meliorem illarum cognitionem'.

[80] On the impact of German Calvinist logicians in Britain cf. Clucas, 'In Search of "the True Logick": Methodological Eclecticism among the "Baconian Reformers"', 68–72.

[81] Cf. *Brevissimum totius Conimbricensis logicae compendium per Hieronymum de Pavia* (London, 1627).

indication of the interests in the British Isles at that time. A third of the book is devoted to the nature and subject of logic, another third to logical doctrines in general, such as the theory of proposition and syllogism, and the last third to science. This last part was the most interesting of the Coimbran exposition of logic: no other logical compendium of the time devoted so much space to the treatment of science. But despite this, we will search in vain for new logical doctrines.

Logic, or dialectic, is defined as an *ars disserendi*, whose end is to teach the rules and modes of argumentation. It can be divided into *logica docens* and *logica utens.*[82] The first is characterized as the logic of true science, which proceeds by rigorous arguments to discover first principles. Logic is defined as a practical science which generates the specific modes of arguments.[83]

Logic has two general subjects: the subject *inhaesionis*, that is the intellect, and the subject *attributionis*, on which logic itself operates.[84] However, the proper and specific subject of logic is the *modus disserendi*, which reasons from the known to the unknown.[85] The Coimbran scholars exclude from logic all the subjects of humanistic and nominalistic logics, such as the argumentations, the terms or the operations of the mind.[86]

The Coimbran textbook firmly states that logic is a necessary preliminary to all other disciplines, in two ways: artificial logic teaches the instruments of science, while natural logic concerns the use of the intellect, without which it would be impossible to make arguments and reach conclusions.[87]

The textbook examines the fundamental elements of logic, of which the first is the universal concept.[88] This is defined as something that pertains to many things as a cause, as a meaning, as a predicate and as a constitutive element.[89] The universal concept is generated by means of abstraction, which is a kind of separation.

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[82] Cf. Ibid. 3: 'Dialectica, seu logica, quae *ars disserendi* definitur; cujusque finis proximus ad hoc tradere normas, remotus ipsum est disserendi opus, in docentem, et utentem dividitur'.

[83] Cf. Ibid. 4: 'Est proprie scientia dialectica docens (non tamen utens) quia procedit in multis … per infallibilem demonstrationem, et proprias de suo subjecto demonstrat passiones. … Est pars philosophiae, cum demonstrative procedat, divisionum, definitionum etc. partes per sua principia deducens. Est practica scientia, cum in disserendi modis conficiendis, quod praxis est, praecipue versetur'.

[84] Cf. Ibid. 5: 'Subjectum scientiae … vel est inhaesionis, in quo scilicet ars inhaeret, quod est intellectus; vel attributionis, quod est materia circa quam scientia versatur'.

[85] Cf. Ibid. 5–6: 'Subjectum dialecticae adaequatum est modus disserendi, cum circa illud totius dialecticae desudet industria: qui modus est oratio, qua ex notis ignotum aliquid aperitur'.

[86] Cf. Ibid. 5: 'Dialecticae subjectum, non sunt voces nudae, non significativae, non ens rationis in tota latitudine, vel ab intellectus operationibus resultans non omnis intellectus operatio, non demonstratio, et definitio solum … non argumentatio, non argumentatio formalis, non demonstratio'.

[87] Cf. Ibid. 6: 'Dialectica perfecta, seu artificialis respectu aliarum scientiarum est solum ad bene esse necessaria, cum sit instrumentum sciendi, et artifex melius, cum parata habet instrumenta, operetur. Dialectica inchoata, seu naturalis est necessaria ad omnes cujusque scientiae conclusiones, cum sit intellectus, quatenus vim obtinet discurrendi'.

[88] Cf. Ibid. 7: 'universale, ut predicabile est, subjectum huius operis constituitur cum scientiae subjectum unitatem habere debeat'.

[89] Cf. Ibid.: 'Universale communissime sumptum est unum quid ad multa pertinens … Simplex in quatuor membra, universale scilicet in causando, significando, essendo et predicando'.

Abstraction is either real or rational, and this latter can be negative, when something is denied to something else, or *praescisiva*, when by means of apprehension from many particulars the mind infers the concept which connects them. The universal concept of logic is abstracted in this last manner.[90] The abstractive process is further described following Aristotle's *Analytica posteriora* II.19: from senses, via the imagination, the mind produces an intelligible species that generates the universal concept in the intellect.[91]

From this process the mind not only generates all universal concepts, but acquires knowledge.[92] It is possible to know only that which the mind has experience of, and this is acquired in two ways, either by learning from a teacher or by direct perception.[93] However, science is not only sensible or experiential knowledge, but, more importantly, the knowledge of things and effects through their proper causes by means of demonstration.[94] But every demonstration, like all scientific knowledge, is grounded on principles apprehended by sensation and induction.[95] This does not mean that science relies solely on the contingent objects of sensation, determined by the actual existence of things; rather, science deals with necessary things. Although all knowledge ultimately depends on experience, and so on the actual existence of things, science itself, as for God and the angels, is independent from this external existence and its conclusions may be applied a posteriori to every object of knowledge.[96]

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[90] Cf. Ibid. 20: 'Abstractio est unius ab alio separatio; haec in genere est realis, vel rationis, haec est duplex: alia negativa, in qua scilicet per praepositionem negamus unum de alio, sive vere, sive falso; alia praescisiva, in qua scilicet per semplicem apprehensionem de pluribus aliquo modo inter se connexis, unum cognoscimus, omissis alijs. Universalis abstractio est praescisiva'.

[91] Cf. Ibid. 21: 'Suppositis quinque sensibus externis, duobus internis communi sensu, scilicet, et phantasia, duobus intellectibus, agente, scilicet, et patiente, quorum primus cum phantasia producit species intelligibiles duobus recipit: universalis abstractio, quae ab intellectu tantum, propter suam immaterialitatem fit, hoc pacto perficitur'.

[92] Cf. Ibid. 229: 'Vera conclusio est, scientiam nostram non esse animae ingenitam, sed proprijs actibus de novo acquisitam. Probatur: quia, si nobis essent ingeniti habitus scientiae experimur nos habere scientiam: quod tamen non experimur'.

[93] Cf. Ibid.: 'Scientia acquiritur, vel ope magistri, signa externa discipulo proponentis, per quae discat; vel notitia experimentali, seu ope sensum'.

[94] Ibid. 254: '*Scire est cognoscere causam ob quam res est*, *illius causam esse*, *et fieri non posse*, *ut aliter se res habeat*: 1. Scientia est cognitio effectus per causam proximam, necessariam, cognitam, ut causam. 2. Demonstrationis: *demonstratio est syllogismus efficiens scire*. 3. Item demonstrationis: *demonstratio est syllogismus constans veris, primis, immediatis, prioribus, notioribus, causisque conclusionis*'.

[95] Cf. Ibid. 235–236: 'Etiam scientia per inductionem parta per se pendet proxime ex antecedente cognitione indicativa remote ex sensitiva. … inductionem esse necessariam, ad notitia principiorum, non ut causam, sed ut dispositionem, vel conditionem ad terminos penetrandos, et ideo notitiam principiorum non esse discursivam, quia non pendet ab alia antecedente, tanquam a causa. Vel dic pendere ab inductione, tanquam a causa effectiva minus principali, et ideo non esse discursivam'.

[96] Cf. Ibid. 240–241: 'Omnis nostra cognitio pendet ab experimento; sed experimentum pendet ab actuali existentia subiecti; … Si sumatur scientia, prout est in nobis, acquiritur inventionis via, tunc pendere proxime a subiecto existente: sed hoc est per accidens scientiae spectatae secundum se, ut patet scientia Dei et angelorum, a subiectu existentia independente'.

Scientific knowledge, as we have said, is grounded on demonstration, which is of two kinds. There is a judicative mental demonstration, also called apprehensive, imperfect, unfinished or *quia*, and a demonstration *propter quid*. The former acquires new knowledge, while the latter, instead, provides a scientific arrangement.[97] Both of these kinds are necessary for acquiring scientific knowledge, for knowing only *propter quid* means knowing a general cause without any specific effect, while knowing only *quia* means knowing the effect without any real explanation.[98] Indeed, without elaborating a theory of *regressus*, the Coimbrans establish that the *demonstratio potissima*, that is scientific demonstration, is characterized by the acquisition of knowledge through the demonstration *quia* and from its arrangement through the demonstration *propter quid*.

Of far more importance was Smiglecki's *Logica*, published first in Ingolstadt in 1618, and reprinted in Oxford in 1634, 1638 and 1658. This textbook is far more difficult than other elementary handbooks of the time, but it is also very clear in its exposition. It contains 18 long *disputationes*, the first of which is devoted to the *ens rationis*.

For Smiglecki, the *ens rationis* can be considered in two ways, either in opposition to the real being, or as something existing in the mind.[99] By real existence, Smiglecki means that which is outside the mind and in the things themselves. The subject of logic is real being outside the mind.[100] The *ens rationis* is essentially different from the *ens reale* and exists objectively in the mind alone. In particular, according to Smiglecki, beings of reason are impossible, for the *ens rationis* does not exist in things and this is impossible. *Ens rationis* is impossible only in this sense, but it can exist in the mind[101]: its objective existence is sufficient to say of the *ens rationis* that 'it is'.[102]

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[97] Cf. Ibid. 259: 'Omnis ac sola demonstratio mentalis judicativa (apprehensiva enim (si datur) est tantum inchoata et imperfecta) et *propter quid*, causat scientiam. Probatur: scientia est cognitio discursiva, quae vi formae comparatur ex antecedente notitia continente causam conclusionis: sed omnis, ac solus syllogismus est argumentatio formalis: ergo omnis, ac solus syllogismus constans materia necessaria, qualis est demonstratio, scientiam gignit'.

[98] Cf. Ibid. 302: 'Scire *propter quid* solitarie est cognoscere causam alicuius effectus, et non applicare illam in aliqua demonstratione. Scire *quia* solitarie est cognoscere effectum per experientiam, non applicare in aliqua demonstratione. Scire *propter quid* applicate est cognoscere effectum per causam proximam applicatam in aliqua demonstratione. Scire *quia* applicate, est cognoscere causam per effectum applicatum in demonstratione'.

[99] Cf. Smiglecki, *Logica*, 2: 'Entis rationis naturam duplici via investigare possumus: primum ex oppositione cum ente reali; deinde ex modo existendi proprio quem habet in intellectu. Hoc enim nomine entis rationis intelligimus, quod cum non sit ens reale, in solo intellectu existit'.

[100] Cf. Ibid.: 'Voco autem realem existentiam eam, quae est extra intellectum in re ipsa. Porro ut hoc intelligatur sciendium est: ens reale dici reale a reali quae est extra intellectum existentia'.

[101] Cf. Ibid. 3: 'Sola entia impossibilia esse entia rationis: quia ens rationis est illud, quod in re non potest existere; at quod in re non potest existere, est impossibile. Ergo ens rationis est id quod est impossibile. … Impossibile aliquid dicitur dupliciter: vel quod non possit in re existere, vel quod non possit in ratione existere. Cum igitur dicimus ens rationis esse impossibile, intelligimus primo modo quod in re est impossibile, nec potest realiter existere. Non negamus autem esse possibile, ut existat in ratione: quidquid enim potest concipi a ratione, quantumvis in re sit impossibile, est in ratione possibile, quia potest in ratione existere'.

[102] Cf. Ibid. 5: 'existentia objectiva sufficit ad ens rationis'.

The *ens rationis* is therefore something that exists objectively in the mind. The problem for Smiglecki is how real being and the being of reason are related. He appeals to a correspondentist and representational theory of knowledge. The intellect generates in itself the concept, which is however expressed by the image of the object itself. The intellect represents the object and presents it to the mind, without, however, acting directly on the object of knowledge.[103] The representation of the object is therefore not the object itself, i.e. the thing outside the mind, but neither is it the concept, which is the essence of the thing. The image of the object, that is the object of the concept, is an *ens rationis* and it reflects the object outside the mind, but it is properly only the content of the concept.[104] The act relating the *ens rationis* to the object and which in some ways represents it, it is called an intentional act.[105]

After defining the relation between the *ens reale* and the *ens rationis*, Smiglecki defines the *entia rationis* themselves. There are two kinds: those which are merely generated by the intellect without any relation to real things (such as the unicorn), and those which are not generated by the intellect and are grounded on real things, as if those real things required representation through an *ens rationis* as a figment of the intellect.[106] For things to be object of the intellect, they must be represented by it, and this can happen only by means of the intentional act through which the *ens rationis* makes the things present to the mind. The *entia rationis* of logic are exactly of this kind.[107] In fact, *entia rationis* are necessary to logic because they can direct correctly all three operations of the intellect.[108] On this basis, i.e. with the *ens rationis* as the intentional act relating the object to its respective concept and directing

[103] Cf. Ibid. 13–14: 'Modus igitur quo fit ens rationis ab intellectu est iste. Intellectus per actionem realem intelligendi producit in se cognitionem obiecti, quae cognitio est expressa quaedam similitudo obiecti, estque qualitas quaedam in intellectu producta; haec porro qualitas, cum sit repraesentativa objecti facit objectum esse praesens intellectui; ex illa enim repraesentatione oritur praesentia objecti in intellectu. Sicut igitur repraesentare, non est proprie agere in objectum, cum per eam nihil producatur in objecto, sed est similitudo quaedam actioni; ita et existentia illa objecti ex repraesentatione orta, est effectus improprie et potius similitudo quaedam effectus'.

[104] Cf. Ibid. 11: 'Ens rationis est obiectum conceptus. Ergo non est conceptus. Major probatur inductione: rosae, verbi gratia, conceptus, non est rosa essentialiter, nam rosa est substantia; conceptus rosae est accidens: rosa habet odorem, saporem, quod conceptui non convenit. Et ratio est quia conceptus est similitudo et imago obiecti expressa ab intellectu. Ergo non est idem quod obiectum'.

[105] Cf. Ibid. 14: 'Porro haec actio productiva entis rationis dicitur a quibusdam actio intentionalis, quia per eam tendit intellectus in objectum cognitum'.

[106] Cf. Ibid. 38: 'Communiter duo genera entium rationis statuuntur, alia enim sunt mera figmenta nullum fundamentum in re habentia, ut sunt hircocervus, hippocentaurus, et similia monstra … Alia sunt quae non sunt mera figmenta nec ad libitum aut temere excogitantur, sed habent fundamentum aliquod in re, quod quasi exigat illam fictionem'.

[107] Cf. Ibid.: 'Talia sunt entia rationis Logica, quae tria numerantur, relatio, privatio, negatio. Ex tota enim universitate entium rationis, tria haec logica sibi usurpavit, quod alia ad operationes intellectus dirigendas non admodum conducant'.

[108] Cf. Ibid. 60–61: 'Entia rationis esse rebus logicis necessaria: necessarium enim est Logicae scire modos concipiendi, sub quibus res concipit et cognoscit intellectus noster; hoc enim est praecipuum logicae obiectum; atqui intellectus noster ob imperfactam et limitatam suam cognoscendi rationem, nihil fere cognoscit, nisi sub aliquibus modis rationis, ut dictum est. Nam limitate

the operations of the intellect, Smiglecki can define logic and its subject. Despite the fundamental role of the *entia rationis*, they are not the proper subject of logic. In fact, logic is directed towards science and science is the knowledge of real beings, therefore its subject cannot be the *entia rationis*, which direct the operations, nor the operations themselves.[109] The subject of logic is what is directed by the *entia rationis*, just as they are directed by the operations of the mind.[110] Logic therefore deals with the ways and the operations through which the mind knows the object of experience scientifically.[111] For Smiglecki, as for Zabarella, logic becomes an instrumental or organic habit for determining the modalities and the precepts through which scientific knowledge is possible.[112]

Once Smiglecki has determined the nature and the subject of logic, he deals with apprehension, which is the first operation of the mind. Apprehension is always grounded on the *ens sensibile*,[113] from which, by abstraction, it grasps the universal concept. Abstraction is the specific act of this first operation and in

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conoscendo partim dijungit, quae sunt in re coniuncta, partim conjungit res sic dijuncte conceptas per praedicationem et illationem. Uterque autem modus est rationis, prior quidem est abstractio, posterior relatio fundamenta in re, ut concepta est ab intellectu: necessario ergo est in logica cognosci entia rationis, ita ut sine illis nihil praestari in logica possit; nam et operationes quae debent dirigi, propter limitatum earum modum cognoscendi, non possunt nisi sub certis modis rationis considerari, et media ad illas dirigendas, hoc est, regulae logicae consistunt in explicatione, et definitione horum modorum rationis. … Per entia rationis dirigi operationes intellectus. Ratio est, quia operationes intellectus tunc diriguntur, quando explicatur modus debitus operationum, quo fieri debent, atqui modi operationum nostrarum, sunt modi quidam rationis, nempe verij modi abstrahendi et conferendi res abstractas inter se, ergo dum hi modi rationis explicantur in logica, diriguntur operationes intellectus … Entia rationis ad logicam pertinent, quatenus dirigunt operationes intellectus, ad alias vero scientias alijs modis'.

[109] Cf. Ibid. 67: 'At logica est scientia dirigens. Ergo ejus objectum non est ens rationis quod dirigit, sed id quod dirigitur, nempe operationes dirigibiles'. On Smiglecki's conception of *ens rations* see Gino Roncaglia, 'Smiglecius on entia rationis', *Vivarium*, 33 (1995), 27–49.

[110] Cf. Ibid. 68: 'Logica nihil aliud considerat nisi modos directionis operationum. Ergo directivitas potius modorum dirigentium quam dirigibilitas operationum directarum est objectum logicae'.

[111] Cf. Ibid. 69: 'Negamus inde sequi ens rationis directivum esse objectum formale logicae, est enim solum causa effectiva objecti formalis, hoc est rectitudinis operationum, sub qua operationes considerat; nam etiam entia rationis in ordine ad hanc rectitudinem inducendam considerat'.

[112] Cf. Ibid. 80: 'logica proprie est habitus organicus seu instrumentarius, quia instrumenta et modos sciendi suppeditat, hocque ipsius est proprium objectum'. Ibid. 90: 'Logica igitur cum utramque conditionem instrumenti habeat, erit vere instrumentum scientiarum; nam et ad effectum scientiarum producendum adhibetur; nempe ad efficiendam scientiam actualem, quae principaliter fit ab ipsis scientiis habitualibus, a logica vero instrumentaliter tantum, et quoad directionem et praeterea virtus illa directiva logicae est per se subordinata habitui scientiae, quia non potest prodire in actum scientiae per se, nisi adhibita et applicata scientiae habitus … logica concurrat instrumentaliter ad actum scientiae, mediante suo actu, hoc est, mediante cognitione praeceptorum et modorum sciendi … Dicendum est logicam esse instrumentariam, non solum quia conficit instrumenta sciendi, ut plerique sentiunt, sed praecipue quia ipsa seipsa, seu suis regulis ac praeceptis est instrumentum scientiarum, causans instrumentaliter actus scientiarum'.

[113] Cf. Ibid. 100: 'Dico igitur primo non omne ens secundum propriam suam rationem potest a nobis apprehendi sed solum ens sensibile'.

particular it is called intellectual abstraction when it abstracts the universal concept from the *ens sensibile.*[114] Abstraction has a twofold foundation, in things and in the intellect. The latter is particularly interesting because for Smiglecki it is an inadequate abstraction of the concept—abstraction, as the first operation of the mind, does not generate in the intellect an adequate concept of the thing.[115] This inadequate concept must be clarified, determined and considered by means of the other operations of the mind. It is important to understand the role of the inadequate concept of the thing as universal and as a means to know the particulars. Smiglecki states that the universal is not something that can exist outside the mind, but only within it.[116] However, this does not mean that it is a mere concept of the mind, it is rather the concept of the object or of the thing that is abstracted from the *ens sensibile.*[117] Therefore the inadequate concept is something which designates the things in the world in a very general way, without producing scientific knowledge.

Related to the problem of the universal concept is the question of whether the words directly signify things or concepts. Smiglecki's treatment of this topic is interesting for its possible influence on Locke's empiricism.[118]

According to Smiglecki, words signify both things and concepts. In fact, by means of words the mind not only signifies things and gives them adequate names, but also conceives and expresses its private mental concepts. The problem consists in determining whether words primarily signify concepts or things. Smiglecki deploys four arguments in favour of the former view. The first argument rests on *De interpretatione* I.1, 16 a 3, where Aristotle says that words are affection of the souls and therefore concepts. The second argument shows that since without words the inner thoughts of the mind cannot be expressed, words must primarily express concepts. The third argument states that words without concepts have no meaning and are not comprehensible, and so words must be always related to concepts. The last argument is that things cannot be signified if not by means of

[114] Cf. Ibid. 116: 'Abstractio est separatio quaedam unius ab altero, quae cum mente fit, dicitur abstractio intellectualis. … Fit autem abstractio per cognitionem, qua cognoscitur unum non cognito alio. Ex quo patet abstractionem formaliter esse actum primae operationis intellectus'.

[115] Cf. Ibid. 117: 'Ex quo patet, fundamentum abstractionis, partim esse in re, partim in intellectu. In re est distinctio duorum conjuctorum vel actualis vel virtualis. Actualis ut cum accidens abstrahimus a subjecto, a quo reipsa distinguitur. Virtualis ut cum animalitatem in homine abstrahimus rationalitate, quae liceat in homine sint unum et idem actu, virtualiter tamen et in potentia distinguuntur, cujus signum est, quod in aliis rebus unum invenitur sine alio: animalitas enim in bove invenientur sine rationalitate. In intellectu autem fundamentum abstractionis est inadaequata rei conceptio, quia intellectus ob suam imperfectionem, non format statim plenum et adaequatum conceptum de re; formando autem conceptum inadaequatum, cognoscit rem sub una tantum ratione non sub altera, et sic dicitur unam rem abstrahere ab altera'.

[116] Cf. Ibid. 143: 'Cum certum sit dari universale, et dari non posse a parte rei extra intellectum, necesse est dari per intellectum, hoc est, per conceptionem intellectus'.

[117] Cf. Ibid. 147: 'Universale non est conceptus in mente existens, sed res huic conceptui obiecta'.

[118] Cf. Ashworth, 'Do Words Signify Ideas or Things? The Scholastic Sources of Locke's Theory of Language', 311–317.

the words through which they are conceived.[119] Therefore Smiglecki adopts a conceptualist position; however, he does not deny that concepts always relate not only to words, but also to things, otherwise the words would signify only mental concepts or impossible concepts, *entia rationis* with no existence outside the mind. Moreover, it is obvious that words also signify things, and so it is necessary to explain the relation between concepts, words and things. Smiglecki's solution is that words signify things only by means of concepts. Indeed, concepts are like a filter through which words can be attributed to things.[120] Therefore, even if Smiglecki sustains that words signify things, he does not defend a realist theory according to which words are naturally associated with things. Rather he elaborates a representationalist correspondence theory according to which concepts are the instrument which provides meaning to things by means of words. Words are therefore an instrument of the human mind for signifying things; they do not signify naturally, but only by the voluntary imposition of mental concepts.[121] Thus Smiglecki supports a conceptualist point of view according to which concepts have an epistemological primacy over ontology.

The other interesting aspect of Smiglecki's textbook is his treatment of demonstration and science. As we have previously said, for the Jesuit logician the *modus sciendi* is the subject of science. In the wider framework of his theory of science, the *modus sciendi* coincides with the *demonstratio quia*, which makes possible scientific knowledge through the cognition of effects, where usually scientific knowledge was based on the cognition of causes. Appealing to Aristotle, Smiglecki distinguishes *scientia* from the *modus sciendi*, in fact, science does not encompass the first principles which are discovered by the

[119] Cf. Smiglecki, *Logica*, 436: 'Videtur enim prius significari conceptus. Primo: quia Aristoteles ait voces esse notas passionum animae. Secundo: quia vox ad hoc est homini data, ut eius beneficio suam mentem, quae occulta et invisibilis est, modo sensibili, exponat et manifestet; isque finis immediatus loquentis est, mentem suam exponere. Tertio: quia is, qui nihil concepit, nihil significat … talibus enim vocibus, illi nihil significare intendunt, quia nihil conceperunt, quo etiam modo psittacus, liceat voces exprimat, nihil tamen per illas significat, quia nihil concepit ad significandum. … Quarto, quia res non significantur vocibus, nisi sub ea ratione, sub qua conceptae sunt. Ergo prius voces significant conceptus, quam res. Antecedens patet, nam intellectus imponit nomina rebus, prout illas concipit, unde si eandem rem diversis modis concipiat, diversa quoque nomina eidem rei imponet, propter illos diversos conceptus ut patet in nomine abstracto et concreto universali et particulari, quae eandem rem sub diversa ratione significant'.

[120] Cf. Ibid. 437–438: 'Dico primo voces primo et immediate significant res, non conceptus. … Dico secundo voces etsi non significent res, nisi interveniente conceptu non tamen immediate significant conceptum, sed rem … Dico tertio. Voces significant conceptus, sed mediante significatione rerum et tanquam signa manifestativa non suppositiva'.

[121] Cf. Ibid. 439–441: 'Vox est data homini naturale instrumentum ad significandum … non est possibile reperiri voces naturaliter significantes res … Cum vox ex impositione habeat significare, impositio autem ad significandum fiat per conceptum, quem habet de re significando is, qui imponit. … vocis significationem sumendam esse ex conceptu imponentis, ita ut non perfectius vox significet quam imponens rem illam conceperit. Ratio est: quia vocis significatio tota ex impositione, impositio autem, tota est ex conceptu intellectus'.

demonstratio quia, which in turn does not provide a real discursive knowledge like science.[122]

There are therefore two kinds of demonstration: the demonstration *quia* which proceeds from the effects and discovers new knowledge, and a demonstration that draws conclusions from specific premises.[123] The second kind of demonstration (*propter quid*) proceeds from the causes to the knowledge of the effects.

Against the common opinion that demonstration *quia* was not a real demonstration, Smiglecki sustains that it is a demonstration in all respects, and one without which the entire edifice of science would collapse. By means of demonstration *quia*, the mind acquires knowledge of the first principles, in particular those of physics, such as matter and form. Furthermore, mathematics itself, which is a science, proceeds from effects to discover causes, namely by means of a demonstration *quia*, without which mathematics would lose its scientific nature. Ultimately, Smiglecki states, demonstration *quia* is the kind on which are grounded all scientific disciplines and on which depend all the other kinds of argumentation.[124] No wonder that Smiglecki's textbook was so widely read in English universities, despite its complexity: its attention to the construction of a scientific method for the discovery of new knowledge applicable to all sciences made it a useful instrument. However, he points out that demonstration *propter quid* is

[122] Cf. Ibid. 529: 'Probabilissimum est quod censet D. Thomas cum plerisque Aristotelem per alium sciendi modum intellexisse demonstrationem quia, quae facit scire per effectum, non per causam, ut cum demonstramus, hominem esse rationalem, quia est risibilis; loquitur enim Aristoteles de scientia discursiva, quae simpliciter est scientia et non comprehendit definitionem et cognitionem primorum principiorum, eae enim cognitiones non sunt discursiva. Vult igitur scientiam quae habetur per discursum, absolute quidem et simpliciter haberi per causam, quia tunc res perfecte cognoscitur, quando per propriam causam cognoscitur propter quam est, quia tamen datur etiam rei scientia per effectum, ut in demonstratione, quia, quae est demonstratio a posteriori; idcirco eum quoque modum sciendi non reiicit, sed promittit se de eo tractaturum inferius, tanquam de minus perfecto sciendi modo'.

[123] Cf. Ibid.: 'Dupliciter enim id potest intelligi, vel effective, generando in nobis novam scientiam a se distinctam, ad eum modum, quo praemissae generant scientiam conclusionis, vel formaliter se ipsa faciendo nos scire, ita ut scientia sit effectus formalis demonstrationis, sicut esse album est effectus formalis albedinis'.

[124] Cf. Ibid. 586: 'Demonstrationem quia, esse vere et essentialiter demonstrationem. Hanc conclusionem quidam probant tali argumento. Si demonstratio quia non esset vere demonstratio, ruerent omnes scientiae; harum enim principia sciri non possunt, nisi per demonstrationem quia: nam et materiam et formam quae sunt principia corporis naturalis in Physica, per motum et mutationem a posteriori investigat Aristoteles; et complexa principia scientiarum, cum sint immediata, nec per se nota, debent a posteriori probari, imo et principia demonstrationis propter quid, cum sint immediata nec semper ex se evidentia non possunt demonstrari, nisi a posteriori. Denique ruerunt demonstrationes mathematicae quas constat non procedere ex causis essendi, nec habere demonstrationes, propter, quid, sed tantum demonstrationes quia. Confirmatur: si demonstratio quia non est vera demonstratio, non generabit veram scientiam, ergo et omnes aliae scientiae quae ab illa dependent et in illa fundantur, non essent perfectae scientiae. Non potest enim firmius esse aedificium, quam sit fundamentum, nec potest esse perfectior effectus sua causa. Verum haec ratio solum concludit, demonstrationem quia debere, esse syllogismum necessarium; sic enim aliae scientiae ab illo dependentes erunt sufficienter necessariae'.

'more perfect' than a demonstration *quia*, because the latter discovers only a generic cause for a given effect, while the former finds the specific cause.[125] Smiglecki, being a good Aristotelian, believes that science is a knowledge of causes and that this is the perfect kind of knowledge.[126]

Smiglecki adds that induction is a kind of demonstration *quia*,[127] which provides knowledge of the premises of the demonstration *propter quid*, that is the principles of demonstration, which are most known to us through the senses.[128] The premises which are conclusions of the demonstration *quia* must be proven again by demonstration *propter quid*. The argument that relates demonstration *quia* to demonstration *propter quid* is called demonstration *potissima.*[129] Unlike Zabarella, therefore, Smiglecki does not identify demonstration *potissima* with demonstration *propter quid*, even if he shares the idea that scientific knowledge must be established through the process of the *regressus*.[130]

The original aspect of Smiglecki's logic is its marked conceptualism on the one hand, and the idea of logic as an instrument of science on the other.[131] These two elements are central to the emerging British empiricism and to another influential Aristotelian movement in the British Isles—that which came from the Netherlands.

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[125] Cf. Ibid. 587: 'Demonstrationem propter quid, esse perfectiorem essentialiter demonstratione quia; nam etsi in ratione generica demonstrationis, convenit cum illa, tamen ex ratione specifica talis demonstrationis, est illa perfectior essentialiter'.

[126] Cf. Ibid.: 'Cognitio rei per causam est perfectior ex genere suo, cognitione rei per effectum, nam per causam cognoscitur propter quid sit res, per effectum autem, solum cognoscitur quod ita sit, non autem propter quid'.

[127] Cf. Ibid. 588–589.

[128] Cf. Ibid. 601: 'Si igitur quaeras: quomodo maior illa cognoscitur a nobis in demonstratione quia. Omne risibile est rationale: quidam putant cognosci per inductionem sed id non videtur verum, praesertim si loquamur de prima cognitione huius propositionis. Primo: quia inductio non fit nisi in rebus nobis notis secundum sensum at connexio effectus cum causa non est sensibilis, cum causae ut plurimum sint occultae. Secundo: quia si per inductionem illa propositio cognosceretur, sequeretur in illa maiori simul cognosci et minorem et conclusionem. Non enim inducimus, omne risibile est rationale, nisi quia ista videmus coniuncta in homine. Ergo in hac inductione maioris, cognoscimus, et omnem nomine esse risibilem, quae erat minor et omnem hominem esse rationalem, quae erat conclusio et sic ante demonstrationem haberemus notitiam conclusionis. Dicendum igitur est: cognosci maiorem illam per resolutionem, adiunctis varijs discursibus, quibus ostendatur talem effectum non posse esse ab alia causa, nisi ab ista, in qua resolutione confuse et imperfecte cognoscitur causa quoad essentiam'.

[129] Cf. Ibid. 590.

[130] Cf. Ibid. 600: 'Circulus imperfectus, datur in demonstrationibus et est valde utilis, ut si ex principio, sensu vel per resolutionem cognito inferam conclusionem et rursum ex conclusione, per rationem probem illud ipsum principium. … Probatur secundo ratione quia si conclusio maiori notitia cognoscatur, quam fuit cognita ex praemissis, poterit etiam maiorem notitiam praemissarum generare et sic vulis erit regressus, quia cum nova notitia. Poterit autem magis cognosci vel quia sub alia ratione et formalitate cognoscitur vel quia secundum eandem rationem magis et perfectius penetratur'.

[131] On Smiglecki's epistemology cf. Ludwik Nowak, 'Les idées gnoséologiques de Martin Smiglecki', *Organon*, 16/17 (1980/1981), 135–150.

7.3 Dutch Aristotelianism

The Dutch school was undoubtedly among the most successful Aristotelian schools in the British Isles, especially with the dissemination of Burgersdijk's *Institutionum logicarum libri duo*, published for the first time in Leiden in 1626, and reprinted in Cambridge and London in 1637, 1644, 1647, 1651, 1660, 1666, 1668 and 1680. In 1651 Adriaan Heerebord published a brief compendium of Burgersdijk's textbook entitled *Ermeneia logica sive synopseos logicae*,[132] and in 1697 appeared an English abstract with the title *Monitio logica or, an abstract and translation of Burgersdicius his Logick.*[133] As the author himself admits in his *Praefatio ad lectorem*, his logic is heavily influenced by Mark Duncan, who was his professor of logic and natural philosophy in Saumur. The most important presence in the textbook is however Zabarella, through the mediation of Keckermann, as is clear from the definition of logic as an instrument to direct the mind in the knowledge of things.[134] Logic is properly characterized as a 'habitus organicus sive instrumentalis'.[135] It is divided into two parts: the first is called 'thematic', the second is called 'organic'. Thematic logic deals with 'thema', i.e. the various affections of the mind and specifically the second notions as the matter of logical instruments. Organic logic deals with particular logical instruments in order to acquire knowledge of things.[136] Burgersdijk's logic is based on the concept of 'thema', defined as 'quod intellectui cognoscendum proponi potest'.[137] The 'theme' of logic is specifically the *secundae notiones*, while the proper 'theme' of the philosopher is the *primae notiones.*[138] Burgersdijk then deals with the four specific logical instruments: (1) definition; (2) division; (3) syllogism; (4) method.[139]

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[132] Cf. Adriaan Heereboord, *Ermeneia logica sive synopseos logicae* (London, 1651).

[133] Cf. Franco Burgersdjik, *Monitio logica or, an abstract and translation of Burgersdicius his Logick* (London, 1697).

[134] Cf. Burgersdijk, *Institutionum logicarum libri duo*, 1: 'Logica est ars conficiens instrumenta, iisque intellectum dirigens in cognitione rerum'.

[135] Ibid. 3.

[136] Cf. Ibid. 5: 'logicae partes duae sunt: thematica et organica. Thematica dicitur, quae agit de thematibus, eorumque variis affectionibus et notionibus secundis, tanquam de materia instrumentorum logicorum. Organica vocatur, quae agit de ipsis organis sive instrumentis, quibus intellectus themata tractat, eorumque cognitionem, quoad sciri potest, adipiscitur'.

[137] Ibid. 6. On the concept of 'thema' in Burgersdijk cf. Michael Karskens, 'Subject, Object and Substance in Burgersdijk's Logic', in Egbert Bos and Henri A. Krop (eds.), *Franco Burgersdijk (1590–1635). Neo-Aristotelianism in Leiden*, 29–36.

[138] Cf. Ibid. 10–11: 'cum mens nostra themata intelligit, aut Philosophicas thematum affectiones, format notiones primas; cum intelligit thematum affectiones Logicas (ut de Grammaticis et Rhetoricis nihil dicam) format notiones secundas. De utrisque in Logica agendum, sed de thematibus obiter tantum; idque eo fine, ut ex eorum varia comparatione entia rationis et secundae notiones formentur. De thematibus et primis notionibus, quantum satis est, agitur in categoriis; de thematum affectionibus et notionibus secundis, in reliquis logicae partibus'.

[139] Cf. Ibid. 151: 'Postquam in prima parte actum est de thematibus, quae instrumentis Logicis tractanda sunt; denique affectionibus eorum, atque notionibus secundis, ex quibus instrumenta Logica conficiuntur: superest, ut in secunda parte agamus de ipsis instrumentis, deque modo instrumenta conficiendi, quam inde Organicam initio appellavimus. … Instrumenta Logica sunt quatuor, definitio, divisio, syllogismus et methodus'.

These four correctly direct the mind in the knowledge of things, avoiding possible defects such as the confused cognition of essences. Definition provides the mind with the knowledge of a thing's essence, division makes this knowledge distinct, syllogism removes every uncertainty and doubt, and method arranges knowledge.[140] In particular demonstration, as a particular form of syllogism, plays a significant role in acquiring scientific knowledge.[141] According to Burgersdijk there are at least three meanings of science. In a wider sense, science is all that kind of knowledge that we presume and consider as true. In a narrow sense, science is firm and infallible knowledge. In a more specific and strict sense, science is the knowledge of effects from causes.[142]

Science can be acquired in two ways, either through sensation or through intellect, which grasps the universal principles that are unknowable or unattainable by means of the senses. Knowledge of these principles comes either by a antecedent demonstration or by means of the light of the mind, as in the case of principles such as 'the whole is greater than the part'. By Burgersdijk, this latter kind of cognition is called 'intelligence', following *Analytica posteriora* II.19, and it must be distinguished from scientific knowledge,[143] which always proceeds discursively by demonstration. Burgersdijk therefore distinguishes dianoetic from noetic knowledge, the former being discursive, the latter intuitive or intellective.[144] Intellective or noetic knowledge is that which grasps the essences and first principles on which dianoetic knowledge is grounded.[145]

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[140] Cf. Ibid. 151–152: 'Mens nostra quadruplici defectu laborat, cum occupata est in investigando rerum cognitionem. Vel enim non assequitur propositae rei essentiam, sed circa illius accidentia solum haeret, ac sensibiles notas; vel essentiam rei confuse tantum concipit, et ratione minime distincta, vel in dubiis non reperit quid statuat, aut etiam statuit quod falsum est; vel denique non servat ordinem in commentando, qui natura rerum consentit. Hisce quatuor malis opponit Logica totidem remedia, quae sunt quatuor illa instrumenta quae jam recensuimus. Definitio exhibet menti essentiam rerum: divisio efficit cognitionem distincta; syllogismus tollit animi incertitudinem et errorem circa themata complexa; methodus, ἀταξίαν sive confusionem'.

[141] Cf. Ibid. 250: 'Demonstrationis genus est *syllogismus*: in quo cum dialectico sillogismo consentit. Differentia est a fine petita, qui est *scientia*'.

[142] Cf. Ibid. 250–251: 'Vocabulum scientiae vel late sumitur, pro qualibet cognitione, sive assensu vero; vel stricte, pro assensu firmo et infallibili; vel denique strictissime, pro assensu propositionum, quae per causam aut effectum cognoscuntur'.

[143] Cf. Ibid. 251: 'cognitio enim firma et infallibilis, vel a sensu est … vel ab intellectu, veluti cum agitur de propositionibus universalibus, ad quarum veritatem sensus non pertingit, ut qui in singularibus subsistit. Cognitio propositionum universalium vel sine syllogismo generatur, vel per syllogismum. Sine syllogismo generatur cognitio, cum propositiones sua luce conspicuas, pleno mentis assensu amplectimur, sine ulla probatione. Sic cognoscimus, *totum esse majus sua parte*, *Deum esse colendum*, et id genus caetera. Ejusmodi cognitionem appellat Aristoteles *lib.* 2. *Post. cap. ult.* ν ν, hoc est, *intelligentiam*, eamque distinguit a scientia … hoc est, cum ratiocinatione conjunctam. … ea solum cognitio *scientiae* nomine hic venit, quae gignitur a causa, aut ab effectu. Atque haec est strictissima scientiae acceptio, et huc loco propria, ut ex sequentibus liquebit'.

[144] Cf. Ibid. 252: 'non solum cognitio sensualis a scientia distinguitur; sed etiam cognitio definitionum, et principiorum, quae non est cognitio dianoetica, hoc est, discursiva; sed noetica, hoc est, intellectiva'.

[145] Cf. Ibid. 252, 256: 'Essentia enim rerum, quae definitione explicatur, et primorum principiorum veritas, sine discursu apprehenditur. … Omnis cognito dianoetica … ex precedente cognitione gignitur'.

The most Aristotelian aspect of Burgersdijk's work is his methodology. There are two kinds of method and in general they depend on the effect. If the effect is a product of the mind, as in the case of mathematics, the method coincides with demonstration τοῦ δίοτι. If the effect is something known by sensation, method coincides with the doctrine of the *regressus.*[146] It is here that we can recognize a strong Zabarellan influence, for Burgersdijk characterizes *regressus* in precisely the same way.[147] Moreover, the Dutch logician emphasizes that the regressive method is particularly useful in physical investigation, where the effects are known by means of sensation and the mind proceeds from the knowledge of the existence of the thing to a knowledge of its essence.[148]

In this context, Burgersdijk refers to the controversy on method between Zabarella and Piccolomini,[149] taking a clear position in favour of the former, but not without reservations. Burgersdijk sustains that it is pointless to deal with the distinction between method and order, one that discovers and the other that arranges, for they coincide when the mind has well-developed cognitive habits.

Like Zabarella, Burgersdijk states that method is grounded on syllogism, the logical instrument that essentially proceeds from unknown to known.[150] Method is not opposed to order; he conceives it radically as an instrumental habit that differs according to the logical instruments.[151] There is a natural method and an artificial or

[146] Cf. Ibid. 271: 'interdum *effectum esse*, ignotum est; *esse causam*, notum: et tum statim adhibetur demonstratio τοῦ δίοτι quemadmodum videre est in multis demonstrationibus mathematicis. … Interdum effectum in sensu incurrit, et causa ignota est: et tum primum ex effecto causa, deinde ex causa effectum demonstrandum est. Haec demonstrandi ratio a Latinis Philosophis *regressus* appellatus est'.

[147] Cf. Ibid. 271: 'Regressus ergo constat tribus partibus: prima est demonstratio τοῦ ὅτι, colligens *causam esse* ex sensibili effecto; secunda est mentis quaedam commentatio, quae comparando causam cum effecto, comperit eam esse causam propositi effecti. Nam ex sensibili effecto nihil aliud colligitur, quam *causam esse*, quae est confusa causae cognitio. Ut autem ex causa colligi effectum possit, demonstratione τοῦ δίοτι, ipsa causa debet distincte cognosci. Causa dicitur distincte cognosci, cum cognoscitur eam esse causam hujus aut illius effecti. … Cum jam mens comperit causam ex effecto demonstratam, esse causam illius effecti, formatur demonstratio τοῦ δίοτι, atque haec est tertia pars regressus'.

[148] Cf. Ibid. 273: 'Regressus maximum habet usum in Physica, quae magnam partem versatur circa sensibiles effectus, quorum ignotae sunt causae. Horum causae primum investigandae sunt ex effectis: deinde ex inventarum causarum cognitione, derivanda est perfecta et distincta cognitio effectorum, quae non solum cognoscimus effecta esse (hoc enim sensus dijudicant) sed etiam cur sint, et quid sint, quo ulterius mens nostra progredi non potest'.

[149] Cf. Ibid. 289–290: 'Zabarella et Piccolohomineus, in iis libris, in quibus inter sese acute de methodi natura disputant, volunt ordinem nihil aliud esse quam rerum tractandarum nudam dispositionem; methodum esse illationem rei ignotae ex re cognita: ac proinde methodum efficere, ut, quae ignota sunt, innotescant; ordinem nullam cognitionem efficere per se, sed tantum ad id conducere, ut res ignotae, methodi alicujus beneficio facilius meliusque cognoscantur'.

[150] Cf. Ibid. 290: 'Instrumenta enim Logica suius officiis distinguuntur: quare, cum ignotum ex notis inferre, sit officium syllogismi, perperam illud methodo tribuitur, ut methodus est: nisi *methodi* nomine omnia instrumenta logica complecti velis'.

[151] Cf. Ibid.: 'Genus methodi *dispositionem* esse dicimus potius, quam *habitum* aut *habitum instrumentalem* cum Zabarella'.

arbitrary method.[152] Natural method follows the natural orders and acquires a distinct knowledge,[153] which is nothing other than the understanding of how things are in nature.[154] Natural method always proceeds from universals to particulars and it can be either total or partial.[155] Total method can be in turn synthetic or analytic. Synthetic method is the method that proceeds from the first, simple principles and it is the specific method of speculative disciplines. Analytic method, instead, proceeds from the end or from the effect to discover the means or the first, simple principles and it is typical of practical disciplines.[156] Both synthetic and analytic method serve the natural order, the former because in a wider sense it generates and reproduces that order, the latter because it is for the sake of natural order that it discovers the first principles.[157] Burgersdijk therefore establishes with Ramism that there is only one method and only one order, but while the Ramists put invention and discovery outside the method, Burgersdijk, like other Aristotelians, considers invention an integral part of methodology. According to the Dutch logician, however, the inventive part must not be understood as another method, precisely because method depends on the use of the logical instrument. But since in this case method concerns the knowledge of things, invention is a constituent part because it serves the synthesis. This view of logic is unique in the period and it generated various controversies, since no other author adopted it. Perhaps Burgersdijk's concessions to Zabarella's methodology led scholars to prefer the latter for his clarity and usefulness, although the Dutch textbook did enjoy some success in the seventeenth century.

The influence in England of authors such as Scheibler and Buergersdijk should not be underestimated: Locke himself in his *Some Thoughts Concerning Education* (1696) writes that 'yet the Burgersdicius's and the Scheiblers did not swarm in those Days, as they do now in these',[158] evidence that the dominant philosophy at the end of the century was still Aristotelianism.

The great impact of Paduan Aristotelianism and its integration with the logical doctrines of Coimbra characterize the last important Dutch logical work printed

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[152] Cf. Ibid.: '*Methodus alia est naturalis, alia arbitraria'*. Burgersdijk characterizes artificial method '*quae, relicto ordine naturae accomodata est ad cognitionem confusam, sive ad captum vulgi, vel ad persuadendum, aut delectandum*', Ibid. 295.

[153] Cf. Ibid. 291: 'Methodus naturalis est, in qua servatur ordo naturae, et cognitionis nostrae distinctae'.

[154] Cf. Ibid.: 'cognitio enim distincta est, quae rebus ipsis respondet, et ordini naturae'.

[155] Cf. Ibid. 292: 'Methodus naturalis semper debet progredi ab universalibus ad particulariora; in eoque progressu partes omnes aptis transitionum vinculis connectendae sunt … methodus naturalis, vel est totalis, vel partialis'.

[156] Cf. Ibid.: 'Estque [methodus totalis], vel synthetica, vel analytica. Methodus synthetica est, quae progreditur a principiis simplicissimis ad ea, quae ex istis principiis componuntur. Hac methodo traduntur disciplinae speculativae. Methodus analytica est, quae facto initio a fine, progreditur ad media proxima, et ab his ad alia remotiora, donec ventum est ad prima ac semplicissima. Hac metodo traduntur artes et disciplinae practicae'.

[157] Cf. Ibid. 293: 'In utraque methodo servatur ordo naturae: in synthetica, ordo naturae generantis sive efficientis; in analytica, ordo naturae intendentis sive destinantis'.

[158] John Locke, *Some Thoughts Concerning Education* (Oxford, 2000), 58.

in the British Isles, Gijsbrecht von Isendoorn's *Cursus logicus systematicus & agnosticus* published in Oxford in 1658.

Isendoorn's *Cursus* is entirely focused on the explanation of logic as a practical science that deals with scientific method, namely how to acquire new knowledge from something already known.[159] The peculiarity of Isendoorn's conception of logic in comparison to that of his contemporaries is, on the one hand, his description of logic as a practical science and, on the other, the idea that the subject of logic is the method of acquiring scientific knowledge. In other words, according to Isendoorn logic is the science of the scientific method. Logic indeed has two ends, an intrinsic and immediate end that consists in the knowledge of the *modus sciendi*, and an intrinsic but remote end that concerns the formation of the *modus sciendi* itself.[160]

The matter of logic can be conceived in two ways: (1) *materia in qua* or *subjectum inhaesionis*, which is the human intellect; (2) *materia circa quam* or *objectum*, which is the *modus sciendi*. Speaking improperly, logic has a *materia ex qua*, which would be all logical rules and precepts.[161]

Isendoorn then examines the three parts of logic, which correspond to the three operations of the mind. The first part of logic is called noetic and concerns apprehension; the second is called synthetic and regards the judgment or the enunciation; the third is called dianoetic and deals with reasoning and discourse.[162]

Noetic is the first part of logic and is at the foundation of both the other parts, because the apprehension is the first and most elementary operation of the intellect, which provides the constitutive elements on which synthetic and dianoetic logic are grounded.[163] In particular, simple apprehension is the knowledge of the terms that signify things without affirmation or negation.[164] It has the specific task of grasping something universal from the senses in such a way that this universal could be the

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[159] Cf. Isendoorn, *Cursus logicus systematicus & agnosticus*, 15: 'Logica est scientia practica tradens modum sciendi: hoc est, veniendi ex cognitione noti in notitiam ignoti'.

[160] Cf. Ibid. 24: 'Finis logicae internus proximus et immediatus est cognitio modi sciendi: tota enim est in tradendis regulis, quibus acquiramus modum sciendi. … Finis ejus internus remotus et mediatus est recta efformatio modi sciendi: finis enim scientiae practicae semper est constructio objecti'.

[161] Cf. Ibid.: '*Materia* in qua, *seu* subjectum inahesionis *logicae* proximum *est* intellectus *humanus*. … *Materiam*, ex qua *componatur*, *Logica* proprie *non habet*, *quia non est compositum* Physicum, quale est homo … Improprie *tamen* et analogice *omnia* praecepta, *et quibus tota conficitur Logica*, *materia ipsius non male statuuntur*. *Materia* circa quam *Logica* occupatur, objectum *vulgo*, et subjectum occupans, tractationis, attributionis, considerationis, convenientiae, demonstrationis *est* modus sciendi *in genere spectatus*, *quatenus sese extendit ad omnes illos modos*, *quibus devenitur ex noto in cognitionem ignoti*'.

[162] Cf. Ibid. 24–25: '*Partes logicae statuimus tres*; noeticam et dianoeticam: *sive*, apprehensivam, enunciativam et discursivam, *prout triplex est mentis humanae actio*, *quam suis praeceptis regit*, *dirigit atque corrigit logica*'.

[163] Cf. Ibid. 64: 'noetica, Latinis apprehensiva, est prima logicae pars, prima continens elementa, et quibus omnia opera, qua in hujus scientiae officina ducuntur, ortum trahunt. Vel, est ea logicae pars, quae de simplici agit apprehensione, seu, ut alii loquuntur, de primae mentis operatione'.

[164] Cf. Ibid. 64 'simplex apprehensio est cognitio, qua rem propositam simplici intuitu cognosci intellectus, absque determinatio judicio. Quod fit, cum, audito aliquo termino, res significata menti simpliciter offertur, sine affirmatione aut negatione'.

object of the intellect. Isendoorn's characterization of the universal concept is also very peculiar, and in fact opposite to that of contemporary Aristotelians—his position is not conceptualist but realist. For Isendoorn, the universal concept can be either *in causando*, when it is cause of many singular things, or *in distribuendo*, when it is the universal sign of particulars, or *in cognoscendo*, when by means of it many things are known, *in repraesentando*, when it is a representation or image of many things, *in significando*, when it signifies many things, *in essendo*, when it is the common nature of other things, or finally *in praedicando*, when is an analogous or univocal concept of other things.[165]

The universal can be considered *materialiter* as a *prima intentio* or *notio*, *formaliter* as a *secunda intentio* or *notio* and *in concreto* as a union of material and formal aspects.[166] In any case, for Isendoorn universals cannot be mere words or concepts, but they are rather things.[167] Isendoorn appeals to Socrates and Plato to sustain his view: for the Greek philosophers if we call 'man' a thing, 'to be a man' cannot apply to the thing only as a word or name, but must express a common nature which constitutes the thing's essence. Moreover, the universal is what is apt to exist in many particulars, but neither words nor concepts are in the nature of things; rather they are only in the mind. Finally, the adequate object of sensation would be something universal, but neither words nor concepts are perceptible to the senses, and so universals cannot be either, but only real things.[168]

Following the analysis of noetic, Isendoorn examines the synthetic or enunciative part of logic dealing with the second operation of the mind,[169] which combines in an affirmation and in a negation two terms apprehended by the first operation of

[165] Cf. Ibid. 66: 'I. *In causando*, quod cum singulare fit, multorum effectuum est causa … II. *In distribuendo*, et est signum universale; III. *In cognoscendo*, quod omnia vel multa cognosci: ita se habet sensus communis et intellectus; IV. *In repraesentando*: sic speculum intuentibus multa repraesentat. V. *In significando*, ut omne nomen appellativum, una significatione multas res ejusdem naturae significans … VI. *In essendo* externum, quod fit natura communis multis, ab iis tamen, quibus communis est, separata; … VII. *In praedicando*: quod iterum duobus modi sumitur, late nimirum, et strictum. Late sumptum comprehendit omnia praedicata, etiam analoga … Stricte vero sumitur pro solis praedicatis univocis'.

[166] Cf. Ibid. 67: 'Universale ultimo hoc modo sumi trifariam: I. materialiter, fundamentaliter, primo intentionaliter; II. formaliter et secundo intentionaliter; 3. Concrete, pro eo, quod ex materiali et formali coalescit'.

[167] Cf. Ibid. 70–71: 'universalia non sunt nuda nomina. … universalia non sunt conceptus. … Universalia sunt res'.

[168] Cf. Ibid. 71–72: 'Prob. I. quia Socrates et Plato conveniunt in hoc, quod uterque sit homo. Atqui non conveniunt in solo nomine, neque in nudo conceptu, ut ex dictis constat, sed in natura quadam una et communi, ob quam uterque est et dicitur homo … II. Universale est, quod aptum natum est in esse multis … neque nomina, neque conceptus sint a natura in rebus, quarum sunt nomina aut conceptus, sed extra eas, et ab hominibus fiant. III. Objectum adaequatum sensus est quid universale … sed hoc universale non est vox, … nec est conceptus, quia sensus non percipit conceptum. Ergo est res sive ens reale'.

[169] Cf. Ibid. 490: 'Noetica, quam et apprehensivam vocari diximus, sic fuit. Sequitur Synthetica, quam Enunciativam nominare liceat … Synthetica est secunda pars logicae, quae docet terminum componere cum termino, determinatum sensum efficere, et mentis aperire conceptus. Sive, quae agit de secunda mentis operatione'.

the mind.[170] After this comes dianoetic logic, whose task is not only to make discourses, but to reason from the known to the unknown.[171]

After the discussion of the various parts of logic, Isendoorn divides logic into natural logic, which pertains to every human mind by nature, and an artificial logic, which is acquired as a habit.[172] Artificial logic is in turn divided into *docens* and *utens*, the former is *ad rebus avulsa* and deals merely with general percepts, while the latter deals with particular rules that must be applied to a specific matter.[173]

Considering the nature and division of logic, Isendoorn rejects the opinions of Thomas Aquinas, Zabarella, Giulio Pace and Robert Balfour.[174] Logic is, as we have already said, a practical science, whose chief aim is not the truth, but the direction of the operation of the mind according to particular rules, and the elaboration of good inferences to acquire scientific knowledge.[175]

Isendoorn's textbook emphasizes the discussion of the object of logic, revealing the complete shift of interest towards epistemological theory to provide a true description of reality, where reality in itself mirrors concepts and gives them their meanings, and not vice versa, as held by contemporary Aristotelians. Isendoorn criticizes both the nominalists[176] and those who believe that logic deals with all

[170] Cf. Ibid.: 'secunda mentis operatio fit ex prima minimum his posita, sive, fit ex duobus terminis per affirmationem aut negationem inter se unitis'.

[171] Cf. Ibid. 585: 'Fuit synthetica: sequitur Dianoetica, tertia pars logicae de tertia mentis operatione, quae discursu seu argumentatione perficitur … argumentatio est oratio significativa discursus rationis ab uno cognito ad aliud incognitum, vel a magis cognito ad minus cognitum'.

[172] Cf. Ibid. 30, 33: 'Naturalis est ipsum lumen intellectus, cuilibet homini ab authore naturae inditum, quo mens nostra, nullis imbuta praeceptis assentitur vero et respuit falsum. … Artificialis est habitus seu qualitas labore ac studio quaesita, per quam intellectus habilis redditur ad bene disserendum. … differunt *realiter* et *essentialiter*: nam 1. Possunt ab invicem separari; etenim naturalis potest esse sine artificiali; at artificialis sine naturali esse non potest. 2. Distinctae species differunt essentialiter. At logica naturalis et artificialis sunt distinctae species: haec enim sub habitu, illa sub potentia naturali continetur. 3. Differunt subjectis: naturalis enim inest omnibus hominibus; arificialis non in omnibus, sed in aliquibus tantum reperitur. 4. Naturalis genuit artificialem, ejusque quasi mater est: artificialis autem non produxit naturalem. 5. Naturalis perficitur ab artificiali: at artificialem naturalis non perficit. Quod intellige de perfectione *accidentali*, non *essentiali*'.

[173] Cf. Ibid. 34: 'docens tradit regulas bene disserendi in quacunque materia. Graeci cum dixerunt *ad rebus avulsam*, quia praecepta ab omnibus rebus separata considerat. Utens praecepta logicae docentis tum propriae, tum aliarum scientiarum materiae applicat'.

[174] Cf. Ibid. 37–40.

[175] Cf. Ibid. 47–48: 'practica, cujus finis principalis et ultimus non est veritas, sed opus; sive, quae non est contenta sola veritatis contemplatione, sed ulterius tendit opus, tradendo praecepta operandi … quia dirigit operationes intellectus, secundum rectitudinem logicam, ut v.g. bonus fiat syllogismus'.

[176] Cf. Ibid. 52–53: 'Nominalium turba, *voces* esse objectum logicae, ad ravim usque clamitat. Sed refutantur facile: nam I. Si logica occupatur in vocibus, vel occupabitur in earum sono, vel in significatione, vel in eo, quod sint signa, quae alterius manifestant conceptum. Sed nullo horum modorum occupatur logica in vocibus. Ergo in vocibus non est occupata logica. Minor prob. nam logica 1. Non occupatur in sono, quia hic est obiectum Physicum auditus, neque 2. in significatione vocum quia hoc est Grammaticae, … neque 3. Quod voces sint signa, quae manifestant conceptus

things.[177] Moreover, he argues against the ontologists, who believe that the subject of logic is the *ens*,[178] or the *ens* and the *non-ens* (e.g. Ramists and Clemens Timpler),[179] or the *ens rationis* (e.g. Balfour).[180] Finally, Isendoorn criticizes logicians like Zabarella, who consider the *secundae notiones* as the subject of logic,[181] and the dialecticians (or Scotists), who maintain that logic deals with logical instruments such as demonstration and syllogism.[182] By contrast, Isendoorn concludes that the absolute and adequate subject of logic is the *modus sciendi*, the logical instrument by means of which the mind discovers something unknown from something known.[183] In particular, according to Isendoorn, there are four

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nostros sic etenim voces objectum quoque essent physicae, metaphysicae, mathematices etc…quia etiam manifestant conceptus physicorum, metaphysicorum, mathematicorum etc…II. Voces *per se primo* non considerantur in logica, sed tantum *secundario et per accidens*, quatenus sunt interpretes et signa nostrorum conceptuum. At logica *per se* debet agere de objecto suo. III. Potest quis addiscere logicam tacendo et formando tantum mentales conceptus ac syllogismos. Ergo non eget per se vocibus. IV. Mutus potest manere perfectus logicus. V. Objectum logicae debet esse immutabile. … Voces autem sunt ex instituto, et pro arbitrio mutari possunt'.

[177] Cf. Ibid. 53: 'Neque audiendi sunt, qui *res omnes* pro objecto logicae nobis obtrudere conatur: nam I. certum est, logicam omnium rerum naturas, causas, species, et affectiones non investigare: quis enim logicorum in Dei naturam. … II. Unaquaeque ars, scientia et facultas ab aliis omnibus distincta peculiare habet objectum logica autem ab aliis omnibus scientis est distincta … logicam tradere modos et instrumenta de rebus omnibus disserendi'.

[178] Cf. Ibid. 54: 'neque recipienda eorum est opinio, qui *ens ut ens est*, argumentum esse putant, in quo vires suas explicet logica: nam I. hoc proprium est metaphysicae; II. logica non considerat entia … *essentialiter et secundum ea*, *quae revera in is reperiuntur*, liceat entium quasdam … habitudines et relationes pertractet'.

[179] Cf. Ibid.: 'errorem itaque errant non levem, qui *ens et non-ens* pro logicae objecto assignant: nam, praeter dicta, non-entis nulla est scientia, cum enim nihil sit, qua ratione concipi possit, non video'. Isendoorn is probably referring to Clemens Timpler.

[180] Cf. Ibid. 54–55: 'Praeterea, *ens rationis* universim sive generaliter sumptum nullo modo est objectum logicae: nam I. logica non explicat naturam; principia, passiones et divisiones entis rationis, neque *per se* considerat ejus species, quae sunt privatio et negatio; II. ad *ens ratonis* non revocantur omnia quae logica per se tractat, ut est affimatio unius de alio, conversio propositionum et argumentatio. III. Ens rationis multa complectitur, quae ad logicam nullo modo pertinet'. Here he is probably referring to Balfour.

[181] Cf. Ibid. 55: '*Ens rationis logicum* sive secunda intentio, ut *praedicatum*, *subjectum*, *terminus major*, *minor*, etc. non est objectum logicae. Prob. I. Logicae agit de realibus operationibus intellectus. Ergo non agit de entibus rationis, quae non possunt proprie dirigere istas operationes: nam 1. Operationes sunt priores entibus rationis; 2. Fieri possunt operationes intellectus, etiamsi nemo fingat ens rationis: possum enim facere syllogismum, etiamsi ignorem, quid sit ens rationis … II. Proprietas, quae demonstrantur in logica, sunt reales … III. Ethica non dirigit operationes voluntatis per entia rationis … ergo nec logica necessario dirigit operationes intellectus per entia rationis'.

[182] Cf. Ibid. 56: 'Objectum quoque logicae neque est demonstratio, neque argumentatio, neque syllogismus: nam objectum adaequatum complectitur omnia, quae in scientia considerantur. Nihil autem horum hoc praestat: nam I. demonstratio non complectitur syllogismum dialecticum, qui est ex probabilibus. II. Argumentatio non comprehendit definitionem et divisionem. III. Syllogismus quoque neque haec duo comprehendit, neque enthymema et inductionem'.

[183] Cf. Ibid. 57: 'objectum *absolute et adaequatum* totius logicae est modus sciendi, quem et disserendi modum appellant alii. Per modum sciendi intelligimus orationem, qua devenitur ex cognitione noti in notitiam ignoti'.

instruments of logic (*modi sciendi*) that can be applied to science: definition, division, argumentation and method.[184]

Since the task of logic as a practical science is to deal with the *modus sciendi*, it is clear that, from Isendoorn's point of view, logic is nothing else than a methodology. In fact, unlike other Aristotelians of the time, Isendoorn devotes no particular space to the doctrine of method, but orients his entire logic towards the proper method of science, which is nonetheless conceived as demonstrative and discursive, that is, based on rigorous demonstration.

All discursive knowledge comes from a previous knowledge called *praenotio* or *praecognitio*. *Praecognitio* is grounded on natural knowledge, namely knowledge that is acquired by sensation or by intellect, and not by divine revelation.[185]

Sensible knowledge is the basis of all other kinds of knowledge and has as objects singular and corporeal things, known also through the accidents. It is not a discursive knowledge, but one which prepares and provides the matter for the other kinds of cognition.[186]

Intellectual knowledge, instead, can be discursive or not discursive. Non-discursive intellectual knowledge is that of the first operation of the mind, which provides the intellect with simple terms and assents to first general principles. Discursive intellectual knowledge can be independent or dependent. It is independent when it is acquired by means of the second operation of the mind, which requires only two terms to provide cognition. It is dependent when it is based on the third operation of the mind, which proceeds from the premises on which the conclusions depend.[187]

In spite of the various degrees of the cognitive process, Isendoorn shows how all knowledge is grounded on sensible knowledge, which can be internal or external. External sensible knowledge can presuppose other external sensible knowledge,

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[184] Cf. Ibid. 29 'Vocatur *modus sciendi*, non tam quod ipsa sit modus sciendi, quam quod illum docet conficere; definitionem, divisionem, argumentationem, methodum: neque enim alio modo scientiae cognoscuntur. Unde colliges, logicam esse modum sciendi, non quidem *formaliter*, sed partim *objective*, partim *causaliter* et *effective*'.

[185] Cf. Ibid. 654: 'Omnis autem nostra naturalis cognitio, de qua solummodo hic sermo est, vel *sensu* fit, vel *intellectu*'.

[186] Cf. Ibid.: 'Sensu, sive *sensitiva cognitione*, cognoscimus res singulares, corporeas, sensibiles, accidentales, … uno momento, et sine ullo discursu, ut cum video *hircum*, statim percipio esse hircum. … Haec vocari potest cognitio *praeparans*'.

[187] Cf. Ibid.: 'Cognitio quae intellectu fit, vel *sine discursu* fit, vel *cum discursu*. Quae sine discursu fit, est *dirigens*, vel *faciens*. Dirigens est cognitio *terminorum simplicium*, per primam mentis operationem, *subiecti* pura et *praedicati*, quae disponit intellectum: ut, si intelligendum sit hoc axioma; *totum est majus sua parte*, praenosse oportet, quid *totum*, quid *pars* sit. Haec vocari potest cognitio *secundum viam formationis*: intellectus enim conceptibus seu specibus, tanquam formis quibusdam, informatur. Facies sive *agens* est, quae efficit assensum conclusionis, et est cognitio *primorum principiorum*, per secundam mentis operationem, quae facit, ut conclusionem intelligam. Haec vocari potest *independens* et *secundum viam verificationis*: proprie enim veritas est in secunda mentis operatione. Quae cum discursu fit, intellectus cognitio … scholastici *discursivam* dicunt, Pacius *ratiocinativam*, qua, per tertiam mentis operationem, cognoscimus enunciationis alicujus veritatem, ex veritate alterius ante cognitae. Unde *dependens* ea dicitur'.

while internal sensible knowledge is self-sufficient. Based on this difference, Isendoorn makes the distinction between imagination and fantasy: the former always works in the presence of the real object or a memory of it, while the latter works independently from the perception of the external object.[188]

Simple intellectual knowledge always presupposes sensible knowledge—the old adage applies, nothing is in the intellect that was not before in the senses.[189] Simple intellectual knowledge is the first step to complex intellectual knowledge, which is acquired by means of the second operation of the mind.[190]

A discursive, complex, intellectual knowledge pertains to the third operation of the mind, i.e. reasoning, whose final deduction depends on the correct apprehension of the premises and of the first principles that come from induction. Therefore, ultimately, sensation and induction, as the generators of experiential knowledge, are the starting point of all kinds of knowledge.[191] Experiential knowledge, however, must be investigated by means of a careful mental examination of the *regressus*, which is for Isendoorn, like Zabarella, the true instrument for acquiring scientific knowledge.[192]

Isendoorn's work, though original in conceiving logic as a method of science rather than a heuristic instrument, is well defined by its emphasis on sensation and induction. However, unlike Aristotelians of his time, for Isendoorn sensation and induction grasp reality truly and directly, because the elements of logic are real and not arbitrarily established by the mind. Isendoorn's perspective is therefore realist rather than conceptualist. This was not the dominant idea of the time because the empirical and conceptualistic strand of British Aristotelianism, as we shall see in the next chapter, had already elaborated during the 1620s more advanced theories than those of the Dutch logician.

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[188] Cf. Ibid. 655: 'sensitiva cognito, *exteriori sensu* facta, praesupponit aliquando aliam cognitionem sensitivam externam … cognitio sensitiva, *sensu interno* facta, aliquando praesupponit aliam sensitivam, aliquando non. Imaginatio enim praesupponit cognitionem sensitivam externam. Sed phantasia, per quam res non *sensatas* percipimus, non praesupponit cognitionem sensitivam externam'.

[189] Cf. Ibid.: 'cognitio intellectiva *simplex*, in prima operatione intellectus, praesupponit aliam cognitionem, puta sensitivam: *nihil* enim *est in intellectu*, *quod non prius* aliquo modo *fuerit in sensu*'.

[190] Cf. Ibid. 654: 'cognitio intellectiva *complexa*, per secundam operationem intellectus, praesupponit cognitionem terminorum semplicem'.

[191] Cf. Ibid. 655–656: 'omnis cognitio, quae fit per discursum, pendet ex cognitione praemissarum, sive antecedentis. Probat hoc Aristoteles I. *inductione*, quia tam mathematicae, quam aliae scientiae, ita docuntur et addiscuntur; II. *a simili*: nam et dialecticus ita argumentatur, et orator itidem persuadet semper ex praecognitis. Patet idem *experientia*, quae docet, non scire nos conclusionem, nisi sciamus praemissas. Et ratio est, quia nemo scit effectum, nisi sciat causas'.

[192] Cf. Ibid. 662: 'Regressus demonstrativus est, cum, post factam demonstrationem ab effectu, regredimur a causa ad ipsum effectum, et per conclusionem, quam collegimus in tali demonstratione, demonstramus alteram praemissarum'.

Chapter 8
The Empiricism of Seventeenth-Century Aristotelianism

8.1 Samuel Smith's Introduction to Logic

The first important seventeenth-century British Aristotelian was Samuel Smith. Anthony à Wood remembers him at Oxford as 'the most accurate disputant and profound philosopher in the university'.[1] It is undoubtedly true that 'throughout the middle of the century the *Aditus ad Logicam* of Samuel Smith, fellow of Magdalen, was in vogue'.[2] In fact, his brief compendium to logic had 11 editions in 80 years: as a matter of fact it was the most popular textbook of the century only after that of Robert Sanderson.[3] The scholarship has always considered Smith as a syncretist, close to the Ramist positions[4]; however, a careful examination of his handbook shows the strong influence of Zabarella and Pace on the *Aditus*, in which entire propositions taken from Zabarella are repeated, revised and expanded. Smith presents a large number of Zabarella's views from an empiricist perspective, especially with regard to the theory of science and of method.

Smith's definition of logic is original and complex. Logic is the science of arguing on any 'theme' and it is the methodical and artificial comprehension of the precepts which make reasoning possible.[5] Logic is then divided into three parts as

[1] Anthony à Wood, *The History and Antiquities of the University of Oxford*, vol. 2, 283.

[2] Thomas, 'Medieval Aftermath: Oxford Logic and Logicians of the Seventeenth Century', 307.

[3] Cf. Samuel Smith, *Aditus ad logicam* (London, 1613). The compendium was subsequently republished in 1615, 1617, 1618, 1621, 1627, 1633, 1634, 1639, 1649, 1656, and 1684.

[4] Cf. Thomas, 'Medieval Aftermath: Oxford Logic and Logicians of the Seventeenth Century', 307; for some apparently Ramist aspects of Smith's theory of method cf. Howell, *Logic and Rhetoric in England 1500–1700*, 294–295. Concerning these pseudo-Ramist elements, however, Howell points out that there are Aristotelian doctrines incorporated into the Ramist dialectic.

[5] Cf. Smith, *Aditus ad logicam*, 3: 'Logica est scientia de quovis themate probabiliter et anguste disserendi … Logica est artificiosa et methodica praeceptorum comprehensio, qua cognoscimus succincte ratione uti ad fidem faciendam in qualibet re probabili'.

M. Sgarbi, *The Aristotelian Tradition and the Rise of British Empiricism*, Studies in History and Philosophy of Science 32, DOI 10.1007/978-94-007-4951-1_8,

are the three operations of the mind: the first deals with simple words, the second with the composition of words, and the third with complex discourses.[6]

Words are signs of things and of concepts, which are arbitrarily imposed by either divine or human will according to what can be written and pronounced.[7] If Smith's position seems to be neutral concerning the problem whether the words signify things or concepts, in truth his thought implies that words signify things, but only by means of concepts. In fact, without the use of concepts it would be impossible to attribute meanings to things in an arbitrary way, but things would signify *naturaliter* what the words express. This is proved also by the fact that the simple word can be conceived as concrete or abstract. A concrete word signifies in connection with the thing: the adjective 'white' attributed to 'man' has a meaning only in the expression 'white man'. An abstract word signifies independently from the thing, as for instance 'whiteness'.[8] Not all words, then, signify things, although all words undoubtedly signify concepts. For this reason we can conclude that according to Smith words signify things by means of concepts.

A further corroboration is the distinction of words into first and second notions or intentions. The former are words with a meaning outside the mind and imposed on the thing they signify, while the latter are words which do not signify the thing directly, but rather are the instrument through which the thing is conceived.[9] Also in this distinction we can recognize that words do not necessarily signify things, but that they are instruments for signifying and conceiving of things. Such instruments are the subject of logic.[10]

The primary instrument of science is demonstration, which is a syllogism grounded on true premises and deducing necessarily true conclusions. By science, Smith (following Aristotle) means the knowledge of causes. Smith points out that there are four requirements for science: first, the knowledge of the ultimate cause; second, the knowledge of the proximate cause; third, recognition of the connection between cause and effect; fourth, certainty that the thing or the effect has no other cause.[11]

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[6] Cf. Ibid. 4.

[7] Cf. Ibid. 5: 'Vox est signum rei et conceptuum ex instituto divino aut humano certa literarum aut syllabarum conformatione scriptum, aut pronunciatum'.

[8] Cf. Ibid. 6: 'Vox simplex rursus subdividitur in concretam et abstractam. Vox concreta est quae res coniunctim significat: ut album, *parietem, hominem, aut talem aliquod subiectum consignificat cum albedine eidem inhaerente*. Abstracta est quae rem separatim significat, ut albedo *qualitatem notat nulli subiecto inhaerentem*'.

[9] Cf. Ibid.: 'Vox primae intentionis est quae aliquid extra animum significat et rei primo est imposita: ut *aurum*, *virtus*. Vox secundae notionis est quae non immediate rem, sed modum aliquem seu instrumentum, quod mediante res intelligitur, denotat, *ut genus, species, omnesque voces artis*'.

[10] Cf. Ibid. 6–7: 'Sic in grammatica *lapis* est *vox* primae notionis, sed quando dicimus lapis est nomen [*nomen*] erit vox secundae notionis. Sic in logica animal est vox primae notionis naturam realem animalis significans, sed ut est *genus* est vox secundae intentionis'.

[11] Cf. Ibid. 97: 'Scire est causam cognoscere, propter quam res est, quod illius causa sit, et quod aliter se habere nequit. Ad scientiam igitur quatuor requiruntur: primo ut causa cognoscatur; secundo ut illa causa sit proxima, tertio ut cognoscatur quatenus est illius rei causa, id est ut connexionem causae cum effectum cognitam habeamus; quarto ut certus sit animus rem aliter se habere non posse'.

The certainty of science is characterized by two elements: (1) the closeness between cause and effect; (2) the mind's certainty that there are no other possible causes. The first directly concerns the object of knowledge, while the second is subjective and concerns the knowing mind.[12]

The twofold nature of scientific certainty comes from the twofold consideration of the object of knowledge, according to its matter or to its form. Concerning the matter, the object of science is the *res considerata* and is common to several disciplines. Concerning the form, it is the *modus considerandi* and is specific to each discipline.[13]

As we have just said, the instrument of science is demonstration, which proceeds from something known to something unknown. This knowledge can concern the *quod sit*, whether the object of investigation exists or not, or the *quid sit*, what the object is. To these two questions correspond two different kinds of demonstration, the demonstration τοῦ ὅτι, or *quod*, and the demonstration τοῦ δίοτι, or *propter quid.*[14] Both demonstrations deduce firm conclusions from true premises; but demonstration τοῦ δίοτι proceeds a priori according to nature, and discovers the proximate cause, while demonstration τοῦ ὅτι proceeds from the effect according to what is most knowable to the mind, and concludes with a cause which is not proximate to the effect.[15] Smith therefore maintains the traditional Aristotelian distinction between what is 'most knowable by us' and what is 'most knowable by nature'.[16]

If what is 'most knowable by us' comes from sensation (as effects of a cause), then demonstration should proceed from this sensible knowledge to the knowledge of what is 'most knowable by nature', that is, universals. Like Zabarella, Smith sustains that this cognitive process is constituted by the regressive method.[17] However, what is striking in Smith's very short textbook is the importance of demonstrative induction

[12] Cf. Ibid.: 'Ex his colligimus duplicem esse scientiae certitudinem, una ratione *obiecti seu rei scibilis*, quando causam eius proximam apprehendimus, alteram ratione *subiecti seu animi scientis*, ut scilicet certus sit, rem aliter se habere non posse, certus autem est, quia causam cognoscit, qua cognita necessario cognoscitur effectus'.

[13] Cf. Ibid. 98: 'In quolibet subiecto duo occurrunt consideranda: 1) res considerata; 2) modus considerandi. Una res considerata pluriuso scientiis potest communicari, at modus considerandi in iisdem alius est atque alius, *sic in scientia naturali naturale corpus est subiectum et res considerata; modus vero ipsum considerandi est qua naturale; idem etiam est res considerata in medicina, non autem qua naturale, sed qua sanabile*'

[14] Cf. Ibid. 110–111: 'Demonstratio non ut univocum, sed ut analogum genus primo dividitur in demonstrationem propter quid et demonstrationem quod. Demonstratio propter quid, est prima et principalis species quam superiori capite definivimus. Demonstratio quod, est qua res quidem esse ostenditur, causa tamen eius non indicatur, sed effectus.'

[15] Cf. Ibid. 111: 'Hae duae species conveniunt, quod ambae fiunt a propositionibus veris, prioribus et notioribus conclusione; sed differunt quod δίοτι procedit a prioribus secundum naturam, et causis proximis conclusionis; at ὅτι, vel ab effectu procedit et sic non erit a causa, vel si a causa procedat, erit remota non proxima et sic non constabit ex immediatis'.

[16] Cf. Ibid. 107: 'Prius autem et notius aliud alio duobus modis dicitur, *vel nobis*, ut sunt omnia singularia, quae sensibus objcuntur; *vel natura*, ut universalia, quae intellectui solum sunt obvia, *sic causae natura*, sed *effectus nobis sunt notiores*'.

[17] Cf. Ibid. 116–117: 'Regressus est illa demonstrandi ratio, qua prius causam ignotam ex effectu notiore colligimus; postea vero regredientes ex eadem causa eundem effectum demonstramus. Quum enim semper a notioribus nobis fit progrediendum, effectus vero saepe numero elucescit,

besides *regressus*, as a method for investigation, as if it were an autonomous method for discovering the principles of science. Smith, much more than Zabarella, emphasizes the role of demonstrative induction and defends its validity as an inventive method against sterile general or dialectical induction. In Zabarella, as we have seen, demonstrative induction was only one of two kinds of analytic method, which is a reduced form of demonstration *ab effectu*. For Smith demonstrative induction is instead the privileged method for discovering the first principles of science.[18]

In any case, like Zabarella, demonstrative induction has as its object something which comes from experience and which really exists, and not mere opinion, as is possible with dialectical induction. In fact, demonstrative induction is concerned specifically with particular objects and cases, and discovers a necessary connection between subject and predicate, cause and effect, leading to a scientific knowledge. Last, demonstrative induction knows the things that are knowable *per se* without any further proof.[19]

By contrast, dialectical induction produces only probable conclusions, based on a limited enumeration of cases and observations. Demonstrative induction also differs from demonstration from effects: while the latter has the task of discovering principles unknown by nature, the former discovers the principles which are knowable to us through sensation.[20]

In his discussion of these matters, Smith follows Zabarella very closely, using the same words. Nevertheless, while Zabarella still favours demonstration from effects (*ab effectu*) based on the syllogism, Smith leans more towards demonstrative induction as the only instrument capable of establishing and discovering principles, which are knowable *per se* from sensation, the source of all knowledge. In giving induction a central role and devoting an entire chapter to it, Smith clearly emphasizes the importance of the empirical part of scientific method, which begins from what is 'most knowable by us', that is, experience.

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quando causa est incognita, ideo eum quandoque sumimus, ut levem cognitionem causae habeamus, causa autem semel inventa de ea discurri intellectus, ut exquisitam eius notitiam haberet, qua parta regredimur rursus ad effectum per eam causam demonstrandum. Tria igitur in regressu sunt ordine consideranda, primo demonstratio causae ab effectu; secundo inventae causae accurata consideratio; tertio demonstratio effectus ex illa eadem causa'.

[18] Cf. Ibid. 120: 'Inductio est proprium instrumentum, quo principia scientiarum quae per se nota dicuntur nobis innotescunt'.

[19] Cf. Ibid.: 'Ad Inductionem tria praecipue requiruntur, primo ut materia sit necessaria, secundo ut sit essentialis connexus subiecti cum praedicato, tertio ut principia Inductione probanda sint naturaliter nota per se, et levi probatione egeant'.

[20] Cf. Ibid. 120–121: 'Per duas priores conditiones Inductio demonstrativa distinguitur a Dialectica, cuius materia non est necessaria et terminorum nexus est tantum accidentalis, et probabilis: unde ad principium dialecticum confirmandum multae Inductiones vix sufficient, ad Demonstrativum vero una aut altera satis superque est propter maximam et evidentem terminorum nexum. Per ultimam conditionem Inductio demonstrativa a demonstratione ab effectu differt, cuius officium est demonstrare principia naturaliter ignota, ad quorum inventionem Inductio parum habet efficaciae, quia forsan res invenienda non est per se sensilis, ut *materia prima quae per generationem invenitur*, Inductione vero inveniuntur eo principia, quae sunt nota secundum naturam, et proinde percipiuntur ut primum ostenduntur'.

8.2 Edward Brerewood's Elements of Logic

Less interesting but just as popular as Smith's *Aditus* was Edward Brerewood's *Elementa logicae*, published posthumously in 1614.[21] Howell sustains that 'his *Elementa logicae* had probably been written some twenty-five years before it was published, for it belongs among the interests he would have had between 1581 and 1590', but there is no evidence to support this thesis.[22] In fact his *Tractatus quidam logici de praedicabilibus et praedicamentis* (1628, repr. 1631, 1637, 1659),[23] shows a logical conception very similar to that of the *Elementa logicae* and mentions as sources logicians such as Zabarella and Smiglecki.[24] It is therefore reasonable to conclude that the *Elementa logicae* were written under the same influences. It is true, however, that the *Elementa logicae* is an atypical textbook for its time, not for its simplicity, but for its organization and presentation, which is probably the result of its incompleteness. For instance, the textbook does not present any definition either of logic, or of its subject or divisions, but *in medias res* it deals with the theory of proposition, without any particular originality. The treatment of logical argumentation such as the syllogism is also quite rudimentary. For example, Brerewood is the only logician of the time who does not distinguish demonstration *ab effectu* from demonstration *propter quid*.

He does, however, devote an unusual amount of space to induction in all its epistemological aspects. Induction is an argument which proceeds from a sufficient enumeration of the singular cases to the universal.[25] By its definition, proceeding from the particulars, induction differs from syllogism and from the enthymeme, which proceed from the universals. It differs also from example because the latter proceeds from a singular to a singular and not from a singular to a universal.[26]

The singular and the universal can be conceived in different ways. The singular can be conceived absolutely as an individual, or comparatively as what is less universal.[27] The universal can be conceived indefinitely, as in the case of 'man breathes', or universally as in the case of 'all men breathe'.[28]

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[21] It was reprinted nine times in 1615, 1619, 1621, 1632, 1638, 1649, 1657, 1668, 1684.

[22] Howell, *Logic and Rhetoric in England 1500–1700*, 298.

[23] Cf. Edward Brerewood, *Tractatus quidam logici de praedicabilibus et praedicamentis* (Oxford, 1628).

[24] On other influences on this work cf. Thomas, 'Medieval Aftermath: Oxford Logic and Logicians of the Seventeenth Century', 304.

[25] Cf. Brerewood, *Elementa logicae*, 101: 'Inductio est argumentatio procedens a singularibus sufficienter enumeratis ad universale: ut, Socrates rationalis, Plato est rationalis, et sic de caeteris, ergo omnis homo est rationalis'.

[26] Cf. Ibid. 101–102: '(Argumentatio) genus est in definitione quam duae sequuntur differentiae. 1. Priori (procedens a singularibus) per eam enim a syllogismo et enthymemate discernitur, quae procedunt ab universalibus ad universalia vel ad singularia: (a singularibus seu sufficienter enumeratis) 1. Omnibus simul collectis in antecedente. 2. Posterior (ad universale) per eam autem discernitur ab exemplo quod ab uno singulari procedit ad aliud et non ad universale'.

[27] Cf. Ibid. 102: 'Notandum quod singulare binaria accipitur. 1. Absolute, pro individuo, ut Socrate, Virgilio. 2. Comparate, pro minus universali, seu pro inferiori respectu alicuius superioris quomodo species alicuius generis possunt dici eius singularia, ut homo et brutum animalis et hoc modo sumitur singulare in definitione inductionis'.

[28] Cf. Ibid.: 'Notandum item, quod universale capitur. 1. Indefinite, ut in hac, homo spirat. 2. Universaliter, ut in hac, omnis homo spirat, et hoc modo intelligitur fieri progressum ad universale in inductione'.

The relation between singular and universal characterizes intellectual activity. Indeed, the intellect knows only by means of universals, but its activity in collaboration with sensation knows in a particular way the singular as well.[29] The universal is what is first by nature and the singular is what is first by us, but in the intellect, together with the senses, the universal, albeit confused, can be what is first known by us. In this sense the knowledge of the universal is twofold: (1) apprehensive, when it proceeds from the singular to the universal; (2) demonstrative, when the mind has a perfect cognition of the particular through the universal.[30]

Despite its simplicity and poor organization, Brerewood's *Elementa* contains an important chapter on induction, the only one devoted to the theory of knowledge. This is good evidence that induction was a fundamental problem for logicians of the period, as Sanderson's successful handbook also testifies.

8.3 Robert Sanderson's Empiricism

The most important and influential seventeenth-century textbook of logic in England was Robert Sanderson's *Logicae artis compendium*, published in 1615 and reprinted 14 times within two centuries. Sanderson's handbook is Aristotelian in many aspects. Sanderson himself in his *De historia logicae* does not hesitate to state that the Ramist school or Eclectic logicians offer no real development or improvement on the Aristotelian doctrines, and that their students would have derived greater benefit from a direct reading of Aristotle or one of his genuine interpreters.[31] Sanderson's purposes follow the direction of the *Nova statuta*, which partly explains his book's success in the universities.

Trentman states that 'Sanderson's views on the nature of logic and the method of logical analysis are worth remarking on for the way in which they supplement what has already been said about the point of view of Aristotelian logicians of the period'.[32] However, he adds that 'it may be remarked that this looks like an excessively psychologistic way to define the subject … such a reading of Sanderson might seem to be supported by the fact that he follows this definition with several pages of standard Aristotelian philosophy of mind, distinguishing the primum, secundum, and tertium actum mentis'. However, as we have seen, such psychologistic standpoint is nothing new in the Aristotelian logical tradition, especially in that of Padua. Sanderson was aware of the latest developments in the field of logic, as some documents and his

[29] Cf. Ibid. 103: 'Intellectus consideratur vel 1. Per se et sic solum universalia cognoscit. 2. Quatenus unitur cum sensu et sic cognoscit singularia'.

[30] Cf. Ibid.: 'Universale, quoad naturam; singulare, quoad nos, notius est. Notitia duplex: 1. Apprehensiva, qua aliquid quovis modo intelligitur: sic singulare nobis notius quam universale; 2. Demonstrativa, qua aliquid perfecte cognoscitur: sic universale nobis notius singularibus'.

[31] Cf. Robert Sanderson, *Logicae artis compendium* (Oxford, 1618), 117–123.

[32] Trentman, 'The Study of Logic and Language in England in the Early 17th Century', 192.

historia logicae show,[33] and from these achievements he tried to elaborate his logical knowledge into a new and original system that marks decisively the empiricist direction of British Aristotelianism.

Sanderson defines logic as an instrumental art that directs the mind in knowing things, recalling Zabarella's definition, but following more probably Keckermann or Timpler.[34] Undoubtedly, as Howell states, Sanderson 'rejects the Ramistic idea that logic or dialectic is the theory of disputing'.[35] The end of logic is to provide the adequate instruments for scientific knowledge. The subject of logic can be of three kinds: (1) *subiectum informationis*; (2) *subiectum operationis*, (3) *subiectum tractationis*. *Subiectum informationis* is constituted by the *materia circa quam* and it is in the first instance everything that the mind conceives (*ens* or *non ens*), and second a discourse. *Subiectum operationis* is every 'theme', considered not for its nature but rather as a logical instrument. In this sense the *subiectum tractationis* consists of *secundae intentiones* or *notiones*. If the end of logic is to acquire scientific knowledge, the main *subiectum tractationis* is demonstration.[36]

There are three parts of logic, following the tripartition of mental operations leading to scientific knowledge. The first part deals with the conception of simple terms, the second with the division and composition of a proposition, while the third deals with discourse and more specifically with argumentation and method.[37]

The most original aspect of Sanderson's logic is the third, which clearly shows its Aristotelian heritage, but which also introduces some new elements in the attempt to elaborate a theory of scientific method.

Sanderson defines demonstration as a syllogism that leads to scientific knowledge, that is to knowledge of the thing by means of its proper cause.[38] Specifically, demonstration is the syllogism that reasons from true, immediate and most familiar

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[33] Cf. Ashworth, *Introduction*, XXXI: 'in Walton's Life of Sanderson we find an interesting passage which suggests that the most important intellectual influences on Sanderson come from both the classical-humanist tradition and from the renewed interest in medieval philosophy which characterized many late sixteenth and early seventeenth century philosophers'.

[34] Cf. Sanderson, *Logicae artis compendium*, 1: 'Logica … est ars instrumentalis, dirigens mentem nostram in cognitionem omnium intelligibilium'.

[35] Howell, *Logic and Rhetoric in England 1500–1700*, 304.

[36] Cf. Ibid. 2: '*Materia circa quam* versatur, est omne illud, sive ens, sive non ens, quod *mente* complecti, vel *oratione* eloqui possumus. Ratio autem formalis considerandi est *secunda intentio*. Logicus enim considerat omnia themata, non secundum proprias suas naturas, sed in quantum logica instrumenta (quae sunt secundae notiones) sunt eis applicabilia. Hinc logicae pro diversa ratione multiplex assignari potest *subiectum*'.

[37] Cf. Ibid. 2–3: 'Ejus tres sunt partes, pro numero actuum mentis ab eam dirigibilium: quarum *prima* dirigit primum actum mentis, scilicet *conceptum semplicem*, et est *de simplicibus terminis … secunda* dirigit secundum actum mentis, scilicet *compositionem et divisionem*, et est *de propositione … tertia* dirigit tertium et ultimum mentis actum, scilicet *discursum*, et est *de argumentatione et methodo*'.

[38] Cf. Ibid. 154: 'Demonstratio est *syllogismus facies scire*. Scire autem unumquodque dicimur *cum causam cognoscimus propter quam res est*, quod illius rei causa sit, nec possit res aliter se habere'.

premises to what is known first by nature, that is, the cause of the effect.[39] The certainty of this knowledge is twofold, one is objective, when the mind knows the proximate cause or the effect, and the other is subjective, when the mind knows that the effect has no other cause.[40]

The perfect demonstration of scientific knowledge is demonstration *potissima*, to which two other kinds of demonstration agree by analogy,[41] *quod* and *propter quid*.[42] Unlike Zabarella, Sanderson does not identify demonstration *potissima* with demonstration *propter quid*. Demonstration *quod* in turn is divided into demonstration *ab effectu* and *a causa remota*; both provide an inadequate explanation of the thing.[43] Demonstration *propter quid*, on the other hand, provides an explanation according to its proper cause. However, neither demonstration *quod* nor demonstration *propter quid*, by themselves, provide scientific knowledge. Scientific knowledge is acquired only by means of demonstration *potissima*, which is the result of a threefold process of analysis, regressus and conversion (into definition).[44] The analysis is the resolution of the effect in the causal chain up to the first cause, which leads to the knowledge of the form which is the end of scientific research.[45] Regressus is the comparison between causes and effects and vice versa. Regressus consists in a mental examination in which the confused empirical knowledge of causes from sensation becomes clear to the intellect with the discovery of the distinct cause of the effect. Regressus has three stages: the first provides knowledge, though confused, of the cause of given effects, the second compares the cause and the effects, and the third clarifies the

[39] Cf. Ibid. 157: 'Demonstrationis definitio prior erat ex finali, alteram exhibet Aristoteles ex materiali talem: demonstratio est syllogismus ex veris, primis et immediatis; et notioribus, et prioribus, et causis conclusionis'.

[40] Cf. Ibid. 154: 'Unde duplex oritur scientiae certitudo: altera obiecti, vel scibilis, quando rei causa proxima apprehenditur; altera subiecti, vel scientis, quando sciens certus est rem non posse aliter se habere'.

[41] Cf. Ibid. 165: 'Quae hactenus de demonstratione dicta sunt simpliciter, de perfectissima duntaxat demonstratione, quam *potissima* vocant, intelligenda sunt absolute; alijs vero demonstrationis specibus, vel gradibus potius, conveniunt solum per analogiam ad potissimam'.

[42] Cf. Ibid. 166–167: '*Quaestiones scibiles* sunt quatuor, quarum duae sunt simplices, *an sit* et *quid sit*; duae complexae, *quod sit* et *propter quid sit*. … Ex duplici ergo ita quaestione, ὅτι et διότι oritur duplex demonstratio. Prior et imperfectior, quae dicitur demonstratio ὅτι, sive *demonstratio quod sit* … posterior et perfectior quae dicitur demonstratio διότι, sive *demonstratio propter quid*'.

[43] Cf. Ibid. 168–169: '*Demonstratio quod* duobus fit modis. Altero, cum causa demonstratur inesse subjecto per effectum proximum … et dicitur *demonstratio ab effectu*. … Altero modo fit *demonstratio quod*, cum effectus demonstratur inesse subjecto per causam remotam non reciprocam, vel potius demonstratur non inesse ei quod est ejus subjectum per talem causam; et dicitur *demonstratio a causa remota*'.

[44] Cf. Ibid. 175: 'Ex his sequuntur quaedam *potentiae* demonstrationis: quae sunt praecipuae tres istae: *analysis*, *regressus*, *conversio in definitionem*'.

[45] Cf. Ibid. 175–176: '*Analysis* est resolutio effectus in causas suas primas ad pariendam perfectam ejus scientiam. Cum enim fit catena quaedam et subordinatio efficientium et effectorum, quamvis effectus posterior possit quidem demonstrari per effectum priorem; non tamen in eo acquiescit mens, sed ulterius requirit causam etiam illius effectus, atque deinceps, quod perveniatur ad primam causam, cujus non datur causa, quae est *forma subiecti*, et in quam solam quitatur animus: ut si demonstretur *augmentatio* de omni vivente per *nutritionem*, illa rursus per *facultatem vegetantem*, atque illa demum per *animam*'.

cause in relation to the effect.[46] Once the distinct cause of the effect is established, the conclusion of the demonstration can be converted into a definition. The converted conclusions can be of three kinds, two partial and one total. The first partial definition is nominal, providing a general explanation of the effect, e.g. a lunar eclipse is the absence of moonlight. The second partial definition can be real or causal when it explains the cause of things, e.g. an eclipse is the interposition of the Earth between the moon and the sun. The total definition, which alone may be called scientific, is when the nominal and the real definitions are considered together, e.g. a lunar eclipse is the absence of moonlight caused by the interposition of the Earth.[47]

Having described the structure of scientific demonstration, Sanderson provides an original contribution to the method of acquiring new scientific knowledge. First of all, following Zabarella, Sanderson distinguishes the order from the method of science: the former arranges knowledge, the latter reaches new conclusions. In this way, method becomes specifically only the means of discovery or invention, and not of explanation. In fact, even if Sanderson acknowledges that order is more noble than method, he considers it useless in acquiring knowledge. Therefore, according to Sanderson, there are two methods, one of discovery and the other of teaching. The former is more important than the latter, which however is nobler. The method of discovery investigates the principles of knowledge and proceeds from what is 'most knowable by us' to what is unknown, progressing upwards from sensible particulars to intelligible universals, which are 'most knowable by nature'. The method of teaching, by contrast, descends from universals to particulars.[48]

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[46] Cf. Ibid. 176–177: 'Regressus est reciprocatio causae et effectus per demonstrationem: quam effectum per causam, per quam ipse prius demonstrabatur, reciproce demonstramus. Dicitur haec potentia *regressus*: quia intellectus noster postquam e confusa quadam et experimentali cognitione effectus, tanquam sensui propinquioris, *progressus fuerit* ad similem et confusam causae cognitionem; atque per multiplicem commentationem, et collationem causae ad effectum, maturaverit illam cognitionem usque adeo ut ex confusa fiat distincta: *regreditur* deinde a cognitione illa causae distincta, ad similem et distinctam cognitionem effectus. *Progressus* ergo fit per *demonstrationem quod* et a posteriori; respicitque confusam cognitionem *causae per effectum*. *Regressus* vero per *demonstrationem propter quid* et a priori; respicitque distinctam cognitionem *effectus per causam* differtque propterea a vitio illo demonstrationis, quem *circulum* appellant, cum quaeritur talis reciproca demonstratio, quae sit utrobique *propter quid* et a priori'.

[47] Cf. Ibid. 177: 'Conversio demonstrationis in definitionem est cum ex terminis demonstrationis per transpositionem construitur definitio accidentis proprij est autem accidentis proprij. Definitio duplex vel 1) *partialis* eaque aut a) *nominalis*, quae genere et subjecto constat: ut *eclipsis est defectus luminis in luna* … b) *causalis*, quae ex ejus causa constat: ut, *eclipsis est interpositio terrae*; 2) *totalis*, quae nominalem simul et causalem complexa, ex genere, subjecto et causa proxima constat: ut *eclipsis est defectus luminis in luna propter interpositionem terrae*'.

[48] Cf. Ibid. 225–226: 'Considerata argumentatione, reliquum est alterum discursus instrumentum, *ordo* seu *methodus*. Qui accuratius ista distinguunt, *ordinem* volunt esse integrae alicujus disciplinae, *methodum* etiam particularium conlusionum; atque *ordinem* disponere, *methodum* etiam inferre. … Methodus alia est *inventionis*, alia *doctrinae*: diversa enim prorsus via ad disciplinarum praecepta indaganda, et ad indagata docenda incedimus. *Inventio* prior est; *doctrina* nobilior. Utraque a notioribus nobis ad ignotiora nobis procedit; sed alio tamen et alio modo: nam praecepta indagamus *ascendendo*; hoc est, progrediendo a sensibilibus et singularibus, quae sunt *notiora nobis simpliciter*, ad intelligibilia et universalia, quae sunt *notiora natura*, et *nobis etiam distincta*, ad minus universalia et sensui propinquiora, velut *ignotiora*'.

The discovery of new knowledge does not belong to *regressus*, which is useful only in verifying the scientific nature of knowledge, but is characterized, following Smith's methodological precepts, by a fourfold process culminating in induction. The primary and fundamental means of acquiring new knowledge is sensation, through which the mind knows the various singular things. The second means of invention is diligent observation, or *historia*, which connects the sensible particulars and places them in the mind. The third means is experience, which collects and classifies the various observations and conserves them in such a way that they can be useful for future knowledge. The fourth means is induction, which from the collection of much experience infers universal conclusions.[49] Induction is specifically for Sanderson a particular kind of argumentation which proceeds from a sufficient enumeration of the particular cases to the formation of universals. It can be of three kinds: (1) perspicuous, clear and distinct, if all enumerated cases are considered; (2) implicit, if only some cases are considered and others assumed to be the same; (3) not perspicuous, when from one only example it infers a general conclusion.[50] Sanderson emphasizes particularly the extreme utility of induction for discovering first principles and universals of the causes and of all other universal things to be proved. But he also recognizes the intrinsic weakness of induction, in that a single exception or counterexample can overturn its conclusions.[51] Exceptions and particular cases must be necessarily considered, because they can confute the conclusions, and so must not be expunged from the theory. Sanderson thus pays particular attention to the empirical aspect of knowledge, more than any other logician of his time; indeed, after 1615 Bacon, as we shall see, would contrast his own ideas to those of Sanderson in the elaboration of his theory of induction.

Sanderson's account of the inventive method, although inspired by Zabarella and Keckermann, shifts radically towards empiricism, focusing on the cognitive process of knowing particulars more than the Stagirite himself ever dared to.

Sanderson's position on the method of learning is also highly original. Earlier theorists had described the process after the acquisition of experience as synthetic, i.e., from universals to particulars. By contrast, Sanderson's method of

[49] Cf. Ibid. 226–227: 'Methodi *Inventionis* quatuor sunt *media* et velut gradus per quos ascendimus. Primus *sensus est*; cujus adminiculo colligimus aliquam singularis rei notitiam; secundus *observatio*, sive *historia*; qua colligimus, et mente collocamus, quae sensu aliquoties hausimus; tertius *experientia*; qua collectas plures observationes ad certum usum applicamus, quartus et ultimus *inductio*, qua collectas plures experientias ad universalem conclusionem constituendam adhibemus'.

[50] Cf. Ibid. 151: '*Inductio* est argumentatio, quae ex singularibus (*sive particularibus*) sufficienter enumeratis colligit universale. Ea explicata est, si omnia particularia enumerentur expresse; implicita, si aliquibus expresse numeratis, reliqua adjecta aliqua clausula, ut *et sic de caeteris, etc*.; quamvis brevitatis studio non expressa, intelligi tamen significentur, ut, *iste magnes trahit ferrum, et ille, et hic, et pariter se habet in reliquis*, ergo *omnis magnes trahit ferrum*'.

[51] Cf. Ibid. 152: 'Inductio est utile admodum et potius argumentandi genus, ut quo probentur prima principia et universalissima, quorum non dantur causae, aut universaliora per quae possint probari. Nititur hoc fundamento necessario. *Quod omnibus inferioribus convenit, id toti superiori convenire*. Evertitur inductio, si fiat exceptio, aut instantia in contrarium'.

learning is twofold, depending on the discipline involved: it is a compositive method if it deals with theoretical disciplines, but a resolutive method with practical disciplines.[52] These two methods, especially in natural investigations, have five rules in common. The first rule, the 'law of brevity', establishes that nothing should be left out or be superfluous in a discipline. The second rule, also called the 'law of harmony', says that the individual parts of each doctrine should agree among themselves. The third rule is the 'law of unity or homogeneity' and states that no doctrine should be taught that is not homogeneous with the subject or end. The fourth rule, instead, is the 'law of generality', which asserts that in teaching must precede what without which the rest can not be understood, and that it does not need further knowledge to be understood. The fifth and final rule, the 'law of connection', establishes that the individual parts of a doctrine ought to be connected by opportune transitions.[53] Even if very brief, Sanderson's treatment of the rules of method had an unexpected influence on experimental philosophers of the second half of the seventeenth century, as can be seen for instance in the case of Isaac Newton, who drew his 'rules of philosophy' or 'rules for methodizing' from the Aristotelian logical textbook.[54]

In conclusion, Sanderson's logic represents a decisive step toward an empirical philosophy, in which the syllogism has given way to the cognitive process of invention based on sensation and induction.[55] It is hard to overstate the importance of Sanderson's theory of scientific method, since all subsequent logicians considered and discussed his approach. If we consider that his *Compendium* was the standard textbook in British universities, we can understand the wide circulation of his empirical ideas and their impact on several generations of thinkers in conceiving logic as an instrument of science, in which knowledge was based primarily on experience.

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[52] Cf. Ibid. 227: 'Methodus doctrinae alia est 1) *compositiva*, quae a notione *subiecti* incipiens principia ejus et affectiones et species investigat, haec tradendis disciplinis *theoreticis* inservit; 2) *resolutiva*, quae a notione *finis* incipiens, ejus subjectum et media investigat, haec disciplinis *practicis*, hoc est prudentijs et artibus tradendis inservit'.

[53] Cf. Ibid. 227–228: 'I Lex brevitatis. *Nihil in disciplina desit, aut redundet.* … II Lex harmoniae. *Doctrinae singulae partes inter se consentiant*. … III Lex unitatis, sive homogeniae. *Nihil in doctrina praecipiatur, quod non sit subiecto aut fini homogeneum*. … IV Lex Generalitatis, sive Antecessionis, et consecutionis. *Praecedat in docendo id sine quo alterum intelligi nequit, sed ipsum sine altero*. V Lex connexionis. *Singulae partes doctrinae aptis transitionibus connectantur*'.

[54] On Newton's debt to Sanderson cf. Maurizio Mamiani, 'To Twist the Meaning: Newton's *Regulae Philosophandi* Revisited', in Jed Z. Buchwald and I. Bernard Cohen (eds.), *Isaac Newton's Natural Philosophy* (Cambridge, Mass., 2001), 3–14. Newton had in his private library the third edition of Sanderson's textbook published in Oxford in 1631. Cf. John Harrison, *The Library of Isaac Newton* (Cambridge, 1978), 231.

[55] Cf. Ashworth, 'Introduction', XLV: 'Although syllogistic represented the main focus of logic for Sanderson as it did for other writers in the renewed Aristotelian tradition, his treatment of it is not lengthy'.

8.4 Crakanthorpe's Doctrine of Induction

Sanderson's work exerted a particular influence on Richard Crakanthorpe's *Logicae libri quinque*, published in 1622 and subsequently reprinted in 1641, 1670 and 1677.[56] Crakanthorpe's textbook was voluminous and hard to teach in class; it made no significant new contributions to the field, and frequently appealed to Zabarella on difficult topics. As with Brerewood's *Elementa logicae*, the most interesting aspect is its treatment of induction. It is noteworthy that although the *Logicae libri* appeared after Bacon's analysis of induction, the book retained the theories expounded by Brerewood and Sanderson.

Crakanthorpe deals with induction in its general treatment of imperfect argumentation, i.e. those arguments whose conclusions can be confuted.[57] Induction is the kind of imperfect argument by which, from a complete enumeration of all the particulars to which a predicate applies, we may conclude that the predicate applies to the genus.[58] Induction can be grounded on the relation of attribution or subordination, as in the case of the relation between species and genus and the part and the whole. In fact, if further characteristics pertain to other species of the same genus, we may infer that this species itself pertains to the genus; or otherwise if other parts have a specific characteristic, we may infer that the whole also has it.[59] For an inductive process to be valid, it must fulfil three criteria. First, it must proceed from a complete and perfect enumeration of all particulars; if only one particular is omitted, the induction will be invalid or inconsequent.[60] Second, it may prove only what has been provided by the senses, individuating in each particular the universal predicate. Crakanthorpe follows Zabarella and other Paduans in stating that induction does not properly prove something, in the sense of a deduction from known to unknown. Induction makes evident only what has already been apprehended by sensation. This is because induction, unlike syllogism, lacks a middle term. It is therefore simply an explanation of what the evidence of the senses has brought to light.[61]

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[56] Cf. Richard Crakanthorpe, *Logicae libri quinque. De praedicabilibus, de praedicamentis, de syllogismo, de syllogismo demonstrativo, de syllogismo probabili* (London, 1622).

[57] Cf. Ibid. 303: 'Sequitur nunc argumentatio imperfecta. Ea definitur esse argumentatio quae ad syllogismum veluti ad perfectius argumentationis genus et aliarum omnium regulam revocari potest ac debet. Huius sunt quatuor species, enthymema, inductio, exemplum, et sortites, de quibus paucis'.

[58] Cf. Ibid. 304: 'Inductio est argumentatio imperfecta, in qua ex plena enumeratione singularium omnium quibus praedicatum aliquod convenit, (quod fit in una praemissa) concluditur idem praedicatum universaliter convenire speciei illorum individuorum'.

[59] Cf. Ibid.: 'Fit etiam inductio, *ex plena enumeratione specierum unius generis, et partium integralium unius totius*. Nam par est ratio arguendi ab omnibus specibus ad genus, et ab omnibus partibus ad totum, atque ab omnibus individuis ad speciem'.

[60] Cf. Ibid.: 'De inductione tria observanda sunt. Primum hoc est, ut *in inductione fiat plena et perfecta enumeratio omnium particularium*. Nam si vel unum tantum omittatur, inductio est *invalida et inconsequens*'.

[61] Cf. Ibid. 305: 'Secundum est hoc, nulla inductio unquam probat aliquid nisi quando vel sensu, vel aliqua evidentia liquet, praedicatum illud inesse singularibus omnibus, quod inesse universali probare volumus. Ut cum probandum sit omnem hominem esse bipedem, si inducas singularia

Third, induction differs from the enthymeme in three respects. First, it proceeds from the enumeration of all particulars, while the enthymeme does not. Second, induction implies one of the two premises that should contain the middle or the means of the syllogistic demonstration. Third, the enthymeme can be reduced to various syllogistic forms—categorical common syllogism, singular syllogism, hypothetical syllogism, copulative syllogism and disjunctive syllogism. Induction, rather, can be reduced only to hypothetical syllogism. This is mainly because the premise of induction is always grounded on particulars and never on universals.[62]

Crakanthorpe's view of induction is far from the humanistic idea of dialectical induction. For him, induction is the first stage of a wider cognitive process which aims to discover causes, and in particular the causes of the physical world. In fact, one of Crakanthorpe's objectives was to elaborate a logic for scientific arguments, in particular concerning natural philosophy, as various examples in the textbook demonstrate.[63]

Crakanthorpe was well aware of the limits of induction, and most of all of the fact that induction provided only a provisory knowledge, which is not scientific because it is still confused and uncertain. Crakanthorpe divides all knowledge into

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omnia· et vere possis oculo demonstrare, ecce, Socrates est bipes, itemque Plato, itemque Aristoteles, et ita de caeteris, cum haec ex inductione manifesta iudicio sensus fecisti, omnem hominen esse bipedem recte concludes. Quoties vero non est evidenter manifestum, praedicatum illud inesse omnibus singularibus quae inducuntur, certe nihil dici potest vere tum probari, sed solum assereri. Nam probare aliquid, est per illud quod notum est ducere nos ad cognitionem eius quod est ignotum. At nisi fit aliquo modo manifestum, praedicatum illud omnibus singularibus inesse, probatio solum est ignoti per ignotum, quae vere est petitio principij … Atque hinc est quod Arist. profunde considerans vim inductionis …, syllogismum fieri per medium (puta notius eo quod probatur) inductionem vero fieri eorum quorum non est medium, (nempe notius eo quod probatur), quare inquit, inductio quodam modo opponitur syllogismo, syllogismus enim per medium (notius) probat maiorem terminum inesse minori. Inductio autem solum probat (vel potius asserit) maiorem terminum inesse medio per minorem. Ex quo fit ut inductio non fit admittendo, ut legitima probatio, quia non affert medium ullum quo probat maiorem termimum inesse minori, sed solum admittenda est ut illustratio vel declaratio propositionis probandae; nec tum etiam admitti debet, nisi quando praedicatum probandum de subiecto conclusionis, sensu vel alia evidentia discernitur inesse singularibus omnibus illius subiecti'.

[62] Cf. Ibid. 305–306: 'Tertio observa, quomodo enthymema et inductio inter se differant. Differunt autem tribus modis. Primo quia semper fit in inductione, enumeratio particularium omnium; hoc nunquam fit in enthymemate. Nam tum *enthymema* non vocandum esset, sed inductio. Secundo quia semper in inductione subintelligitur *maior*, at enthymemate modo *maior*, modo *minor* deest et intelligitur. Tertio, quia enthymema ad quamvis syllogismi speciem reduci potest, vel ad *categoricum communem*, vel ad *categoricum singularem*, vel ad *syllogismum hypotheticum* sive *conditionalem*, sive *copulativum*, sive *disiunctivum*. At inductio ad nullum alium syllogismum reduci potest et revocari, nisi solum ad *hypotheticum conditionalem*'.

[63] On Crakanthorpe's special interest in astronomy cf. Mordechai Feingold, 'The Mathematical Sciences and New Philosophies', in Nicholas Tyacke (ed.), *The History of the University of Oxford. Seventeenth-Century Oxford*, 359–448, esp. 379.

the confused (or imperfect) and distinct (or perfect). Confused knowledge is of particulars and effects, which are not comprehended by means of their causes, while distinct knowledge may also be of particulars, but comprehended by the universal governing them, and effects understood by their causes. But the entire cognitive process has its origin in the confused and imperfect knowledge of sensible particulars,[64] before acquiring the distinct and perfect knowledge of universals and causes.[65] The complete scientific cognitive process is possible only by means of demonstration, in which the mind proceeds from a knowledge of the effects to a knowledge of the causes.[66]

Demonstration is therefore the proper instrument of science. It is a syllogism by which we may reason from true, firm, necessary and 'most knowable by us' premises to equally true, firm and necessary conclusions, which are 'most knowable by nature'.[67]

There are two kinds of demonstration according to Crakanthorpe, *a causa* and *ab effectu*. The former is probably the most original element of his treatment of logic; this makes possible the scientific knowledge of a thing through its cause.[68]

Demonstration *a causa* differs according to the kind of cause. It can be: (1) demonstration *a causa efficiente per emanationem*; (2) demonstration *a causa efficiente per externam actionem*; (3) demonstration *a causa finali.*[69] The first is when the effect emanates from its efficient cause,[70] the second when the middle term or effect

[64] Cf. Crakanthorpe, *Logicae libri quinque*, 312: 'Omnis nostra cognitio (quae cum discursu fit) oritur a sensu, et sensitiva cognitione, quae per se ac sine omni discursu, per ipsos sensus res apprehendit'.

[65] Cf. Ibid. 318: 'Duplex est nostra rerum cognitio, una *confusa et imperfecta*, qua singularia per accidentia quaedam, non per naturam suam cognoscimus, et effecta non per causas, sed per alia adventitia. Altera *distincta et perfecta*, qua singularia per sua universalia ac naturas, et effecta per suas causas cognoscimus. Iam certum est, nos in *confusa et imperfecta* rerum cognitione, prius cognoscere singularia quam universalia et effecta prius quam causas, ideoque in hac *confusa et imperfecta* rerum cognitione, singularia nobis notiora sunt universalibus et effecta suis causis. Sed quando res *plene, perfecte, ac distincte* cognoscimus, tum universalia et rerum causae, *nobis* notiora sunt et prius cognita, quam singularia aut effectus'.

[66] Cf. Ibid.: 'Iam quia in omni demonstratione gignitur in nobis cognitio, ideo omnis demonstratio procedit ab ijs quae nobis sunt notiora. In omni demonstratione quidem causae per effectum, proceditur a cognitione effecti quod est nobis notius, ad cognitionem causae, quae est nobis ignotior: in demonstratione autem effectus per causam, proceditur ab eo quod est et natura sua notius, et simul etiam nobis notius, perfecte ac distincte effectum illud cognoscentibus'.

[67] Cf. Ibid. 311: 'Demonstratio est syllogismus in quo ex praemissis veris, certis, necessarijs, nobisque notioribus, docemus conclusionem inde sequentem esse veram, certam et necessariam'.

[68] Cf. Ibid. 320: 'Sequuntur nunc species demonstrationis. Eae duae sunt, una est a causa, altera ab effectu. … Demonstratio a causa est demonstratio, quae facit nos scire aliquid quare ita fit. … Scire, est rem per causam sit cognoscere ut sciamus hanc esse veram, propriam et proximam causam cur tale accidens alicui subiecto insit, ita ut aliter esse non possit quin propter hanc causam insit'.

[69] Cf. Ibid. 325.

[70] Cf. Ibid.: 'Demonstratio a causa efficiente per emanationem est, quando medium est causa efficiens per emanationem, eaque proxima et immediata, maioris termini, id est, illius effectus, qui subiecto inesse demonstratur'.

is brought about externally by its efficient cause,[71] and the third when the middle term is the final cause of the last term of the major premise.[72]

Demonstration *a causa* is, in Crakanthorpe's methodology, that through which the mind acquires scientific knowledge. However, the fundamental form of demonstration is *ab effectu*, defined as that which discovers the causes of a necessary effect, according to a particular relation of agreement between them, which is in the subject.[73] Demonstration *ab effectu* is necessary because the mind acquires a knowledge of causes from their effects, which are known first. Effects are known as inherent in the subject of investigation, either by sensation or by induction.[74] However, demonstration *ab effectu*, which represents the empirical side of every cognitive process, is only the beginning of the path to science. It is still necessary to prove that the cause discovered by the mind is the proper one; to demonstrate this requires the *regressus*.

The knowledge of the effect, as we have said, precedes that of the cause, and it is confused and indistinct. Before distinctly knowing the effect, we must distinctly know its immediate cause. The first part of the process therefore proceeds from the effects to the cause, producing an imperfect and confused knowledge of the cause through the effect itself. The second part of the cognitive process consists in an accurate and diligent mental examination, in order to determine whether the found cause is the actual proximate cause or not. For Crakanthorpe like all other Aristotelians, this examination is decisive for the transition from confused to distinct knowledge, although nobody explores the topic carefully. Once the cause has been discovered, it is possible to regress to the effect, so as to know it by means of its proper cause.[75] For Crakanthorpe, as for Zabarella, *regressus* encompasses the

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[71] Cf. Ibid. 331: 'Demonstratio a causa efficiente externa est, quando medium est causa efficiens externa, eaque proxima et immediata, maioris termini, id est, illius effectus, qui subiecto inesse demonstratur'.

[72] Cf. Ibid. 334–335: 'Demonstratio a causa finali est *demonstratio in qua medium est causa finalis maioris extremis*. Nam medium hic semper exprimit finalem causam quae movet efficientem ad agendum et maior terminus est ipsa actio efficientis qui agit propter illum finem. Finis autem non alio sensu causare dicitur, aut esse causa *quam quia movet efficientem*, nec alius est effectus finalis causae, quam *ipsa actio efficientis*. Finis autem movet efficientem non *physice* sed *moraliter*, suadendo aut excitando'.

[73] Cf. Ibid. 348: 'Demonstratio ab effectu, est demonstratio in qua ex necessario effectu alicuius causae, quam inesse aut convenire alicui subiecto declaramus, proximam ac immediatam illius effectus causam eidem subiecto inesse aut convenire concluditur'.

[74] Cf. Ibid. 350: 'Usus harum demonstrationum ab effectu, longe maximus est, et plane necessarius. Is est, ut per effecta ducamur ad cognitionem causarum. Nam omnis nostra cognitio, praesertim in illis scientijs quasi ipsi invenimus, incipit ab effectis. Effecta nos saepe sensu aut inductione magis facili ac sensibili, cognoscimus subiectis convenire [….] Hoc cognito, inde causas illorum effectuum eisdem subiectis convenire concludimus'.

[75] Cf. Ibid. 356: 'Effectum scimus ante causam, sed *confuse* non autem *distincte*; et ista confusa cognitio effectus, ducit nos ad cognitionem causae. Priusquam autem distincte cognoscimus effectum, oportet nos distincte cognoscere hanc esse proximam et immediatam illius effectus causam. Quando autem id cognoscimus de causa, tum facile possumus distincte cognoscere effectum per illam causam. In primo igitur processu qui est *ab effectu ad causam*, confuse adhuc, et imperfecte

entire cognitive process that leads to science; on the other aspect of methodology he refers directly to the Paduan's works.[76]

Like other British Aristotelians, Crakanthorpe emphasizes, more than Zabarella, the fundamental importance of the empirical element of the regressive method, showing once again how the Aristotelian movement took a clear empirical orientation in its doctrine of science.[77] In addition, Crakanthorpe conceives his logic as an instrument of natural philosophy, paying attention to the connection between causes and effects and their possible explanations.

8.5 Aristotelianism During the 1620s and 1630s

Another exponent of Aristotelian logic during the first half of the seventeenth century, influenced by Paduan Aristotelianism and German Aristotelianism, is Christopher Airay (1601–1670). In 1628 Airay published the *Fasciculus praeceptorum logicorum in gratiam juventutis academicae compositus*, designed for the Oxford classroom, with a second edition in 1660. It is a simple work, but of great significance for our understanding of logic at Oxford during the 1620s. His main source is Keckermann's logic, from which Airay copies many passages, interweaving them with the doctrines of Sanderson and Brerewood. The *Fasciculus* was written at the end of Airay's studies in Oxford, just before he was appointed as professor in 1627; it therefore draws on his experience as a student and as a teacher.

Airay uses Sanderson's definition of logic as an instrumental art for directing the mind in knowing things.[78] Logic concerns reason as the part of the human

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cognoscimus tam causam esse huius effecti causam, quam effectum esse huius causae effectum; sed postea per accuratum et diligens examen mentis, discernimus hanc esse proximam causam huius effectus; et tum ex ea causa, in secundo processu (qui regressus dicitur) demonstramus et effectum illud tali subiecto inesse et quare insit scimus. Inter primum ergo processum qui confusam solum generat notitiam causae, *intervenit diligens examen mentis*, per quod distincte cognoscimus causam esse hujus effectus causam, et ex ea effectum subiecto huic inesse demonstramus. Ita neque penitus ignoramus causam, cum facimus primum processum (nam tum ad notitiam causae nunquam duceremur per effectum); nec plene tamen et perfecte cognoscimus, (nam distinctam adhuc non habemus scientiam quod haec sit proxima illius causa) sed postquam per examen (quandoque longius, quandoque breve ac subitum) percepimus causam hanc, esse proximam illius effectus causam, tum in secundo processu, statim regredimur ad demonstrandum effectum, quem iam scimus propter hanc causam subiecto inesse'.

[76] Cf. Ibid. 357: 'Si quis vero plenam, solidam, ac perfectam eorum omnium quae ad demonstrationem spectant, notitiam habere desiderat, eum ego ad doctissimum Iac. Zabarellam iterum remitto: a quo haec, aliaque omnia quae in hac causa scire cupit, hauriri, nec tamen unquam exhauriri possunt. Certe enim in hac parte logicae ille palmam meruit, *palmam ergo ille habeat secum, servetque sepulchro*'.

[77] On Crackanthrope's general attitude towards science cf. Mordechai Feingold, *The Mathematicians' Apprenticeship: Science, Universities and Society in England 1560–1640* (Cambridge, 1984), 66–67.

[78] Cf. Christopher Airay, *Fasciculus praeceptorum logicorum in gratiam juventutis academicae compositus* (Oxford, 1628), 1: 'Logica est ars dirigens mentem in cognitione rerum'.

soul capable of knowing, understanding and thinking.[79] In fact, its primary subject may be considered the mind itself and in this respect logic is called natural. The secondary subject of logic is discourse, not in the sense of a combination of letters or words as in grammar, nor of ornate words as in rhetoric and poetics, but as what the mind properly conceives, and by means of which it signifies and explains things.[80]

Following Keckermann, according to Airay logic has the task of directing the mind in knowing things since the cognitive process can be defective in three ways. First, the mind can err in the apprehension of the thing; second, it can know the thing confusedly; third, it can arrange its acquired knowledge confusedly.[81] The ultimate end of logic is therefore to teach the rules that prevent the mind from erring, and to lead it from obscure to clear, from uncertain to firm, from false to true, from confused to well-ordered knowledge.[82]

Airay, like all the other Aristotelians, distinguishes the three operations of the mind as the formation of concepts, the formation of propositions, and the formation of discourse.[83] In particular the simple terms are basic logical notions, namely the most simple instrument of logic. The simple term is also called 'thema', that is what the mind represents to itself,[84] and this is the subject of logic. The theme can be considered in two ways, recalling Zabarella's position: according to its material aspect as the *res considerata*, common to many disciplines, and according to its

[79] Cf. Ibid.: '*Ratio* autem est mentis sive animae humanae praecipua facultas, quae et cognitio et meditatio dicitur; hinc ratione uti cognoscere, intelligere et cogitare, ejusdem significationis sunt; nec aliud sunt hominis cogitationes, quam mens seu ratio et intellectus circa res occupatus'.

[80] Cf. Ibid. 2: 'Obiectum circa quod versatur logica est duplex: 1) primarium, quod est *mens*; ratio, intellectus seu cogitatio quaevis hominis, quae quatenus sine arte, solo lumine naturali expeditur, naturalis logica dicitur …; secundarium est *oratio* seu verba, non quae suis sunt combinata literis (sic enim ad Gram. pertinent) nec quatenus sunt ornate decoranda, sic enim sunt Rhetoricae et Poetices propria, sed quatenus mentis conceptus respiciunt, ijsque aliquid significant et explicant, atque ideo sunt conceptuum symbola'.

[81] Cf. Ibid. 3: 'tres magnos hos morbos in aeternum sibi contraxit: primum est *aberratio* a re apprehendenda; secundus est *obscuritas,* cum saepe quidem res apprehendat, attamen naturas earum interiores, harumque notas, seu verba, quasi per nebulas conspicit; tertius est *confusio* et ἀταξία quod scilicet res non apprehendit et cognoscit eo ordine quo debet. His tantis defectibus mentis nostrae dum per praecepta sua medetur logica, dicitur eam dirigere in cognitione rerum; dirigit enim logica mentem et ejus conceptum, non absolute, sed in relatione ad res, id est, quatenus actu circa res apprehendendas sunt occupata'. Cf. Keckermann, *Systema Systematum*, 67.

[82] Cf. Ibid.: 'Hinc facile intelligitur quisnam sit scopus et finis et fructus disciplinae logicae: is scilicet, ut nostrae de rebus cogitationes per huius divinae artis praecepta et regulas dirigantur et rectificentur, ne inter cogitandum, implicata et obscura pro perspicuis; incerta, pro certi; falsa, pro veris; confusaque, pro ordinatis animus aprrehendat'.

[83] Cf. Ibid. 4: '*Mens* seu ratio per tres gradus seu *actus* est distincta. Primus mentis actus est *simplicium* terminorum apprehensio seu formatio conceptus semplici. Secundus actus est *compositio* et *divisio*; seu formatio integrae *propositionis* et sententiae. Tertius actus est διάνοια, seu discursus; seu collectio unius ex altero'.

[84] Cf. Ibid. 4–5: 'Terminus *simplex* est logica notio sive instrumentum, quo unum quid et simplex rei thema, vel propositum menti repraesentatur'.

formal aspect as *modus considerandi*, determining the *res considerata* and specific to each science.[85]

These simple terms are not 'naked words', but images generated in the mind to facilitate knowledge and comprehension of real things outside the mind. Thus, for instance, the genus 'man' is a logical image through which the mind understands the common nature of many individuals.[86] Logical terms, therefore, are instruments to know the external world. Knowledge of the external world depends entirely on the power of the mind to conceive things through logical terms, and this is why logic is an essential instrument for correcting any possible errors.

Mental errors are particularly dangerous in the composition of terms as propositions and complex arguments. Like other Aristotelians, Airay gives a pivotal role to the theory of argumentation. An argument is a logical inference which derives its conclusions from one or more statements. It can be imperfect or perfect.[87] The perfect argument is the syllogism, which from known premises deduces a necessary conclusion according to precise rules. Imperfect arguments are reducible to syllogisms, and include the enthymeme, induction, the example and the *sortites*.[88]

Imperfect argumentation is defective either in the number of its premises, in its arrangement of them, or in its inference.[89] The most important form for Airay is induction, and his treatment of this subject closely follows Brerewood and Sanderson. Induction is an imperfect argument by which the mind infers a universal conclusion from every particular.[90] By particulars Airay means not only individuals, but also what is less universal, as for instance the species with respect to the genus or the part with respect to the whole. It is certain, he asserts, that if the mind does not conduct a complete enumeration of the particulars, the conclusion must be false. Despite this, induction is the best instrument for discovering and acquiring new knowledge,

[85] Cf. Ibid. 134: '*Materiale*, (quod *res considerata* vocatur) et hoc in diversis disciplinis et scientijs locum habet, v.g. *homo* tractatur in *physicis, anatomicis, ethicis, medicinal. chirurgicis etc. … Formale*, quod praeter rem consideratam includit *modum considerandi*, secundum quem res considerata determinatur ad hanc vel illam scientiam'.

[86] Cf. Ibid. 5: 'Sed id hoc in loco notabunt logicae studiosi non nuda tantum vocabula esse hos terminos logicos, *Genus, Species, etc.*; sed significare imprimis imaginem quandam et picturam (arte formatam in ejus mente et cogitatione, qui logicam discit aut docet) qua imagine utitur ad cognoscendas et intelligendas res ipsas *extra mentem* positas. Ita genus est imago et pictura logica in mente hominum cujus picturae beneficio mens intelligit naturam multis communem … et ita de alijs logicae terminis, quos ego similitudine quadam artium aliarum soleo declarare'.

[87] Cf. Ibid. 114: '*Argumentatio* est oratio perfecta in qua ex una propositione vel pluribus concluditur aliquid cum hac vel simili nota illationis, ergo estque duplex: 1) imperfecta; 2) perfecta'.

[88] Cf. Ibid. 114–115: '*Imperfecta* ad syllogismum reducitur, estque quadruplex, *enthymema*, *inductio*, *exemplum*, *sortites* … *perfecta*, dicitur *syllogismus* … syllogismus est argumentatio in qua ex duabus praemissis rite et secundum regulas dispositis conclusio sequitur necessario'.

[89] Cf. Ibid. 125: '*Imperfectus syllogismus* est qui deficit in praemissarum numero, vel dispositione vel (ab ijsdem) illatione'.

[90] Cf. Ibid. 126: '*Inductio* est imperfectus syllogismus per quem ex omnibus singularibus inductis colligimus universalem conclusionem'.

such as those principles which form the basis of scientific knowledge.[91] However, induction alone does not guarantee the acquisition of scientific knowledge, since this is based also on demonstration.

Demonstration leading to scientific knowledge must necessarily involve a perfect syllogism grounded on premises which are true, immediate and 'most knowable by us'.[92] Science itself is an intellectual knowledge of the proper cause of things, and one which correctly describes the object of investigation.[93] Demonstrative knowledge is based on prior sensible and intellectual knowledge. Sensible knowledge offers a notification of the first principles, which are then grasped by the intellectual knowledge which proceeds from them to the deduction of the demonstration.[94]

Sensible and intellectual knowledge differ also by degree in relation to what is 'most knowable by us' and what is 'most knowable by nature'. What is 'most knowable by nature' is self-sufficient and universal knowledge. What is 'most knowable by man', on the other hand, can be of two kinds: (1) distinct and acquired, when it proceeds from universals to particulars and effects; (2) confused and original, when it proceeds from singulars to universals, from effects to causes.[95]

Like Crakanthorpe, Airay distinguishes several species of demonstrations, which differ in the kind of cognition of the causes. The transition from a confused and experiential knowledge of the effect to a distinct understanding of the cause is possible through a regressive process.[96] The end of *regressus* is therefore to acquire a distinct knowledge of the effect, progressing from a confused knowledge of the

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[91] Cf. Ibid.: 'Per singularia non tantum intelligimus individua, sed et minus universalia, et species respectu generis, ut et partes omnes integrales respectu totius. Nisi plena sit omnium singularium enumeratio, falsa erit conclusio. Inductio est accomodatissimum instrumentum ad artes inveniendas'.

[92] Cf. Ibid. 130: '*Demonstratio* est syllogismus constans ex veris, primis, immediatis, notioribus, prioribus et causis conclusionis'.

[93] Cf. Ibid. 130–131: 'Definitur *scientia*, notitia certa conclusionum, quibus propter demonstrationem assentimur. Vel sic, *scientia* est cognitio alicujus propriae passionis, inaherentis suo proprio subjecto, per propria et immediatae principia … *Scire* est causam cognoscere propter quam res est, illius rei causam esse, nec aliter se habere posse, cujus ultimae definitionis partes sic explicantur. Genus est *cognitio*, non quaevis tamen sensibilis notitia, sed *intellectiva*, neque haec indiscriminatim universalis, sed *ad rectum obiectum definita*; non terminorum simplicium, sed *complexorum*; non principij sed *conclusionis*'.

[94] Cf. Ibid.: '*Intellectiva* quae duplex est, vel enim antecedit 1) *conclusionem immediatae* et tum dicitur praecognitio *complexa*, sive *agens*, estque tum axiomatum, tum praemissarum perceptio; 2) *totam demonstrationem*, et dicitur *simplex* sive *dirigens*, quae tres terminos simplices ex quibus demonstratio constat, aequaliter respiciat'.

[95] Cf. Ibid. 143: '*Notius* dicitur aliquid duplici modo. 1) *Natura*, quod secundum naturam est magis noscibile, sive cuius notitia non dependet ab alio, vel saltem non a tam multis medijs, quam alterius cognitio, quale est *magis universale* respectu minus universalis, sive singularis. 2) *Nobis*, quod contingit vel in *cognitione nostra*: a) *distincta et habituali*, atque sic *universale*, quam singulare, *causae*, quam effectus sunt notiores, quia horum perfecta cognitio ab illis pendet; b) *confusa* et *originali* et sic *singularia* prius cognoscuntur a nobis imperfecte per adjuncta et accidentia, quam universalia et effectus quam causae'.

[96] Cf. Ibid. 160: '*Regressus* tum fit, cum inter causam et effectum, sit attributio reciproca, ita ut a confusa et experimentali cognitione effectus procedamus ad distinctam causae intelligentiam et rursum a causa distincte cognita, regredimur ad distinctam cognitionem effectus'.

cause, passing through the mental examination of the cause, leading back to the distinct knowledge of the effect.[97]

Airay's *Fasciculus* presents no theoretical innovation, but it does show the wide dissemination of Aristotelian logic in the second and third decades of the seventeenth century and the increasing importance of induction in scientific method for discovering the causes of natural things, as the works of John Prideaux (1578–1650) also testify.

In his brief introduction to logic, *Heptades logicae*, published in 1639, Prideaux defines logic as an artificial doctrine that directs the innate elements of reason to a ready and correct use of what is conceived by the mind.[98] Prideaux distinguishes seven parts of logic: (1) noematic; (2) thematic; (3) axiomatic; (4) dianoetic; (5) methodic; (6) analytic; (7) genetic. Of particular interest is the part on method, which is defined as the instrument that investigates what is unknown, and discovers, researches and appropriately arranges new knowledge.[99] The 'methodic' of logic is in turn composed of seven parts: (1) heuretic; (2) synthetic; (3) analytic; (4) topic; (5) dramatic; (6) historic; (7) cryptic. Heuretic is properly the inventive part of method and is constituted by four processes that Prideaux takes directly from Sanderson: (1) sensation; (2) observation; (3) experience; (4) induction.[100] Such methodological issues remain substantially unchanged in his *Hypomnemata* (1650), evidence that Sanderson's logical perspective remained successful.[101]

British Aristotelianism of the first half of the seventeenth century focused entirely on the inventive method of scientific knowledge, and in particular on the empirical aspects of the cognitive process, such as observation, sensation and induction. The same aspects were at the very heart of the investigations of the reformers of Aristotelian logic such as Bacon, Harvey and Hobbes; although these figures are usually interpreted as modern anti-Aristotelian thinkers, they brought with them all the doctrines elaborated by British Aristotelians in the first decades of the seventeenth century.

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[97] Cf. Ibid. 161–162: 'In *regressu* vero finis est distincta scientia effectus, atque primus progressus est ab effectu confuse cognito, ad causam confuse cognoscendam, a causa vero confuse cognita, adhibita mentis negotiatione ad distinctam causae cognitionem perveniums, a qua semel intellectui habitata et radicata, regredimur ad effectum distincte cognoscendum'.

[98] Cf. John Prideaux, *Heptades logicae* (Oxford, 1639), 1: 'Logica artificialis est doctrina, quae dirigit rationem innatam, ad quodvis intelligibile dexterius librandum et discutiendum'.

[99] Ibid. 12.

[100] Ibid. 13: '*Euretica*, per 1) *sensum*; 2) *observationem*; 3) *experientiam*; et 4) *inductionem*, artes excogitat'.

[101] Cf. John Prideaux, *Hypomnemata logica, rhetorica, physica, metaphysica, pneumatica, ethica, politica, oeconomica* (Oxford, 1650), 90: 'Methodus est rerum inveniendarum aut tractandarum ordinata inquisitio et dispositio qua facilius ignota eruantur et eruta discantur. Itaque vel incognita quaerit et invenit, vel inventa et judicata disponit ad propriam informationem et aliorum institutionem. … Euretica sive inventiva per 1. sensum; 2. observationem; 3. experientiam; 4. inductionem'.

Chapter 9
The Reformers of Aristotelian Logic

9.1 Francis Bacon and the Problem of Induction

For the first half of the seventeenth century, as we have seen, Aristotelian logic dominated in the British Isles, pervading not only universities but also sophisticated treatises from outside the academic framework. The consent was almost unanimous, and a British Aristotelian school with an empiricist strand was born and disseminated at the universities. The problem of sensation and induction was paramount to all the most important Aristotelian philosophers, who tried to elaborate a method for scientific knowledge. This is a peculiarity of British Aristotelianism. In Germany, logic was useful for solving theological disputes or as an ancillary discipline to ontology and metaphysics—that is, its study was not primarily the foundation of scientific method.

However, not all British philosophers of the time were favourable to Aristotle in finding a scientific method. The most notorious example is undoubtedly Bacon, who seems to have made a struggle against Aristotelianism one of his programmatic ideas. But a closer look at his methodology reveals that his philosophy would be inconceivable outside the framework of the British Aristotelian movement, which had reevaluated the roles of sensation and induction for research and discovery. As we shall see, Bacon took certain ideas on the doctrine of induction from Aristotelians such as Digby, Brerewood and Sanderson, and re-elaborated them within a wider philosophical project. In this sense, even Bacon may be considered to some extent as an Aristotelian.[1]

Bacon's projected image as an anti-Aristotelian (or, better, as an anti-Scholastic) was forcefully defended by John Stuart Mill in his *A System of Logic*, where he states that the Cambridge logician, simply for elaborating a new scientific method grounded on induction, should be opposed to the Aristotelian tradition: 'it was,

[1] On Bacon's alleged Aristotelianism cf. Robert E. Larsen, 'The Aristotelianism of Bacon's Novum Organum', *Journal of the History of Ideas*, 4 (1962), 435–450; Louis A. Kosman, *The Aristotelian Backgrounds of Bacon's* Novum Organum (Harvard, 1964).

M. Sgarbi, *The Aristotelian Tradition and the Rise of British Empiricism*,
Studies in History and Philosophy of Science 32, DOI 10.1007/978-94-007-4951-1_9,

above all, by pointing out the insufficiency of this rude and loose conception of induction, that Bacon merited the title so generally awarded to him, of founder of the inductive philosophy. … His writings contain, more or less fully developed, several of the most important principles of the inductive method'.[2] In particular, Mill recognizes Bacon's criticism of the logicians of his time: 'the method almost exclusively employed by those professing to treat such matters inductively, is the very *inductio per enumerationem simplicem* which he condemns; and the experience, which we hear so confidently appealed to by all sects, parties, and interests, is still, in his own emphatic words, *mera palpatio*'.[3] According to Mill, therefore, Bacon's own logical position did not accept Aristotelian induction as simple enumeration of cases and it rejected the appeal to experience as almost useless.

In the previous chapter, I have shown that the theories of experience, sensation and induction were much more complex than those which, Mill claims, Bacon rejected. If Bacon focused on an inductive methodology for science, it was precisely because of the great attention which contemporary Aristotelians paid to the problem of induction and experience.

In order to understand Bacon's debt to Aristotelian philosophy, and therefore also his innovations, it is necessary to reconstruct without prejudices his entire theory of induction, which is known very well from a theoretical perspective, but very little from a historical standpoint.[4]

First we may say, as some interpreters have done, that the Baconian point of view is not anti-Aristotelian *in toto*, and that he instead opposes the inductive and deductive methods for acquiring scientific knowledge.[5] Other scholars, meanwhile, have sustained that Bacon was not against synthetic and deductive method, but only against its exclusive use, focusing more on induction.[6] Both of these claims are partially true; as we shall see, Bacon supported both inductive and deductive method. But we should also keep in mind that, as we have seen in the previous chapters, the British Aristotelian school did not privilege deduction either; on the contrary, the inventive method coincided most of the time with induction itself. It is however true that the Aristotelians favoured demonstration and the regressive method at the

[2] John S. Mill, *A System of Logic, Ratiocinative and Inductive* (London, 1843), vol. 1, 378.

[3] Ibid.

[4] On Bacon's conception of induction cf. Morris R. Cohen, 'Bacon and Inductive Method', in Id., *Studies in Philosophy and Science* (New York, 1949), 99–106; Michael Hattaway, 'Bacon and Knowledge Broken. Limits of Scientific Method', *Journal of the History of Ideas*, 39 (1978), 183–197; Laurence J. Cohen, 'Some Historical Remarks on the Baconian Conception of Probability', *Journal of the History of Ideas*, 41 (1980), 219–231; Michel Malherbe, 'L'induction baconienne: De l'échec métaphysique à l'échec logique', in Marta Fattori (ed.), *Francis Bacon. Terminologia e fortuna nel XVII* (Rome, 1984), 179–200; John R. Milton, 'Induction before Hume', *British Journal for the Philosophy of Science*, 38 (1987), 49–74.

[5] Cf. Michel Malherbe, 'Bacon's Critique of Logic', in William A. Sessions (ed.), *Francis Bacon's Legacy of Texts* (New York, 1990), 69–87; Stephen Gaukroger, *Francis Bacon and the Transformation of Early-Modern Philosophy* (Cambridge, 2001), 132–164.

[6] Cf. Angelo Crescini, *Il problema metodologico alle origini della scienza moderna* (Rome, 1972), 101.

final stage, but these two kinds of inferences were useful only for arranging what the mind already knew, rather than for acquiring new knowledge. Deductive method had a prominence for British Aristotelians only in the systematization and confirmation of what the inventive method had discovered. The method of scientific discovery, as Bacon considered it, was for them also an inductive method based on experience. However, the Aristotelians were aware that the discovery of new knowledge by induction was not sufficient to guarantee the universal character required by the Aristotelian concept of *scientia*. Thus, Bacon was an anti-Aristotelian neither in his distinction between inductive and deductive method, nor in his rejection of deductive method for scientific discovery; it is very improbable, furthermore, that he was unaware of contemporary developments in logic. We might also contest the claim that for Bacon scientific method was only the method of discovery and not also that of the arrangement of knowledge. In fact, in other places, Bacon seems to consider both aspects of method, that is discovery and arrangement (or judgment, in Ramist terms). If Bacon was an anti-Aristotelian, other reasons must be sought.

In fact, Bacon's thought may be better represented as a development of British Aristotelianism on the subject of induction. In fact, as Fulton H. Anderson and Paolo Rossi have shown, Bacon's polemic against Aristotelian philosophy does not directly involve Aristotle himself, but only his medieval interpreters, and it must be understood within the frame of Bacon's entire logical system.[7]

Bacon's gravest attack on Aristotelian logic, which at the same time betrays his deep knowledge of British Aristotelianism, is § 69 of the *Novum Organum*. The implicit reference is probably Sanderson, or more generally the British logicians of the first two decades of the seventeenth century. According to Bacon, Aristotelian logic is guilty of subordinating the world to human thought, and human thought to words.[8] Bacon's criticism seems directed against Aristotelian conceptualism or Ockham's nominalism, which subordinated the world to the mind and the mind to its concepts. The danger for Bacon is that once the mind has acquired primacy over the world, any error will lead, without the possibility of denial or rebuttal, to a distorted description of reality. However, in general Bacon is not against conceptualism, demanding only that logic closely adhere to reality, and follow a specific order and arrangement.[9]

Bacon states that all arguments proceeding from sensation to axiomatic conclusions are erroneous and inadequate. Bacon seems to be openly criticizing the Aristotelian conception of the inventive method. However, Bacon adds, there are four stages in the process from sensation to abstract principles, referring implicitly

[7] Cf. Fulton H. Anderson, *The Philosophy of Francis Bacon* (Chicago, 1948), 130–131; Paolo Rossi, *Francis Bacon. From Magic to Science* (Chicago, 1968), 60–61.

[8] Cf. Francis Bacon, *The Instauratio magna part II: Novum Organum and Associated Texts (=NO),* ed. by Graham Rees and Maria Wakely (Oxford, 2004), 108: 'At pravae demonstrationes, idolorum veluti munitiones quaedam sunt et praesidia; eaeque, quas in dialecticis habemus, id fere agunt, ut mundum plane cogitationibus humanis, cogitationes autem verbis, addicant et mancipent'.

[9] Cf. Ibid.: 'Demonstrationes vero potentia quadam philosophiae ipsae sunt et scientiae. Quales enim eae sunt, ac prout rite aut male institutae, tales sequuntur philosophiae et contemplationes'.

to Sanderson's theory.[10] To these four stages correspond four errors. First, a sense-impression may be at fault, because it can be deceived. Thus, we must constantly take care to correct our sensory deficiencies and errors.[11] Second, the notion may be inadequately abstracted from the sense-impression, and therefore may be indeterminate and confused, rather than clear and distinct.[12] Third, the inductive process, which discovers the first principles of science by means of simple enumeration, without exclusions, analysis or division, is fallacious.[13] Last, the method of discovery and proof, by which the most general principles are first established, and then the intermediate axioms applied to them and tested, is the source of all errors and the ruin of every science.[14]

Bacon therefore criticizes the Aristotelian school on four points of weakness—sensation, abstraction of confused notions, induction and syllogistic demonstration. However, it would be wrong to conclude that Bacon rejects *in toto* the Aristotelian inventive method; we should rather say that Bacon accepts Aristotelian methodology, but insists a strong reform of its account of the cognitive process, starting with syllogsim.[15]

In *Cogitata et visa*, Bacon states that syllogism is like an oracle for Aristotle, but it is unable to grasp the difficulty of natural things under investigation.[16] However, this does not mean that he rejects syllogism: only that he relegates it to second place in the process of discovery, behind induction.[17] In *Of the Proficience and Advancement of Learning*, Bacon is very clear on this point. There are two arts of judgment dealing with the nature of proofs and demonstrations: induction and syllogism. Induction, being an immediate process of proof, coincides with

[10] Cf. Ibid.: 'Fallunt autem et incompetentes sunt eae quibus utimur in universo illo processu qui a sensu et rebus ducit ad axiomata et conclusiones. Quidem processus quadruplex est, et vitia ejus totidem'.

[11] Cf. Ibid. 108–109: 'Primo, impressiones sensus ipsius vitiosae sunt; sensus enim et destituit et fallit. At destitutionibus substitutiones, fallaciis rectificationes debentur'.

[12] Cf. Ibid. 109: 'Secundo, notiones ab impressionibus sensuum male abstrahuntur, et interminatae et confusae sunt, quas terminatas et bene finitas esse oportuit'.

[13] Cf. Ibid.: 'Tertio, inductio mala est, quae per enumerationem simplicem principia concludit scientiarum, non adhibitis exclusionibus et solutionibus, sive separationibus naturae debitis'.

[14] Cf. Ibid.: 'Postremo, modus ille inveniendi et probandi, ut primo principia maxime generalia constituantur, deinde media axiomata ad ea applicentur et probentur, errorum mater est et scientiarum omnium calamitas'.

[15] On Bacon's scientific method as reform of the Aristotelian methodology cf. Michel Malherbe, 'Bacon's Method of Science', in Markku Peltonen (ed.), *The Cambridge Companion to Bacon* (Cambridge, 1996), 75–98.

[16] Cf. *The Works of Francis Bacon (=FB)*, edited by James Spedding, Robert Leslie Ellis and Douglas Denon Heat (London, 1860-), vol. 3, 607: 'Atque de syllogismo, qui Aristoteli oraculi loco est, paucis sententiam claudendam … rerum vero naturalium subtilitati et obscuritati imparem et plane incompetentem'.

[17] Cf. Ibid.: 'Rem esse nimirum, in doctrinis quae in opinionibus hominum positae sunt, veluti moralibus et politicis, utilem et intellectui manum quandam auxiliarem … Restare inductionem, tanquam ultimum et unicum rebus subsidium et perfugium'.

invention: invention and judgment are the same in induction. In syllogism, which proves mediately, the invention of the means differs from the judgment of the conclusion.[18]

For Bacon the intrinsic weakness of syllogism lies in the fact that it is grounded in a kind of induction which is not sufficient to guarantee scientific knowledge. In fact, Bacon frequently remarks elsewhere that syllogism is constituted by propositions, propositions by words, and words are labels and signs of mental concepts. If mental concepts are vague, imprecise and confused, the entire structure of a demonstration collapses.[19] Yet on the first page of the *Novum organum*, recapitulating the Aristotelian distinction between *primae* and *secundae notiones*, Bacon warns that the former, which the mind passively receives, stores and accumulates, can be faulty and abstracted confusedly, while the latter are just as obscure, having been elaborated arbitrarily by the mind.[20]

The only way to reach clear and distinct mental concepts is to use induction correctly; by a laborious inductive process one can appropriately collect information from things for the intellect.[21] But there are two key problems with induction. The first is in its application, when it is impatiently conducted only to reach the first principles of science in the hope of finding the middle terms by means of syllogistic deduction. The second problem is that induction, unlike syllogism, has never been

[18] Cf. Francis Bacon, *The Advancement of Learning*, ed. by Micheal Kiernan (Oxford, 2000), 122: 'Now we pass unto the arts of Judgment, which handle the natures of Proofs and Demonstrations; which as to Induction hath a coincidence with Invention. For all inductions, whether in good or vitious form, the same action of the mind which inventeth, judgeth; all one as in the sense; but otherwise it is in proof of syllogism; for the proof being not immediate, but by mean, the invention of the mean is one thing, and the judgment of the consequence is another'. *FB*, vol. 1, 640: 'In arte autem ista judicandi (ut etiam vulgo receptum est) aut per inductionem aut per syllogismum concluditur … At quatenus ad judicium quod fit per inductionem, nihil est quod nos detinere debeat; uno siquidem eodemque mentis opere illud quod quaeritur, et invenitur et judicatur. Neque enim per medium aliquod res transigitur, sed immediate, eodem fere modo quo fit in sensu. Quippe sensus, in objectis suis primariis, simul et obiecti speciem arripit et ejus veritati consentit'.

[19] Cf. *FB*, vol. 3, 607: 'Nam syllogismum certe ex propositionibus constare, propositiones ex verbis, verba notionum sive animi conceptuum tesseras et signacula esse. Quamobrem notiones ipsae, quae verborum animae sunt, si vagae, nesciae, nec satis definitae fuerint (quod in naturalibus longe maxima ex parte fieri consuevit), omnia ruere'; *NO*, 68: 'nihilominus hoc subest fraudis, quod syllogismus ex propositionibus constet, propositiones ex verbis, verba autem notionum tesserae et signa sint. Itaque si notiones ipsae mentis (quae verborum quasi anima sunt, et totius hujusmodi structurae ac fabricae basis) male ac temere a rebus abstractae, et vagae, nec satis definitae et circumscriptae, denique multis modis vitiosae fuerint, omnia ruunt'; *FB*, vol. 1, 621: 'si notiones ipsae … male et varie a rebus abstrahantur, tota fabrica corruit. Neque laboriosa vel consequentiarum, vel veritatis propositionum examinatio rem in integrum unquam restituet, cum error sit … in digestione prima, quae a functionibus sequentibus non rectificatur'.

[20] Cf. *NO*, 2: 'propterea quod notiones rerum primae, quas mens haustu facili et supino excipit recondit atque accumulat (unde reliqua omnia fluunt), vitiosae sint et confusae et temere a rebus abstractae; neque minor sit in secundis et reliquis libido et inconstantia'.

[21] Cf. *FB*, vol. 3, 607: 'quae opera laboriosa et fida rerum suffragia colligere et ad intellectum perferre possit'.

investigated thoroughly; previous logicians elaborated only a simple and puerile form of induction which proceeds only by enumeration and leads to dubious and merely probable conclusions.[22]

Bacon's objective is to go beyond syllogism and examine induction as a real instrument of discovery.[23] In this sense, he follows the other British Aristotelian logical works of his time. In fact, he states that there are two ways of discovering truth. The first proceeds hastily from the senses and from particular cases to general principles, by whose means the mind may ascertain the middle axioms. The second also begins from the senses, and proceeds to principles, but continues to ascend without interruption, finally reaching general axioms.[24] The first way is Aristotelian, the second that of Bacon himself. The two ways, even if superficially similar, differ enormously. In fact, although both proceed from the senses and particulars and rest on general notions, the first touches experience very briefly, while the second investigates it methodically; the first establishes abstract general notions from the start, while the second proceeds gradually to what is 'most knowable by nature'.[25]

The main reason why Bacon rejects the puerile induction of some Aristotelians, but not that of logicians such as Brerewood, Sanderson and Crakanthorpe, is that the former was not really a process of discovery, but rather of notification of something

[22] Cf. Ibid. 607–608: 'Verum et hujus nomen tantummodo notum esse; vim et usum homines hactenus latuisse. De inductione enim ita decernendum. In usu ejus atque etiam forma homines dupliciter peccasse. Primo quod morae impatientes et compendia viarum undique lustrantes et quaedam in certo ponere, circa quae tanquam circa polos disputationes verterentur, properantes; eam tantum ad generalia scientiarum principia adhibuerentur, media per syllogismorum derivationes expedire temere sperantes. Rursus, quod de syllogismo accurate, de hac autem demonstratione cursim et negligenter inquirentes, formam ejusdem meditati sunt admodum simplicem et plane puerilem; quae per enumerationem tantum procedat, atque propterea precaria, non necessario concludat'.

[23] Cf. *NO*, 28: 'Atque est ea quam adducimus ars (quam *interpretationem naturae* appellare consuevimus) ex genere logicae; licet plurimum, atque adeo immensum quiddam, intersit. Nam et ipsa illa logica vulgaris auxilia et praesidia intellectui moliri ac parare profitetur: et in hoc uno consentiunt. Differt autem plane a vulgari rebus praecipue tribus: viz. ipso fine, ordine demonstrandi, et inquirenti initiis. … In logica enim vulgari opera fere universa circa syllogismum consumitur. De inductione vero dialectici vix serio cogitasse videntur; levi mentione eam transmittentes et ad disputandi formulas properantes'.

[24] Cf. *NO*, 70–71: 'Duae viae sunt … ad inquirendam et inveniendam veritatem. Altera a sensu et particularibus advolat ad axiomata maxime generalia, atque ex iis principiis eorumque immota veritate iudicat et invenit axiomata media, atque haec via in usu est. Altera a sensu et particularibus excitat axiomata, ascendendo continenter et gradatim, ut ultimo perveniatur ad maxime generalia, quae via vera est sed intentata'.

[25] Cf. Ibid. 71: 'Utraque via orditur a sensu et particularibus et acquiescit in maxime generalibus, sed immensum quiddam discrepant, cum altera prestringat tantum experientiam et particularia cursim, altera in iis rite et ordine versetur. Altera rursus iam a principio constituat generalia quaedam abstracta et inutilia, altera gradatim exurgat ad quae revera naturae sunt notiora'.

already known by sensation.[26] This was the case with Zabarella's and Smith's positions, in which, as we have seen, induction was explicitly defined as the notification of general principles which the mind had acquired by experience. Bacon generalizes that all Aristotelians sustain that induction as notification is an inventive process, but that if this were the case, it would not discover anything new. He therefore aims to reform the inductive process into a real inventive method, because he considers induction as notification to be completely useless for the progress of scientific knowledge. Bacon's project, then, is not so different from that of the British Aristotelians of the time, since their objective had also been to reform induction and emphasize the empirical aspect of the inventive method.

Induction for Bacon, as for the other Aristotelians, rests first of all on sensation. Sensation is in itself weak and subject to error, and the other logical instruments that should improve it are useless.[27] In fact, once material has been gathered very roughly and variably by experience, no laborious examination, no logical inference can amend the errors in it. Scepticism towards scientific knowledge, defending instead the knowledge of mere appearances and probable things, appears to be well-grounded for Bacon.[28] However, the sceptics ascribed all the errors of knowledge to the senses, whereas for Bacon these were enough to reach the truth if their evidence was used comparatively.[29] Errors must be ascribed instead to the weakness of the intellect and to our way of gathering and inferring from sense-data. What Bacon challenges, then, is not the validity of sensation in itself,[30] but the way we proceed from sensible knowledge of particulars to intellectual knowledge of universals.[31] In other words, the error lies in the inductive process.

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[26] Cf. *FB*, vol. 1, 633–634: 'Inventio argumentorum inventio proprie non est. Invenire enim est ignota detergere, non ante cognita recipere aut revocare. Huiusce autem inventionis usus atque officium non aliud videtur quam ex massa scientiae, quae in animo congesta et recondita est, ea quae ad rem aut quaestionem institutam faciunt, dextre depromere. Nam cui parum aut nihil de subiecto quod proponitur innocui, ei loci inventionis non prosunt. Contra, cui domi paratum est, quod ad rem adduci possit, is etiam absque arte et loci inventionis argumenta producet. Adeo ut hoc genus inventionis … inventio proprie non sit; sed reductio tantum in memoriam, sive suggestio cum applicatione'.

[27] Cf. *NO*, 86: 'Sensus enim per se res infirma est et aberrans, neque organa ad amplificandos sensus aut acuendos multum valent'. On the relation betwenn induction and sensation cf. Michel Malherbe, 'L'experience et l'induction chez Bacon', in Michel Malherbe and Jean-Marie Pousseur (eds.), *Francis Bacon. Science et méthode* (Paris, 1985), 113–133.

[28] On the 'uncritical reliance on sense experience' cf. Gaukroger, *Explanatory Structures: Concepts of Explanation in Early Physics and Philosophy*, 126. On Bacon's relation to Scepticism cf. Miguel A. Granada, 'Bacon and Scepticism', *Nouvelles de la Republique des Lettres*, 2 (2006), 91–104.

[29] Cf. *FB*, vol. 1, 622: 'Sensus vero, licet saepenumero homines aut fallant aut destituant, possint tamen multa adjuti industria ad scientias sufficere; idque non tam opere instrumentorum (licet et haec quoque aliqua ex parte prosint) quam experimentorum ejus generis, quae objecta subtiliora, quam pro sensus facultate, ad objecta sensu comprehensibilia producere queant'.

[30] On Bacon's account of sensation and perception cf. Stephen Gaukroger, 'Bacons Psychologie von Wahrnehmungskognition', in Dominik Perler and Markus Wild (eds.), *Sehen und Begreifen: Wahrnehmungstheorien in der frühen Neuzeit* (Berlin-New York, 2008), 71–94.

[31] Cf. Ibid.: 'Debuerant autem potius defectum hac in parte imputasse mentis tum erroribus tum contumaciae (quae rebus ipsis morigera esse recusat), et pravis demonstrationibus, et modis ratiocinandi et concludendi ex perceptione sensuum perperam institutis'. On the ambiguous roles of sensation in Bacon's epistemology cf. Guido Giglioni, *Francesco Bacone* (Rome, 2011), 125.

Bacon, like the Aristotelians, is convinced that sensible knowledge is always the knowledge of individual things that affect the mind. Impressions which come from the senses generate, by means of the imagination, the images of individual things; these are perfectly fixed in the memory as the object of intellectual knowledge.[32] Imagination is an intermediate faculty, a messenger between sensation and the intellect.[33] Sensation provides the material of knowledge to the imagination, which will be the further object of the intellect, according to Aristotle's *Analytica posteriora* II.19.

In the *Descriptio globi intellectualis*, Bacon once again presents the Aristotelian model to characterize the transition from sensible to intellectual knowledge. Individual images come from sensation and are fixed in memory as they are perceived by the senses. The mind reflects on these images, composing and dividing them into parts, because every individual thing represented by these images has something in common with something else, but also something that distinguishes it from other things. Such a process of division and composition happens either according to the human will or according the natural qualities of the things.[34]

In the first case, the parts of a given image may be taken apart and recombined by the imagination, with no constraint from the nature of reality itself: thus from the parts of horses and other animals, it can create unicorns and hippogriffs. However, the imagination is limited to elements derived from sensory experience: if something is not grasped by senses, it creates no images in the mind.[35]

If the parts of the images are combined or divided according to their natural qualities, or at least according to the subjective appearance of nature to the individual mind, then the process is carried out by reason and, according to Bacon, the control of these functions must be assigned to reason.[36]

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[32] Cf. Ibid. vol. 1, 494–495: 'Individua sola sensum percellunt, qui intellectus janua est. Individuorum eorum imagines, sive impressiones a sensu exceptae, figuntur in memoria, atque abeunt in eam a principio tanquam integrae, eodem quo occurrunt modo'.

[33] Cf. Ibid. vol. 1, 615: 'Verum quidem est, quod phantasia in utraque provincia, tam judicali quam ministeriali, legati cujusdam aut internuncii aut procuratoris reciproci vices gerit. Nam sensus idola omnigena phantasiae tradit, de quibus postea ratio judicat: at ratio vicissim idola electa et probata phantasiae transmittit, priusquam fiat executio decreti'.

[34] Cf. Francis Bacon, *Philosophical Studies 1611–1619*, ed. by Graham Rees (Oxford, 1996), 96: 'Etenim individuorum imagines excipiuntur a sensu, et in memoria figuntur. Abeunt autem in memoriam tanquam integrae, eodem quo occurrunt modo. Has rursus retrahit et recolit mens; atque (quod officium ejus proprium est) portiones earum componit et dividit. Habent enim individua singula aliquid inter se commune, atque aliud rursus diversum et multiplex. Ea vero compositio atque divisio vel pro arbitrio mentis fit, vel proac invenitur in rebus'.

[35] Cf. Ibid. 96–98: 'Quod si fiat pro arbitrio mentis, atque transferuntur portiones illae ad placitum in similitudinem quandam individui, phantasiae opus est, quae nulla naturae aut materiae lege et necessitate astricta, ea quae in rerum natura minime conveniunt conjungere, quae vero nunquam separantur discernere potest; ita tamen ut intra primas illas ipsas individuorum portiones coerceatur. Nam eorum quae nulla ex parte se sensui obtulerunt, non est phantasia, ne somnium profecto'.

[36] Cf. Ibid. 98: 'Quod si eaedem individuorum portiones componantur et dividantur pro ipsa rerum evidentia et prout vere in natura se proditur aut saltem pro caput cujusque se prodere notantur, ea partes rationis sunt: atque universa hujusmodi dispensatio rationi attribuitur'.

Bacon's explicit objective is to reform the Aristotelian method that proceeds from sensation to intellect, rejecting all those operations which can cause errors and deceptions.[37]

For Bacon, as for all the Aristotelians of his time, scientific knowledge is the knowledge of causes, and in particular of the formal cause.[38] The method of ascertaining the form of a particular thing is divided into two parts: invention and deduction. Invention discovers from experience general principles, while deduction infers new knowledge from those principles. In particular, invention is focused on the operations of sensation, memory and reasoning. First of all, it is necessary according to Bacon to acquire a lot of experience of the object of knowledge, so that it can carefully discover natural laws. But experience in itself is not sufficient to guarantee knowledge; a perfect order and arrangement is also required. Even after the arrangement of the experiential data, the intellect is unable by itself to discover the principles if it is not helped by a true and legitimate process of induction.[39]

Induction thus becomes the specific form of demonstration which supports sensation and investigates nature.[40] Giving induction a pivotal role, Bacon aims to invert the traditional order of demonstration. In fact, according to Bacon, Aristotelians were accustomed to proceed too hastily from sensory particulars to general principles, which was inadequate for careful natural investigation.[41] The intellect must not

[37] Cf. *NO*, 52: 'Nostra autem ratio … ea est, ut certitudinis gradus constituamus, sensum per reductionem quandam tueamur, sed mentis opus, quod sensuum subsequitur, plerunque reiiciamus, novam autem et certam viam, ab ipsis sensuum perceptionibus, menti aperiamus et muniamus'.

[38] Cf. Ibid. 200: 'Datae autem naturae formam sive differentiam veram, sive naturam naturantem, sive fontem emanationis … invenire, opus et inventio humanae scientiae … recte ponitur, vere scire esse per causas scire … qui causam alicuius naturae … Datae autem naturae formam sive differentiam veram, sive naturam naturantem, sive fontem emanationis … invenire, opus et inventio humanae scientiae … recte ponitur, vere scire esse per causas scire … qui causam alicuius naturae … incertis tantum subiectis novit, eius scientia imperfecta est … at qui formas novit, is naturae unitatem in materiis dissimillimis complectitur … Quare ex formarum inventione sequitur contemplatio vera et operatio libera'.

[39] Cf. Ibid. 214: 'Atque indicia de interpretatione naturae complectuntur partes in genere duas: primam de educendis aut excitandis axiomatibus ab experientia; secundam de deducendis aut derivandis experimentis nobis ab axiomatibus. Prior autem trifariam dividitur, in tres nempe ministrationes: ministrationem ad sensum, ministrationem ad memoriam, et ministrationem ad mentem sive rationem. Primo enim paranda est historia naturalis et experimentalis, sufficiens et bona; quod fundamentum rei est; neque enim fingendum aut excogitandum, sed inveniendum, quid natura faciat aut ferat. Historia vero naturalis et experimentalis tam varia est et sparsa, ut intellectum confundat et disgreget, nisi sistatur et compareat ordine idoneo. Itaque formandae sunt tabulae et coordinationes instantiarum, tali modo et instructione ut in eas agere possit intellectus'.

[40] Cf. *NO*, 30: 'Inductionem enim censemus eam esse demonstrandi formam, quae sensum tuetur et naturam premit et operibus imminet ac fere immiscetur'.

[41] Cf. Ibid.: 'Ordo quoque demonstrandi plane invertitur. Adhuc enim res ita geri consueti, ut a sensu et particularibus primo loco ad maxime generalia advoletur, tamquam ad polos fixos circa quos disputationes vertantur, ab illis caetera per media deriventur, via certe compendiaria sed precipiti et ad naturam impervia, ad disputationes vero proclivi et accomodata'.

be allowed to jump from particulars to general and immutable principles, nor to prove and frame the middle axioms by reference to them.[42]

However, always beginning from sensation, Bacon's method reaches general principles gradually and without interruption, proceeding from particular to lower axioms, and then to middle and higher axioms, up to the most general. In fact, lower axioms differ only slightly from bare experience, while the most general axioms are abstract, grounded in notions of the mind without solidity. The middle axioms, finally, are true, firm and solid axioms, on which all of science depends.[43] In terms of the grounding of scientific principles, middle axioms are not empty notions, like general axioms, but that which is most knowable *per se* and which concerns the ultimate nature of things. In order to discover middle axioms, it is necessary to introduce consistent changes to the form of induction, because the inductive method of the dialecticians—Bacon was probably referring to the humanists and Ramists—based on simple enumeration is puerile, and leads to uncertain conclusions, being continuously exposed to contradictory instances.[44] In particular, dialecticians would be guilty of being content with the *primae notiones* and the immediate information which comes from the well-ordered senses. However, the *primae notiones* of the intellect may themselves be questionable and obscure. It is always necessary to examine sense-data, since they deceive in at least two ways. First of all there are many things that are not grasped by sensation; and second, even if sensation can grasp the object, its understanding is not certain, never what is 'most knowable by nature' (*ex analogia universi*), but only what is 'most knowable by us' (*ex analogia hominis*). It is therefore a serious mistake, according to Bacon, to claim that sensation is the measure of things, even if we indicate its errors and possible remedies.[45]

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[42] Cf. *NO*, 160: 'Neque tamen permittendum est, ut intellectus a particularibus ad axiomata remota et quasi generalissima (qualia sunt principia, quae vocant, artium et rerum) saliat et volet; et ad eorum immotam veritatem axiomata media probet et expediat: quod adhuc factum est, prono ad hoc impetu naturali intellectus, atque etiam ad hoc ipsum, per demonstrationes quae fiunt per syllogismum, jampridem edocto et assuefacto'.

[43] Cf. Ibid.: 'Sed de scientiis tum demum bene sperandum est, quando per scalam veram, et per gradus continuos et non intermissos aut hiulcos, a particularibus ascendetur ad axiomata minora, et deinde ad media, alia aliis superiora, et postremo demum ad generalissima. Etenim axiomata infirma non multum ab experientia nuda discrepant. Suprema vero illa et generalissima (quae habentur) notionalia sunt et abstracta, et nil habent solidi. At media sunt axiomata illa vera et solida et viva, in quibus humanae res et fortunae sitae sunt; et supra haec quoque, tandem ipsa illa generalissima; talia scilicet quae non abstracta sint, sed per haec media vere limitantur'.

[44] Cf. *NO*, 30: 'At secundum nos axiomata continenter et gradatim excitantur, ut nonnisi postremo loco ad generalissima veniatur. Ea vero generalissima evadunt non notionalia sed bene terminata et talia, quae natura ut revera sibi notiora agnoscat, quaeque rebus haereant in medullis. At in forma ipsa quoque inductionis, et judicio quod per eam fit, opus longe maximum movemus. Ea enim de qua dialectici loquuntur, quae procedit per enumerationem simplicem, puerile quiddam est, et precario concludit, et periculo ab istantia contradictoria exponitur, et consueta tantum intuetur, nec exitum reperit'.

[45] Cf. *NO*, 32: 'Etenim dialectici principia scientiarum a scientiis singulis tanquam mutuo sumunt: rursus, notiones mentis primas venerantur; postremo, informationibus immediatis sensus bene dispositi acquiescunt. At nos logicam veram, singulas scientiarum provincias, majore cum imperio quam penes ipsarum principia sit debere ingredi decrevimus, atque illa ipsa principia putativa ad

For rigorous science, instead, we require a form of induction which can explain and analyze experience, drawing necessary conclusions by means of exclusions and eliminations.[46]

Novum organum I, §105 is devoted entirely to the explanation of scientific induction. Genuine scientific induction should discover not only the first principles, but also the lower and middle axioms—it must be the means of every demonstration. This criticism suggests that Bacon had a limited knowledge of his contemporaries' accounts of induction, since they too had presented it as the privileged means of acquiring the knowledge of principles, or even as the sole instrument of discovery. This is confirmed by their repeated criticism of the idea of induction as simple enumeration, since it led to precarious conclusions based on only a limited number of cases. For Bacon, a proper inductive method for discovery and demonstration, instead, must examine nature by means of exclusions and confutations, and can conclude only after a sufficient number of negative proofs have been provided on the basis of affirmative instances. According to Bacon, a similar view of induction has been developed by Plato, but only to discover definitions. With real scientific induction, instead, the mind can discover both principles and notions.[47] But the discovery of principles and notions was the chief aim of seventeenth-century British Aristotelians; Bacon's polemic target, then, must have been the Ramists or other humanists who dealt with induction very briefly as a dialectical

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rationes reddendas compellere quousque plane constent. Quod vero attinet ad notiones primas intellectus; nihil est eorum quae intellectus sibi permissus congessit, quin nobis pro suspecto sit, nec ullo modo ratum, nisi novo judicio se stiterit et secundum illud pronuntiatum fuerit. Quinetiam sensus ipsius informationes multis modis excutimus. Sensus enim fallunt utique, sed et errores suos indicant: verum errores praesto, indicia eorum longe petita sunt. Duplex autem est sensus culpa: aut enim destituit nos aut decipit. Nam primo, plurimae sunt res quae sensum etiam recte dispositum nec ullo modo impeditum effugiunt; aut subtilitate totius corporis, aut partium minutiis, aut loci distantia, aut tarditate atque etiam velocitate motus, aut familiaritate objecti, aut alias ob causas. Neque rursus, ubi sensus rem tenet, prehensiones ejus admodum firmae sunt. Nam testimonium et informatio sensus semper est ex analogia hominis, non ex analogia universi: atque magno prorsus errore asseritur, sensum esse mensuram rerum'.

[46] Cf. *NO*, 30 : 'Atqui opus est ad scientias inductionis forma tali, quae experientiam solvat et separet, et per exclusiones ac rejectiones debitas necessario concludat'.

[47] Cf. *NO*, 162 'In constituendo autem axiomate forma inductionis alia quam adhuc in usu fuit excogitanda est, eaque non ad principia tantum (quae vocant) probanda et invenienda, sed etiam ad axiomata minora et media denique omnia. Inductio enim quae procedit per enumerationem semplicem res puerilis est et precario concludit, et periculo exponitur ab instantia contradictoria, et plerumque secundum pauciora quam par est, et ex his tantummodo quae praesto sunt, pronunciat. At inductio, quae ad inventionem et demonstrationem scientiarum et artium erit utilis, naturam separare debet per reiectiones et exclusiones debitas, ac deinde post negativas tot quot sufficiunt super affirmativas concludere; quod adhunc factum non est, nec tentatum certe, nisi tantummodo a Platone, qui ad excutiendas definitiones et ideas, hac certe forma inductionis aliquatenus utitur. Verum ad hujus inductionis, sive demonstrationis, instructionem bonam et legitimam, quamplurima adhibenda sunt quae adhuc nullius mortalium cogitationem subiere; adeo ut in ea major sit consumenda opera, quam adhuc consumpta est in sillogismo. Atque hujus inductionis auxilio, non solum ad axiomata invenienda, verum etiam ad notiones terminandas, utendum est. Atque in hac certe inductione spes maxima sita est'.

inference based on the simple enumeration of a few cases. It cannot have been Sanderson, who considered induction as the essential process of discovery, based on a long series of observations, or Crakanthorpe, who was aware of the epistemological problems of induction by enumeration. Furthermore, Sanderson calls the observational process 'historia', exactly as Bacon describes the well-ordered gathering of sense-data.[48]

The process of gathering data, i.e., observation, should be well-arranged according to three tables: (1) the table of essence or presence; (2) the table of absence; (3) the table of degrees. The task of these three tables is to make a presentation to the intellect of instances. Once the presentation has been made, induction is necessary; as for Sanderson, it comes immediately after observation and experience. In fact, upon an individual review of all the instances, according to Bacon, it will be found that the thing is either always present or absent in the given object of experience, or increases and decreases with it. This process cannot be carried out affirmatively, otherwise the mind would conclude with fantasies, chimeras, and problematic, indeterminate concepts.[49] The results of such an affirmative research will depend entirely on the limited capacities and the forces of the intellect. God alone can know affirmatively; man must proceed negatively by means of exclusions.[50] Bacon's proposal is a mental examination similar to that of the Aristotelians in the *regressus*, one which must confirm the result of the inductive operation from experience. This examination is the first task of genuine induction and it consists in the rejection and exclusion of individual natures, which are not found in a particular instance where the given nature is present, or are found in any one instance where it is absent, or are found to increase in an instance where the given nature decreases,

[48] On the primacy of the 'historia' and nature over method and reason cf. Guido Giglioni, 'Reading Nature without Making a Book of It. Francis Bacon's Novum Organum', in Pascale Hummel (ed.), *Mélivres/Misbooks. Études sur l'envers et les travers du livre* (Paris, 2009), 55–70; Guido Giglioni, 'Mastering the Appetittes of Matter. Francis Bacon's Sylva Sylvarum', in Ofer Gal and Charles T. Wolfe (eds.), *The Body as Object and Instrument of Knowledge. Embodied Empiricism in Early Modern Science* (Dordrecht, 2010), 149–167.

[49] On Bacon's negative method cf. Michael McCanles, 'The New Science and the Via Negativa. A mystical Source for Baconian Empiricism', Julie R. Solomon and Cathrine Gimelli Martin (eds.), *Francis Bacon and the Refiguring of Early Modern Thought. Essays to Commemorate* The Advancement of Learning *(1605–2005)* (Aldershot, 2005), 45–68.

[50] Cf. *NO*, 252: 'Atque opus et officium harum trium tabularum Comparentiam instantiarum ad intellectum vocare consuevimus. Facta autem comparentia, in opere ponenda est ipsa inductio. Invenienda est enim, super comparentiam omnium et singularum instantiarum, natura talis, quae cum natura data perpetuo adsit, absit, atque crescat, et decrescat; sitque (ut superius dictum est) limitatio naturae magis communis. Hoc si mens jam ab initio facere tentet affirmative (quod sibi permissa semper facere solet), occurrent phantasmata et opinabilia et notionalia male terminata et axiomata quotidie emendanda; nisi libeat (scholarum more) pugnare pro falsis. Ea tamen procul dubio erunt meliora aut praviora pro facultate et robore intellectus qui operatur. At omnino Deo (formarum inditori et opifici) aut fortasse angelis et intelligentiis competit formas per affirmationem immediate nosse, atque ab initio contemplationis. Sed certe supra hominem est; cui tantum conceditur, procedere primo per negativas, et postremo loco desinere in affirmativas, post omnimodam exclusionem'.

or *vice versa*. At the end of this negative process of exclusion the mind discovers the solid, true and well-determined form.[51]

The difference between the forms of examination proposed by the Aristotelians and by Bacon is that, for the latter, examination should be systematic, i.e. experimental. The experiment plays a crucial role in Bacon's inductive method: while Aristotelian empiricism was merely experiential, his was experimental.[52] Only the experiment, in fact, can help induction to acquire scientific knowledge. Therefore, according to Bacon, sensation and experiential empiricism are scientifically valid only if proved by experimentation.[53]

As a matter of fact, Bacon's philosophical perspective was not so different from that of the Aristotelians in its re-evaluation of the role of the empirical processes and of induction in scientific knowledge, but rather was its natural development. Indeed, in opposition to the Aristotelians, Bacon added, or made explicit, the experimental side of the inventive method, which was neglected from the logical textbooks of the time, and which was only implicit in the theory of mental examination. Bacon's methodological innovation was to clarify this idea of examination, which had been neglected by the Aristotelians, and which, he insisted, must be based on experiment.

It is doubtful, however, that Bacon's experimental empiricism was successful, for, at least up to the end of the seventeenth century the experiential empiricism of the Aristotelians prevailed,[54] not only in the academies, but also in publications by important philosophers such as Harvey, Hobbes and Locke.[55]

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[51] Cf. *NO*, 254: 'Est itaque inductionis verae opus primum (quatenus ad inveniendas formas) reiectio sive exclusiva naturarum singularum, quae non inveniuntur in aliqua instantia, ubi natura data adest, aut inveniuntur in aliqua instantia, ubi natura data abest, aut inveniuntur in aliqua instantia crescere, cum natura data decrescat, aut descrescere, cum natura data crescat. Tum vero post *reiectionem* et *exclusivam* … secundo loco … manebit … forma affermativa, solida et vera et bene terminata'.

[52] On 'experience' and 'experiment' in Bacon cf. Didier Deleule, 'Experientia-experimentum ou le mythe due culte de l'expérience chez Francis Bacon', in Fattori (ed.), *Francis Bacon. Terminologia e fortuna nel XVII secolo*, 59–72; Marta Fattori, 'Experientia-experimentum: *Un confronto tra il corpus latino e inglese di Francis Bacon*, in Marco Veneziani (ed.), *Experientia* (Florence, 2002), 243–268.

[53] Cf. *NO*, 34: 'Experimentorum longe maior est subtilitas quam sensus ipsius, licet instrumentis exquisitis adjuti; (de iis loquimur experimentis, quae ad intentionem ejus quod quaeritur perite et secundum artem excogitata et apposita sunt). Itaque perceptioni sensus immediatae ac propriae non multum tribuimus, sed eo rem deducimus, ut sensus tantum de experimento experimentum de re iudicet'; *NO*, 86: 'Omnis verior interpretatio naturae conficitur per instantias et experimenta idonea et apposita, ubi sensus de experimento tantum, experimentum de natura et re ipsa iudicat'.

[54] Cf. George Dyer, *The Privileges of The University of Cambridge* (London, 1824), vol. 2, 187: 'But, though Bacon's writings were so well received at Cambridge, it should seem, that Aristotle, for several years after their publication, had some influence in our Schools and Colleges: for an edition of Burgersdicius was published at Cambridge some years after Bacon's works were known; and all Burgersdicius's Theses are formed either from Aristotle, or his more modern interpreters'.

[55] For a different perspective on the same topic cf. Stephen Gaukroger, 'Philosophical Responses to the New Science in Britain, 1644–1799: A Survey of Texts', *Metascience*, 4 (1986), 60–71.

9.2 William Harvey and the Return of Paduan Aristotelianism

Bacon's methodological novelties were almost ignored by his contemporaries, even by philosophers like Harvey, who had a great interest in experimental empiricism.

It is difficult to underestimate Harvey's importance in the field of medicine; but scholars have often neglected his contribution to the field of logic, presented in the preface to his *Exercitationes de generatione animalium* (1651); here he outlines the method that both the physician and the anatomist must follow to acquire scientific knowledge.[56] In this short preface, which is really a treatise on method, Harvey develops an Aristotelian methodology following the Paduan School where he studied in his youth, as well as his British contemporaries.[57] In particular, he systematizes the Aristotelian doctrines of sensation, observation and experiment for the scientific discovery elaborated by authors such as Sanderson and Flavell, ridiculing at the same time Bacon's poor methodology: John Aubrey recalled Harvey's notorious remark that Bacon 'writes philosophy like a Lord Chancellor'.[58] Harvey therefore looks to Aristotle and not to Bacon as his guide, 'though by the same token he did not hesitate to disagree with the Stagirite whenever the observed evidence led him to do so'.[59]

Harvey's method is, in Schimtt's words, 'both different and superior to that of Bacon'.[60] He refers to the most faithful interpreters of Aristotle, so much that 'in reading the preface one is immediately struck how close it is to contemporary logical treatises such as those by Jacopo Zabarella'.[61] Zabarella was Harvey's chief reference: 'in terms of the discussion of method, the structure of science, how knowledge is obtained, the preface is very close indeed to the doctrine found in Zabarella's *Opera logica*'; we might go so far as to say that 'the *Praefatio* is nothing more than the methodological principles of the tradition culminating in Zabarella

[56] On Harvey's methodology cf. George K. Plochmann, 'William Harvey and His Methods', *Studies in the Renaissance*, 10 (1963), 192–210; Schmitt, 'William Harvey and Renaissance Aristotelianism. The Praefatio to De generatione animalium (1651)', 117–138. For a general overview on the impact of physicians' methodology on the history of logic see Maclean's seminal investigations cf. Ian Maclean, *Logic, Signs and Nature in the Renaissance. The Case of Learned Medicine* (Cambridge, 2002); Ian Maclean, *Les mondes et les hommes dans la médicine de la Renaissance* (Paris, 2006).

[57] Aristotelian influence can be found in *De motu cordis* and in *De motu locali animalium*, cf. James S. Wilkie, 'Harvey's Immediate Debt to Aristotle and Galen', *History of Science*, 4 (1965), 103–124; Jerry Stannard, 'Aristotelian Influences and References in Harvey's De motu locali animalium', in Richard Tursman (ed.), *Studies in the Philosophy and History of Science. Essays in Honor of Max Fisch* (Kansas City, 1970), 122–131.

[58] John Aubrey, *Brief Lives* (Oxford, 1898), vol. 1, 299. For a general idea of Bacon's influence on Harvey, cf. Roger K. French, *William Harvey's Natural Philosophy* (Cambridge, 1994), 325–328.

[59] Schmitt, 'William Harvey and Renaissance Aristotelianism. The Praefatio to De generatione animalium (1651)', 121.

[60] Ibid. 125.

[61] Ibid. 124.

applied to a specific, concrete empirical science'.[62] Ultimately Harvey's new method 'is rather conventional Aristotelian doctrine of the sort he certainly must have imbibed at Padua joined to a quite remarkable emphasis on direct observation'.[63]

According to Harvey there is only one way to acquire scientific knowledge and this proceeds from what is most knowable to what is less knowable, from what is more evident to what is more obscure. Science has the aim of acquiring knowledge of the most universal concepts, and the mind itself reasons from these concepts to particulars. However, the understanding of universal concepts by the mind, and in particular by the intellect, is grounded on the perception of individual things by means of sensation. Thus for Harvey it is necessary to explain the way in which the mind grasps universal concepts from particulars.[64]

To this end, Harvey refers directly to Zabarella's theory of sensation, according to which universal concepts are imbibed by emanation.[65] What is acquired by the senses, however, is not the clear and distinct universal concept conceived by the mind, but an indistinct and confused whole.[66] According to Harvey, in fact, the human mind cannot acquire universal concepts through any kind of (Platonic) intellection which makes them immediately evident. Sensible knowledge of the universals is still obscure and confused and only successive analyses can clarify and transform it into scientific knowledge.

All knowledge begins from sensation, and proceeds from a precise knowledge of the particulars to a confused knowledge of the universals. The object of knowledge is always perceived as singular from the external sensation; but when the impression of the external senses is abstracted from the thing, and judged and conceived from inner sense, it becomes something universal. This is the reason why some persons abstract different impressions and conceive different ideas, even though they look at the same object in the same respect.[67]

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[62] Ibid.

[63] Ibid. 125.

[64] Cf. William Harvey, *Exercitationes de generationis animalium* (Amsterdam, 1651), 19: 'Quamvis ad scientiam quamlibet via unica pateat, qua nempe a notioribus ad minus nota, et a manifestis ad obscuriorum notitiam progredimur; atque universalia nobis praecipue nota sint (ab universalibus enim ad particularia ratiocinando, oritur scientia) ipsa tamen universalium in intellectu comprehensio, a singularium in sensibus nostris perceptione exsurgit'.

[65] More generally Schmitt states that for Harvey 'our senses, primarily our eyes, reveal the truth to us. The way this comes about …, is precisely the way it was rehearsed in Aristotle, as interpreted by the Italian peripatetic writers on method epitomized by Zabarella', cf. Schmitt, 'William Harvey and Renaissance Aristotelianism. The Praefatio to De generatione animalium (1651)', 127.

[66] Cf. Harvey, *Exercitationes de generationis animalium*, 20: 'licet primo intuitu inter se pugnare videantur: quoniam universalia primo per sensum a singularibus hauriuntur; et eatenus duntaxat nobis notiora sunt, quatenus universale est totum et indistinctum quid; totumque nobis notius est, secundum sensum'.

[67] Cf. Ibid.: 'Licet enim in omni cognitione a sensu ordiamur, quia (ut ibidem Philosophus) sensibilia singularia sensui notiora sunt; ipsa tamen sensatio est universalis. Nam (si bene animum adverteris) etsi in sensorio externo, dum sentimus, inest singulare … quod inde tamen abstractum a sensorio interno judicatur et intelligitur, universale est. Unde fit, ut plures eodem tempore, ab eodem objecto, varias species abstrahant, et notiones diversas concipiant'.

Harvey sustains that a singular impression is clear and distinct, but appears confused and indistinct (1) when the object is removed from sight; (2) when it becomes abstracted by the imagination; or (3) when it is retained in the memory. In these cases it is conceived no longer as a particular, but as a general concept.[68] Therefore, according to Harvey, impressions are vivid and distinct because they immediately refer to the singular perception, while the idea is confused and indistinct because it no longer refers immediately to the object.

Harvey refers directly to Seneca's 58th *Epistle*, which explains that an idea is the eternal exemplar of a natural thing, in the same way that a portrait painter derives an impression of his subject, and then transfers this impression to the canvas. The face which guides and directs the painter, and from which the imitation is made, is the idea. Thus, if the artist wants to paint a likeness of Virgil, he forms an intuitive image of his subject: the idea is the face of Virgil, i.e., the prototype of his future picture, and that which the artist produces is the resemblance or portrait. The difference is that the one is the pattern or prototype, while the other is the form taken from the pattern and fixed in the work: the artist imitates the one, he creates the other. The idea, as model and universal, is vague, but the impression on the canvas, for instance, is an object of clear and distinct sensation. In the same way, for Harvey, if the object is present to senses, then the mind has a precise, detailed, clear and distinct knowledge of it, while the memory retains only a confused knowledge of it and its characteristic marks. It is noteworthy that Seneca seeks to emphasize the ontological and epistemological primacy of the ideas over the impression, whereas Harvey does the opposite. Harvey makes an epistemological inversion between ideas and impressions: for him, impressions are vivid and originary, while ideas are mere faint and derivative copies.

Such a distinction between impression and idea is fundamental for Harvey's methodology of science. Science concerns the objects of immediate, clear and distinct vision. It is natural, therefore, that Harvey's methodology posits sensation and experience as the principles of all knowledge. It would be impossible to have science without direct experience, without 'autopsy'. Harvey is undoubtedly referring to what he knew best—anatomical inspection—although the same process was possible for every natural science. Harvey voluntarily ignores metaphysical questions of immaterial objects: since we cannot experience these, no scientific knowledge of them is possible.

What the mind perceives of the sensible object differs from the image that it retains in the imagination or memory. In the first case, the mind deals with a real entity, while in the second case it deals only with a representation, a resemblance, a *ens rationis*. Perception is of unique particulars, while the representation is universal and common to many things. Sensible things are relatively clear in the mind,

[68] Cf. Ibid. 21: 'Quod in ipsa visione, sive actu videndi, singulare, clarum, et distinctum erat; id ipsum mox, remoto visibili (clausis nimirum oculis) in phantasia abstractum, vel in memoria reservatum, obscurum et indistinctum apparet; neque amplius ut singulare, sed ut commune quiddam, et universale apprehenditur'.

while *entia rationis* are more obscure, because the latter proceed from and are illustrated by the former.[69]

Harvey therefore emphasizes unequivocally the importance of sensation as an initial process of scientific knowledge, because sensible things precede the intelligible, which are conceivable only from the former. Without observations and repeated experiments, the mind is only chasing after phantoms and appearances without any scientific value.[70]

Harvey concludes that careful and diligent observation is a minimal requirement of every science. To this, Harvey adds the frequent appeal to sensation, which is the only operation of the mind that can provide a clear and distinct knowledge of things. Every true science is grounded on sensation, otherwise the mind acquires empty and unstable opinions, and firm scientific knowledge becomes impossible.[71] For Harvey this is the true method of scientific knowledge according to Aristotle.

Harvey states that the mind contains nothing from birth—no innate knowledge, no opinions, no art, intellect, discourse or reason. All knowledge is acquired through the senses.[72]

However, Harvey is aware that his position against innatism could be construed as anti-Aristotelian, since Aristotle states that all scientific knowledge comes from previous knowledge. Harvey brilliantly solves the problem by following the commentary of British Aristotelians, examining the passage of *Analytica posteriora* II.19: things perceived by senses remain in the mind; the permanence of the impression generates memory; from accumulated memories, experience arises; and from experience, universals, definitions, maxims and axioms, which are the most certain principles of knowledge.[73] Therefore, according to Harvey's interpretation of

[69] Cf. Ibid. 22: 'ita scientia circa cognoscenda, est habitus … haec a rerum naturalium cognitione procedit. Utriusque origo est sensus, et experientia; cum fieri nequeat, ut alterutri (nisi spectatis exemplaribus) recte insit vel ars, vel scientia. In utrisque differt id, quod in rebus sensibilibus speculamur; a spectro ipso, quod in phantasia, vel memoria retinetur. Illud exemplar, idea, forma informans; hoc imitamentum, idos, species abstracta. Illud res naturalis, ens reale; hoc repraesentatio, sive similitudo, et ens rationis. Illud, circa rem singularem versatur, ipsumque est singulare, et individuum: hoc, universale quid, et commune. Illud, in omni artifice et sciente, est sensibile, clarius et perfectius: hoc, intelligibile et obscurius. Quippe certiora nobis et manifestiora, qua a sensu percipiuntur, quam qua ab intellectu; siquidem haec ab iis proveniunt et illustrantur. Denique sensibilia sunt per se, et priora: intelligibilia autem, posteriora, et ab illis orta; cum nobis ne inesse quidem possint, citra illorum opem'.

[70] Cf. Ibid.: 'Quare, absque recto sensus adminiculo, crebris observationibus, certaque experientia adhibito; de phantasmatis et apparentiis mente nostra comprehensis, perperam judicamus'.

[71] Cf. Ibid. 23–24: 'In omni nempe disciplina, diligens observatio requiritur; et sensus ipse saepe consulendus. … Quoniam enim scientia omnis perfecta, iis principiis innititur, quae ex sensu compertis originem ducunt'.

[72] Cf. Ibid. 25: 'Nulla cognitio nobis innata est, ex sententia Aristotelis. Neque enim opinio, nec ars, nec intellectus, nec loquela, nec ratio ipsa, a natura, et ortu primo nobis insunt'.

[73] Cf. Ibid. 27: 'Quibus Aristotelis verbis clare constat; quo ordine cujuslibet artis, aut scientiae cognitio acquiratur. Nempe, ex sensu permanet sensatum: ex permanentia sensati, fit memoria: ex multiplici memoria, experientia: ab experientia, ratio universalis, definitiones et maxima sive axiomata communia, cognitionis certissima principia'.

Aristotle, the 'previous knowledge' required for intellectual knowledge is only that garnered by the memory of past experience, which comes from sensation.[74]

Referring to the first book of Aristotle's *Metaphysica*, Harvey states that for a person to be well-informed about something, he must have personal experience, a clear memory, and have undertaken frequent and diligent sensory observation. Only through this cognitive process can the mind begin to know scientifically. Without experience the mind can only imagine, believe, or draw false images and empty visions; it conjectures from shadows, phantoms and chimeras, and its knowledge is nothing else than a waking dream or a delirium.[75]

In conclusion, Harvey proposes a methodology of science grounded on the Aristotelian perspective. His Aristotelianism can be traced to his youth in Padua, but he differs from the Paduans in his neglect of syllogism; in this respect he is closer to the British Aristotelian tradition. Furthermore, the appeal to a terminology that privileges sensation, observation, memory, and the total rejection of innate knowledge, more closely resembles the British than the Paduan school.

The Aristotelian methodology dominated in the British Isles well beyond the first half of the century, influencing even the so-called 'modern philosophers' and giving a definite empirical direction to their thought—this can also be said of Thomas Hobbes.[76]

9.3 Hobbes and Logic as Calculus

Hobbes is generally considered by the scholars as one of the first great early modern thinkers to break with tradition and direct his work instead towards the new philosophical and scientific developments. Not infrequently, passages have been considered out of context, with scholars stating that Hobbes abandoned Aristotelian philosophy and logic,[77] because of his vitriolic attack upon Scholastic philosophy and theology, even though a large part of his thought, and especially of his logic, had been decisively influenced by the Aristotelian tradition.[78] This aspect of his work is often neglected in

[74] Cf. Ibid. 28: 'Quare, ut supra diximus, nulla perfecta cognitio, quae nostra appellanda sit, nobis inest; nisi ab experientia a nobis facta, et sensu nostro, aliquo modo proficiscatur; vel saltem ab his examinetur, comprobetur, et super cognitionem aliquam in nobis prae-existentem firmissime exstructa appareat'.

[75] Cf. Ibid. 30: 'Qui enim Autorum verba legentes, rerum ipsarum imagines (eorum verbis comprehensas) sensibus propriis non abstrahunt, hi non veras Ideas, sed falsa Idola, et phantasmata inania mente concipiunt; unde umbras quasdam et chimeras sibi fingunt: totaque ipsorum theoria, sive contemplatio, (quam tamen scientiam arbitrantur) vigiliantium insomnia, aut aegrotantis animi deliria repraesentat'.

[76] On the influence of Harvey's methodology on Locke and his entourage cf. Robert G. Frank Jr., *Harvey and the Oxford Physiologists* (Berkeley, 1980).

[77] Cf. Thomas Hobbes, *Opera philosophica quae latine scripsit* (London, 1839), LXXXVI–LXXXVII.

[78] Cf. Douglas M. Jesseph, '*Scientia* in Hobbes', in Tom Sorell, John G.A. Rogers and Jill Kraye (eds.), Scientia *in Early Modern Philosophy: Seventeenth-Century Thinkers on Demonstrative Knowledge from Initial Principles* (Dordrecht, 2010), 117–128.

favour of his natural philosophy,[79] and the few existing studies on the topic merely describe the analogies and similarities between Hobbes and contemporary Aristotelians, without a real assessment of his influences.[80] In his insightful investigations Jan Prins has suggested that some ideas of Paduan Aristotelianism are incompatible with Hobbes' philosophy, which was influenced instead by the Ramist and Melanchthonian tradition.[81] In this case we must not compare two philosophical doctrines without reference to time or context, in a purely theoretical manner, rather we must historically investigate Hobbes' original reappraisal of the doctrines of Paduan Aristotelianism, through the mediation of British Aristotelianism, which is not considered by Prins. We shall see that both doctrinally and terminologically, Hobbes' logic ermeges from the British Aristotelian context. Of course, this does not mean that other traditions, such as Ramism, exerted no impact on certain of Hobbes' claims, but these are not necessarily inconsistent with Aristotelianism. It is the great merit of Quentin Skinner's investigation to have placed Hobbes' thought on logic and rhetoric in its historical context.[82]

It is well known that Hobbes never wrote a textbook of logic, nor taught logic in the university. However, the general introduction to his *Elementa philosophiae* presents a dense treatment of logic, the result of 10 years' thought on the topic; this can be considered as a work in its own right. In fact, if the first part of the *Elementa philosophiae*, i.e. *De corpore*, was published only in 1655, we have drafts of the logic from around 1645–1646.[83] Hobbes' acquaintance with contemporary logicians, however, may be dated to his student days at Magdalen Hall, Oxford, where he studied Aristotelian logic with the commentary of the Paduan school, as we saw earlier. In Oxford he probably met Sanderson, who took the same classes in the same years, even if the latter was at Lincoln College.

Hobbes' knowledge of the Aristotelians must have increased with his travel in Italy (1610–1613) following William Cavendish, but not necessarily with positive effects. He stayed in Venice, where he knew Fulgenzio Micanzio, a friend of Paolo Sarpi and Galileo.[84] In this period Hobbes began to read Galileo and Euclid, and hatched the plan to establish a rigorous mechanical science of reality as a whole. Probably under

[79] Cf. Cees Leijenhorst, *The Mechanization of Aristotelianism. The Late Aristotelian Setting of Thomas Hobbes's Natural Philosophy* (Leiden, 2002). Leijenhorst's insightful research refers particulary to Jesuit philosophy, rather than to British Aristotelianism.

[80] Cf. Mario Dal Pra, 'Note sulla logica di Hobbes', *Rivista critica di storia della filosofia*, 4 (1962), 411–433; Aldo G. Gargani, *Hobbes e la scienza* (Torino, 1983), 32–96; Edwards, 'Paduan Aristotelianism and the Origins of Modern Theories of Method', 205–220; Martine Pécherman, 'La logique de Hobbes et la tradition aristotélienne', *Hobbes Studies*, 8 (1995), 105–124.

[81] Cf. Jan Prins, 'Hobbes and the School of Padua: Two Incompatible Approches of Science', *Archiv für Geschichte der Philosophie*, 72 (1990), 26–46. See also Jan Prins, 'The Influence of Agricola and Melanchthon on Hobbes' Early Philosophy of Science', in Fokke Akkerman and Arie J. Vanderjagt (eds.), *Rudolphus Agricola Phrisius 1444–1485* (Leiden, 1988), 293–301; Karl Schuhmann, 'Hobbes and Renaissance Philosophy', in *Hobbes Oggi* (Milan, 1990), 331–349.

[82] Cf. Skinner, *Reason and Rhetoric in the Philosophy of Hobbes*, 19–65, 215–293.

[83] Cf. Arrigo Pacchi, *Convenzione e ipotesi nella formazione della filosofia naturale di Thomas Hobbes* (Florence, 1965), 15–31.

[84] Cf. Jeffrey R. Collins, *The Allegiance of Thomas Hobbes* (Oxford, 2005), 55.

the impulse of Galilei's philosophy, which was full of Aristotelian ideas,[85] Hobbes focused his interests on Paduan logic, whose legacy is quite evident in his works.

From the incipit of his *Logica*, which could be considered as a work in its own right, Hobbes shares with his contemporaries the intention of establishing a scientific method. Such a method should take as its model the advancements and developments of geometry and should proceed with the same rigour. In this respect, like Bacon and Harvey, Hobbes seeks to reform Aristotelian philosophy, upon which, however, it is necessary to build.

The Aristotelian framework of Hobbes' logic is quite clear from his definition of philosophy as the knowledge, acquired by right reasoning, of effects or phenomena grasped from their causes or origins, and of the process by which they came about from the known effects themselves.[86] In other words, knowledge is the knowledge of causes, and this knowledge can be acquired in two ways, either analytically, from the effects to the causes, or synthetically, from the causes to the effects. The twofold way to knowledge corresponds to a twofold way to reality—from cause to effect, and from effect to cause—which forms the subject of logic. Hobbes conceives this twofold logic from a heuristic and instrumental standpoint; that is, logic determines how the mind knows, rather than how things are. Such a conception of logic was undoubtedly inspired by the Aristotelians of his time, who had in turn drawn on the doctrines of Oxford nominalism. For instance, it is noteworthy that Smith wrote in his textbooks that 'ratio est, quia ordo instrumentum est ad cognitionem non ad rerum generationem conferens'.[87] The cause is therefore an instrument for the knowledge and explanation of things, but does not determine the generation of the things. This means that the causes of a given thing are not its efficient causes, but only ways by which the mind gives reason to it. The ontological level is thereby detached from the epistemological level from the very first paragraph of Hobbes' logic; this gap will increasingly widen from chapter to chapter.

In order to understand the Hobbesian definition of philosophy, we ought to keep in mind that Hobbes's notion of 'philosophy' coincides with that of 'science'. This explains why for Hobbes the sensation and memory of things, even if they lead to knowledge, do not lead to philosophy. The reason is that sensation and memory are common to all animals because they are given by nature, but it is evident that animals do not philosophize, which requires reason. Nor is science the same as experience or prudence, i.e. the expectation of things similar to what we have already observed.[88]

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[85] Cf. Enrico Berti, 'Galileo di fronte alla tradizione aristotelica', in *Tribute to Galileo in Padua* (Trieste, 1995), 131–147.

[86] Cf. Hobbes, *Opera philosophica quae latine scripsit*, 2: 'Philosophia est effectuum sive phaenomenωn ex conceptis eorum causis seu generationibus et rursus generationum quae esse possunt, ex cognitis effectibus per rectam ratiocinationem acquisita cognitio'.

[87] Smith, *Aditus ad logicam*, 154.

[88] Cf. Hobbes, *Opera philosophica quae latine scripsit*, 2–3: 'Ad quam definitionem intelligendam, considerare oportet primo, sensionem acque memoriam rerum, quae commune homini sunt cum omnibus animantibus, etsi cognitiones sint, tamen quia datae sunt statim a natura, non ratiocinando acquisitae, non esse philosophiam. Secundo cum experientia nihil aliud sit quam memoria; prudentia autem sive prospectus in futurum, aliud non sit quam expectatio rerum similium iis rebus quas jam experti sumus; nec prudentiam quidem philosophiam esse censendum est'.

Philosophy as a science is grounded on reasoning (*ratiocinatio*) and this is first of all a form of calculation.[89] Hobbes has a broad definition of calculation—it is not only the reckoning of numbers, but also the addition and subtraction of proposition to proposition, discourse to discourse, etc.[90] Indeed, as Aristotle had said, it is not true that man differs from other animals because it can count, as Pythagoras believed; human beings are different because they can calculate with discourses.[91] This is because everything which is added or subtracted, 'that is, which we put into an account, we are said to *consider*, in Greek λογίζεσθαι, in which language also συλλογίζεσθαι signifies to *compute*, *reason*, or *reckon*'.[92] Reasoning, which is the proper operation of philosophy, means primarily to compute, namely to add and subtract. This idea of reasoning as a form of computation had ancient roots, but its most immediate source is sixteenth-century Ramism.[93]

Reasoning as a computation is possible, according to Hobbes, by means of 'silent reflection'; this is of clear Aristotelian origin, traceable to *De interpretatione*, and recalled also by Bacon, who wrote that 'Aristotle saith well, *words are the images of cogitations, and letters are the images of words*. But yet it is not of necessity that cogitations be expressed by the medium of words'.[94] The reflection may be silent, because if someone sees something obscurely at a distance, he will have an idea of it even if he cannot put a word to it. In the *Leviathan*, after his assertion that not all reasonings require words, Hobbes sustains that all reasoning is grounded on silent reflection, which is always a computation. Hobbes is dealing with mental discourse, distinct from verbal discourse; mental discourse defined as the succession of thoughts one after another.[95] There are two kinds of mental discourse. One is unguided and without design, and the other is planned and regulated;

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[89] Cf. Ibid. 3: 'Per ratiocinationem autem intelligo computationem. Computare vero est plurimum rerum simul additarum summam colligere, vel una re ab alia detracta, cognoscere residuum'.

[90] Cf. Ibid. 4–5: 'Non ergo putandum est computationi, id est, ratiocinationi in numeris tantum locum esse, tanquam homo a caeteris animantibus (quod censuisse narratur *Pythagoras*) sola numerandi facultate distinctus esset, nam et magnitudo magnitudini, corpus corpori, motus motui, tempus tempori, gradus qualitatis gradui, actio actioni, conceptus conceptui, proportio proportioni, oratio orationi, nomen nomini (in quibus omne philosophiae genus continetur) adjici adimique potest'.

[91] Cf. Aristotele, *Problemata*, XXX.6, 956 a 11–14.

[92] Hobbes, *Opera philosophica quae latine scripsit*, 5: 'Rem autem quamcumque addimus vel adimimus, id est, in rationes referimus, eam dicimur *considerare*, Graece λογίζεσθαι, sicut ipsum computare sive ratiocinare συλλογίζεσθαι nominat'.

[93] On reasoning as computation cf. Petrus Ramus, *Dialecticae institutiones* (Paris, 1543), f. 20 r–v: 'syllogismus igitur … est argumenti cum quaestione firma, necessariaque collocatio, unde quaestio ipsa concluditur, atque aestimatur … ubi quemadmodum boni ratiocinatores addendo deducendoque vident quae reliqui summa fiat: ita hic dialectici partibus addendis, subducendisque summam quandam rationis explicant, et complectionem conclusionis efficiunt'. Cf. Gabriel Nuchelmans, *Late-Scholastic and Humanist Theories of the Proposition* (Amsterdam, 1980), 168–169; Robert Goulding, *Defending Hypatia: Ramus, Sanvile, and the Renaissance Rediscovery of Mathematical History* (Dordrecht, 2010), 35–116.

[94] Bacon, *The Advancement of Learning*, 128.

[95] Cf. Thomas Hobbes, *The English Works of Thomas Hobbes* (London, 1839), vol. 3, 11: 'By *consequence*, or *train* of thoughts, I understand that succession of one thought to another, which is called, to distinguish it from discourse in words, *mental discourse*'.

logic is concerned only with the latter.[96] Planned mental discourse is itself of two sorts, which correspond to the two methods implicit in Hobbes' definition of philosophy. The first kind is when the mind seeks the causes or means that generate an effect, this being common to men and animals; the second is when the mind, imagining something, seeks all the possible effects which can produce it, this being possible only for men.[97]

The clarity and distinctness of the ideas generated by the mind do not depend on words, but only on the impressions of the senses. Thus, when a man starts to run he loses the distinctive marks of rationality, and becomes distinguishable only as an animate body. For Hobbes, as for Harvey, the knowledge of an idea depends directly on the sense-impressions on which is grounded the entire knowledge of the properties of the given objects. The senses, however, are not sufficient to provide scientific knowledge; in fact, when we see a figure resembling a circle, we cannot know by sight alone if it is actually a circle. To know that, the mind needs knowledge of the figure's cause and manner of generation.

Hobbes' *Logica*, as for all the other Aristotelian works of the time, always proceeds from the examination of simpler elements of reasoning up to the more complex. The simplest element is the name. To explain the nature of the name, Hobbes begins from the assertion that human thoughts are so fluid and ephemeral that all reasoning would disappear immediately if there were no way of fixing it in the mind. According to Hobbes sensible 'moniments' (*monimenta*) are necessary for past thoughts to be registered in the mind in their own order. Such moniments are properly called 'marks', that is sensible things, adopted arbitrarily, with the aim of recalling similar thoughts to the mind.[98] Such marks must be common to all human beings; if the thoughts they represent were merely that of a single individual, they would die with him. Marks which are outside the mind, common and communicable to others for the progress of science are called signs; these can be natural, just as dark clouds presage rain, or arbitrary, assumed by the mind out of pleasure or convention. Of the latter kind are words, which signify thoughts and the affections of souls. The difference between marks and signs is that the

[96] Cf. Ibid. 12–13: 'This train of thoughts, or mental discourse, is of two sorts. The first is *unguided, without design*, and inconstant; wherein there is no passionate thought to govern and direct those that follow to itself as the end and scope of some desire, or other passion; in which case the thoughts are said to wander, and seem impertinent one to another, as in a dream. … The second is more constant, as being *regulated* by some desire and design'.

[97] Cf. Ibid. 13: 'The train of regulated thoughts is of two kinds: one, when of an effect imagined we seek the causes or means that produce it; and this is common to man and beast. The other is, when imagining anything whatsoever, we seek all the possible effects that can by it be produced; that is to say, we imagine what we can do with it when we have it'.

[98] Cf. Hobbes, *Opera philosophica quae latine scripsit*, 12: 'Ex quo sequitur, *ad philosophiae* acquisitionem, necessaria esse monimenta aliqua sensibilia, quibus et reduci cogitationes praeteritae, et suo quaeque ordine tanquam registrari possint. Hujusmodi monimenta sunt quas vocamus *notas*; nimirum, *res sensibiles arbitrio nostro adhibitas, ut illarum sensu cogitationes in animum revocari possunt similes iis cogitantionibus quarum gratia sunt adhibitae*'.

former are for our own private use, while the latter are for the use of the others.[99] In the *Leviathan*, after repeating that reasoning is a form of computation, Hobbes states explicitly that marks are useful when we compute only in the mind, while signs, by which the mind signifies things to others, are used for communal demonstration or explanation.[100]

Discourse is defined as words connected in such a way as to be the signs of thoughts; the name is each individual part. Names are necessary like signs and marks: through marks the mind remembers thoughts, through signs the mind makes its thoughts known to others, while names perform both offices.[101] However, Hobbes establishes that names are primarily marks and only secondarily signs, because if a man were alone in the world, marks would be useful to him in helping him to remember, while signs would be of no use at all.[102] Moreover, names are in themselves marks because they recall thoughts to the mind, and become signs only if arranged in a discourse as parts of the same.

A name is thus a word taken arbitrarily to serve as a mark by means of which the mind expresses its thoughts in discourse, and as it communicates them as signs to others. In considering names as arbitrary or conventional words, Hobbes, unlike Bacon, follows the Aristotelian tradition.[103] As we have mentioned, this was the thesis defended by Pace and Crakanthorpe.[104] Such a standpoint detaches names from things and attaches them instead to concepts, which are primarily marks. This view,

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[99] Cf. Ibid. 12–13: 'Signa autem vocari solent antecedentia consequentium, et consequentia antecedentium, quoties plerumque ea simili modo praecedere et consequi experti sumus. … Notae ergo et signi differentia est, quod illa nostri, hoc aliorum gratia institutum sit'. On the possible influence of Goclenius on Hobbes, cf. Cees Leijenhorst, 'Insignificant Speech: Thomas Hobbes and Late Aristotelianism on Words, Concepts and Things', in Eckhard Kessler and Ian Maclean (eds.), *Res et Verba in der Renaissance* (Wiesbaden, 2002), 348.

[100] Cf. Hobbes, *The English Works of Thomas Hobbes*, vol. 3, 30: 'For *reason*, in this sense, is nothing but *reckoning*, that is adding and subtracting, of the consequences of general names agreed upon for the *marking* and *signifying* of our thoughts; I say *marking* them when we reckon by ourselves, and *signifying*, when we demonstrate or approve our reckonings to other men'.

[101] Cf. Hobbes, *Opera philosophica quae latine scripsit*, 13: 'Voces humanae, sic, ut cogitationum signa sint, connexae, *oratio*, partes vero singulae nomina appellantur. Cum autem philosophiae ut diximus et *notae* et *signa* (*notae* ut recordari, *signa* ut demonstrare cogitationes nostras valeamus) necessaria sint; nomina utramque rem praestant'.

[102] Cf. Ibid.: 'Praeterea, nomina per se singula *notae* sunt, nam cogitata revocant etiam sola, signa vero non sunt, nisi quatenus in oratione disponuntur et partes ejus sunt'.

[103] Whether language was conventional or natural was one of the most discussed issues of the time, on which cf. Lia Formigari, *Linguistica ed empirismo nel Seicento inglese* (Rome-Bari, 1970), 29–43. On the conventional nature of language in Hobbes cf. Leijenhorst, 'Insignificant Speech: Thomas Hobbes and Late Aristotelianism on Words, Concepts and Things', 340–346.

[104] Cf. Pace, *Institutiones logicae*, 13: 'Interpretatio est vox articulata ex instituto sensa animi significans […] Ex instituto dicitur Graece κατὰ συνθηκίω, quod non est a natura, sed hominum arbitrio positum'; Crakanthorpe, *Logicae libri quinque*, 223: 'Vox significativa ad placitum, est vox significativa quae pro voluntatate & arbitrio eius qui rebus nomina imposuit, res vel conceptus significat'.

characteristic of Hobbes' logic, represents a conceptualistic and heuristic position, without any ontological implication. Logic provides an instrument to describe the world, but it does not say properly that things *are* like this and not like that. The radical consequence is that names are the marks and signs of thoughts and not of things.[105] There can even be names corresponding to imaginary, non-existent things. However, Hobbes adds, perhaps—as Leijenhorst suggests—under the influence of the Jesuit logical textbooks, since every name refers to something named, even if the named thing does not exist outside the mind, it is right to call it a 'thing'.[106]

Having established the nature of the name, Hobbes introduces the classical Aristotelian distinction between *primae* and *secundae intentiones*. *Primae intentiones* are names of things, while *secundae intentiones* are names of names or of discourses. Hobbes betrays an imperfect understanding of this distinction, claiming that the *primae intentiones* are such because at the beginning it was decided to give names to everyday things, and only afterwards to such things that pertain to science.[107] Unlike the Aristotelian conception, Hobbes' conceptualism, which puts concepts before things, precludes that *primae intentiones* are such because the *secundae* are based on them. For him it is impossible that the *primae intentiones* immediately refer to things, as for Zabarella, rather than to concepts. All names refer primarily and immediately to mental concepts and only indirectly to the real existing thing. Some names, *secundae intentiones*, do not refer to any real existing thing, but only to the concept of a concept. We could interpret Hobbes' position as a kind of nominalism; but although there is a priority of names over things, these names are grounded on mental concepts, and therefore his philosophy is better described as an advanced conceptualism, rather different from that of Zabarella and closer to that of the British Aristotelians who were influenced by Jesuit logic. A concept, for Hobbes, may or may not be the mark of something really existing; from his youthful work *De principiis* onwards, he makes the necessary assumption that concepts faithfully mirror the external world, although, like Zabarella, he never provides good reasons for this assumption.

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[105] Cf. Hobbes, *Opera philosophica quae latine scripsit*, 15: 'Quoniam autem nomina, ut definitum est, disposita in oratione, signa sunt conceptuum; manifestum est ea non esse signa ipsarum rerum'. On the question of what words signify according Hobbes, whether things or concepts cf. Dawson, *Locke, Language and Early-Modern Philosophy*, 137–143; Leijenhorst, 'Insignificant Speech: Thomas Hobbes and Late Aristotelianism on Words, Concepts and Things', 347–353.

[106] Cf. Ibid. 15–16: 'Neque vero ut omne nomen, alicujus rei nomen sit, necessarium. Sicut enim voces *homo*, *arbor*, *lapis*, ipsarum rerum nomina sunt, ita quoque imagines hominis, arboris, lapidis, quae occurrunt somniantibus, sua sibi habent nomina, quamvis res non sit, sed rerum figmenta tantum et phantasmata. Datur enim ipsarum meminisse, ideoque nominibus eas non minus quam res ipsas notari et significari oportet. … Quoniam autem *nomen* omne ad aliquod *nominatum* relationem habeat, et si nominatum non semper res sit, existens in rerum natura, licebit tamen doctrinae causa pro *nominato rem* dicere, tanquam idem essent, sive *res* illa vere existat, sive ficta sit'.

[107] Cf. Ibid. 18: 'Atque hinc distinctio nominum tertia exsistit, vide licet ut alia *primae*, alia *secundae intentionis* dicta sint. … Quare autem illa primae, haec secundae intentionis dicta sunt, difficile est pronuntiare; nisi forte iis rebus nomina imponere quae ad vitam quotidianam conducebant, intentio prima, deinde vero iis rebus quae pertinebant ad scientiam, idem est nominibus dare nomina posterior et secunda cura fuerit'.

In *De principiis* Hobbes states that mind is a mirror capable of receiving the representation and the image of all existing things, which are retained in the memory as ideas or concepts.[108] For logic, however, real existents are not necessary, as Hobbes explains with his well-known hypothesis of the *annihilatio mundi*: if we imagine the world destroyed, except for one man, who retains his ideas of everything he has previously observed, he could apply the same logical processes to these ideas as he could if they still existed.[109] The core of Hobbesian logic lies in the possibility of dealing with and combining mental concepts independently from their actual existence. In Hobbes the relation between mental images and reality is not established, although by means of his logic this relation may be treated *as* established.

From the connection of many names, as we have seen, the mind generates a discourse, which can be of various kinds. The peculiarity of scientific discourse is to distinguish truth from falsehood in the cognitive process.[110] This kind of discourse is indifferently called assertion, enunciation, declaration, or proposition. A large number of logical textbooks of the time characterized the proposition as an articulated connection between two significant names, in particular by a subject and a verb and in some cases also a predicate. In their definitions of the proposition there is no reference to the problem of truth and falsehood, which is limited to a subset of propositions. Hobbes, instead, following Pace, includes in his own definition the ideas of truth and falsehood.[111] The reason for this inclusion is that he conceives the proposition as a discourse in which the former name may be comprehended or not by the latter, therefore in either case the proposition will always be true or false.[112]

The interesting aspect of Hobbes' theory of proposition in relation to Aristotle is its conceptualism in the problem of truth: 'truth consists in discourse, and not in the things spoken of'.[113] This conception of truth, completely different from the

[108] Cf. Thomas Hobbes, *Critique du* De mundo *de Thomas White*, ed. by Jean Jacquot and Harold Whitmore Jones (Paris, 1973), 449: 'the mind of man is a mirror capable of receiving the representation and image of all the world'. Cf. John W. Yolton, 'As in a Looking-Glass: Perceptual Acquaintance in Eighteenth-Century Britain', *Journal of the History of Ideas*, 40 (1979), 207–243.

[109] Cf. Ibid.: 'The exordium and beginning of the learning and knowledge of nature may be conceived thus from privation. If we conceive the world annihilated except one man to whom there would remain ideas or images of all the things he had seen, or perceived by his other senses (that is) a memory and imagination of the *magnitudes*, *motions*, *sounds*, *colours* etc. and likewise of their *order* and *parts*: all which though in truth they would be only ideas and phantasms internally happening and falling to the imaginant himself, nevertheless they would appear as if they were external and *not depending upon the power or virtue of the mind*'.

[110] Cf. Hobbes, *Opera philosophica quae latine scripsit*, 27: 'Philosophiae unica orationis species est, quam vocant alii quidem *dictum*, alii *enuntiatum*, et *pronuntiatum*, plerique autem *propositionem*; videlicet orationem *affirmantium*, vel *negantium*, notamque veritatis et falsitatis'.

[111] Cf. Pace, *Institutiones logicae*, 14: 'enunciativa oratio sive enunciatio est, quae significat verum vel falsum: *homo currit*, *homo non currit* et haec sola ad logicum spectat'.

[112] Cf. Hobbes, *Opera philosophica quae latine scripsit*, 27: 'Est autem propositio oratio constans ex duobus nominibus copulatis qua significat is qui loquitur, concipere se nomen posterius ejusdem rei nomen esse, cujus est nomen prius; sive (quod idem est) nomen prius a posteriore contineri'.

[113] Ibid. 31: 'Veritas enim in dicto, non in re consistit'.

Scholastic *adaequatio intellectus et rei*, is sustained above all by his recollection of Aristotle's famous claim in *Metaphysica*, VI.4, 1027 b 25–28, that 'the true and the false are not in things, but only in thought'. Truth is for Hobbes in a proposition and never in the things themselves.[114] For instance, the statement that 'something is thinking' is true or false by logical, not ontological criteria. Whether it is really the case that 'something is thinking' does not involve truth or falsity, but only whether the thing affects the mind in such a way to recognize that 'something is thinking'.

Hobbes' treatment and classification of propositions, syllogism and fallacies is also typical of the Aristotelian tradition and common to all the logical textbooks of the time.

The most Aristotelian part of Hobbes' logic is, as Edwards has remarked, the sixth chapter, devoted to the study of method, which is greatly expanded in the final draft from his preparatory work of 1645–1646.[115]

Philosophical method is characterized as the shortest investigation of the effects from known causes or of the causes by means of the effects,[116] as Hobbes had already written in his definition of science in the first chapter.

There are therefore two ways to acquire knowledge, which have different epistemic values. For Hobbes, true knowledge is *cognitio rei per causas*, that is the knowledge of causes. Science is thus eminently τοῦ διότι, namely of the 'why' or 'what is'. Knowledge of the effects, instead, comes either from sensation, or from imagination or memory, and is knowledge τοῦ ὅτι, namely 'that something is'.[117] The distinction between these two kinds of knowledge is typical of the Aristotelian tradition and reflects the distinction between *demonstratio quia*/*quod*/*ab effectu* and *demonstratio propter quid*.

These demonstrations are grounded on first principles, which come from the senses and the imagination and are knowable *per se*. However, in order to discover them scientifically both the analytic and synthetic method are necessary.[118] Taken separately, knowledge of causes from effects and of effects from causes cannot provide an efficient method of research. If the research begins from the causes to discover the effects, the

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[114] Cf. Leijenhorst, 'Insignificant Speech: Thomas Hobbes and Late Aristotelianism on Words, Concepts and Things', 361.

[115] Cf. Edwards, 'Paduan Aristotelianism and the Origins of Modern Theories of Method', 205–220.

[116] Cf. Hobbes, *Opera philosophica quae latine scripsit*, 58–59: 'Est ergo methodus philosophandi, effectuum per causas cognitas, vel causarum per cognitos effectus brevissima investigatio'.

[117] Cf. Ibid. 59: 'Scire autem aliquem effectum tunc dicimur, cum et causas ejus, quod sunt; et in quo subjecto insunt, et in quod subjectum effectum introducunt, et quomodo id faciunt cognoscimus. Itaque, scientia τοῦ διότι sive causarum est; alia cognitio omnis quae τοῦ ὅτι dicitur, sensio est vel a sensione remanens imaginatio sive memoria'.

[118] Cf. Ibid.: 'Principia itaque scientiae omnium prima, sunt phantasmata sensus et imaginationis, quae quidem cognoscimus naturaliter quod sunt; quare autem sunt, seu a quibus proficiscuntur causis cognoscere ratiocinatione opus est, quae consistit … in compositione et divisione sive resolutione. Itaque omnis methodus per quam causas rerum investigamus, vel compositiva est, vel resolutiva, vel partim compositiva, partim resolutiva. Et resolutiva quidem *analytica*; compositiva autem *synthetica* appellari solet'.

mind can begin from a false cause and consequently deduce a false effect; while if it begins from the effects, the mind may not discover the correct cause. Therefore, for Hobbes the correct method of research involves the union of both methods. This was the position sustained by the Paduans, summarized in the *demonstratio potissima*, characterized in turn by the *regressus*, to which Hobbes also seems to refer.

It is indicative that Hobbes recurs, even if implicitly, to the Aristotelian passages used by the British school to define scientific method, such as *Analytica posteriora* II.19 and *Physica* I.1. According to Hobbes every method of research proceeds from the known to the unknown. But what is initially known is not always distinct; even if the whole phenomenon is more knowable than the specific elements of sensory experience, our knowledge of it is confused and indistinct. For instance, when we see a man—Callias in Aristotle's example[119]—the whole idea of man, even if confused, is known before his particular but distinct attributes: figurate, animate, rational, etc. This is only the knowledge of the thing's existence and its specific properties or *essentialia*, which define what it is.

Knowledge τοῦ ὅτι, which is knowledge that something exists, is the starting point of all research. Knowledge τοῦ διότι, by contrast, is the final stage of the cognitive process by which the mind knows the causes of the parts better than the cause of the whole.[120] The latter is composed of the causes of the parts: one must know the parts before one can know the compound. Hobbes does not mean the parts of the thing itself, but rather its essential properties such as its shape, quantity, the movement and so on. It would be paradoxical if the mind first knew the whole and then the parts, but the parts were also necessary to know the whole. To solve the problem Hobbes recurs to the usual Aristotelian distinction between what is 'most knowable by us' and what is 'most knowable by nature'.[121] Hobbes warns us that what is 'most knowable by us' is ontologically the same as what is 'most knowable by nature', but known differently, in different times by the mind and following different procedures, and this is why the thing appears different, when in truth it is the same.[122]

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[119] Cf. Aristotele, *Analytica posteriora*, II.19, 100 a 14–18.

[120] Cf. Hobbes, *Opera philosophica quae latine scripsit*, 59: 'Omni methodo commune est hoc, ut procedatur a cognitis ad incognita; id quod manifestum est ex allata philosophiae definitione. In cognitione autem sensuum, totum phaenomenon notius est quam quaelibet pars ejus; ut cum videmus nomine, prius notus, seu notior est conceptus, sive idea illa tota hominis, quam particulares ideae *figurati*, *animati*, *rationalis*, hoc est, prius videmus nomine totum, cognoscimusque quod est, quam animum ad particolaria illa advertimus. Itaque in cognitione τοῦ ὅτι sive *quod est*, initium quaerendi est a tota idea. Contra in cognitione τοῦ διότι sive cognitione causarum, id est, in scientiis, notiores sunt partium causae quam totius'.

[121] Hobbes refers directly to Pace, cf. Pace, *Institutiones logicae*, 75: 'dicuntur priora secundum nos ea quae maxime accedunt ad sensum'.

[122] Cf. Hobbes, *Opera philosophica quae latine scripsit*, 60: 'Atque in hoc consistit id quod vulgo dicitur, alia esse *nobis*, alia esse *naturae* notiora; non enim arbitror eos qui sic distinguunt, notum quicquam esse existimare quod etsi homini nemini, naturae tamen notum sit; notiora igitur *nobis* de notitia sensuum notiora *naturae* de notitia ratione acquisita intelligi debent, et sic tota partibus, idem est, eae res quae nomina habent minus universalia (quas brevitatis causa singulares) quam quae nomina habent magis universalia (quas universales dicemus) notiores *nobis*; partium autem causae, quam causa totius, hoc est, universalia singularibus notiora *naturae* dici solent'.

If science properly speaking is the knowledge of causes of all things, and the causes of all particulars involve the causes of the universals, then it is necessary to know the causes of the universals, that is the first principles. According to Hobbes, universals are in the particulars and are abstracted by reason through a process of resolution. Hobbes' example is quite clear: if we consider the concept of 'gold', from its resolution we will find the ideas of 'solid', 'visible', 'heavy', and many other general concepts, which in turn can be resolved to find the most universal concepts. Continuing this process, in the same way, we know also the things whose causes, when known individually and taken together, provide the knowledge of the cause of the particulars. Thus, Hobbes concludes, it is evident that the method of discovering the first principles is purely analytical.[123]

Having outlined the first principles of τοῦ διότι knowledge, he must explain how these principles generate effects, and the method of research to explain this is compositive. The philosophical method for acquiring knowledge in general is thus partly analytic and partly synthetic. What is most striking in Hobbes' treatment of method is the lack of any characterization of the process from sensation to the first principles, which in the logical textbooks of the time (Smith, Sanderson, even Bacon) corresponded to induction. We can suppose from this that in his commentary on these two Aristotelian passages, Hobbes followed Harvey's interpretation,[124] which is, as we have seen, entirely Aristotelian in character, but which ignores induction.[125] Such a supposition seems to be confirmed by the fact that this last part was entirely revised from the early draft of 1645–1646, and by his use of term 'idea', rare in contemporary works, but central to Harvey's preface.

Although scholars have sustained the influence on Hobbes of Euclid and Pappus,[126] his appeal to the distinction τοῦ ὅτι/τοῦ διότι is more directly reminiscent of Aristotelian methodology. If this were not enough, the last paragraph of the section on method is significantly titled 'why the analytical method of geometricians cannot be treated in this place', confirming that Hobbes' concepts of 'analysis' and 'synthesis' in this context are those of the Paduan school, mediated by the British Aristotelians.

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[123] Cf. Ibid. 61: 'Rursus, si proponat sibi conceptum auri, venient inde resolvendo ideae *solidi*, *visibilis*, *gravis*, (id est conantis ad centrum terrae sive motus deorsum) aliaque multa magis universalia quam est ipsum aurum, quae rursus resolvi possunt, donec perveniatur ad universalissima. Atque eodem modo alia atque alia resolvendo, cognitum erit quaenam ea sunt, quorum causis sigillatim cogniti set compositis, cognoscuntur causae rerum singularium. Concludemus itaque methodum investigandi notiones rerum universales, esse pure analyticam'.

[124] On Hobbes' relationship with Harvey, cf. Skinner, *Reason and Rhetoric in the Philosophy of Hobbes*, 215–216.

[125] Cf. Harvey, *Exercitationes de generatione animalium*, 19–20.

[126] Cf. William Sacksteder, 'Hobbes: The Art of the Geometricians', *Journal of the History of Philosophy*, 18 (1980), 131–146; Richard A. Talaska, 'Analytic and Synthetic Method According to Hobbes', *Journal of the History of Philosophy*, 26 (1988), 207–237. Against this interpretation in favour of my reading cf. Stewart Duncan, 'Hobbes, Thomas', in Edward N. Zalta (ed.), *The Stanford Encyclopedia of Philosophy* (Stanford, 2009), URL=<http://plato.stanford.edu/entries/hobbes/>.

The strong heuristic and epistemological framework of Hobbes' logic is also evident in his sharp distinction between the methods of investigation and of demonstration. If the method of investigation is the union of analysis and synthesis, the method of demonstration for Hobbes, as for Zabarella, is synthetic only. In the latter process we must neglect the analytic part of the method which proceeds from sensation to first principles, because these latter principles cannot be demonstrated, and, being known by nature, require explanation rather than demonstration.[127] The entire method of demonstration is thus synthetic, proceeding from first principles known *per se*, to a continuous compounding of propositions into syllogisms.[128] Like Zabarella, Hobbes conceives the analytic or resolutive method as ancillary to the demonstrative or synthetic method, because the aim of science is the knowledge not of principles, but of their effects.[129]

From this we may conclude that Hobbes characterizes the method of discovery as analytic, as was common in the Aristotelian textbooks of his time. The Aristotelian tradition has exerted a determining influence in the constitution of his scientific methodology. Hobbes' natural philosophy, like his logic, is imbued with Aristotelian doctrines, which have been transformed and re-elaborated after much consideration.[130] Aristotle's solutions to logical problems, and to an even greater extent those of faithful interpreters, such as Zabarella, were in Hobbes' eyes still valid—a validity they would retain for the rest of the seventeenth century.

[127] Cf. T. Hobbes, *Opera philosophica quae latine scripsit*, 71: 'eadem erit methodus demonstrandi quae fuerat investigandi, nisi quod pars methodi prior nempe quae procedebat a sensu rerum ad principia universalia omittenda sit'.

[128] Cf. Ibid.: 'Tota igitur demonstrandi methodus synthetica est, consistens in orationis ordine incipientis a propositionibus primis sive universalissimis per intellectis, et propositionum in syllogismos perpetuam compositionem procedentis, donec a discente intellecta sit conclusionis quaesitae veritas'.

[129] Cf. Zabarella, *Opera logica*, 266 f.

[130] Hobbes' Aristotelian perspective had some impact on the intellectual *milieu* of the time cf. Richard Cumberland, *De legibus naturae* (London, 1672), which is an explict critique of Hobbes' moral theory.

Chapter 10
Late Seventeenth-Century Aristotelianism

10.1 Aristotelianism, 1650–1670

The dissemination of the works of Bacon, Harvey and Hobbes did not mark the end of the Aristotelian tradition; rather, with their latent Aristotelianism they promoted the integration of Aristotelian philosophy with the new science.

Indeed, Aristotelianism was the dominant philosophical movement of the second half of the seventeenth century as well, as witnessed by the large number of textbooks published in this period. Aristotelianism remained the official philosophy of British universities—newer trends had almost no influence on academic handbooks. The methodology and epistemology developed by British Aristotelians, with their empiricist leanings, remained the basis of the logic curriculum taught throughout the last 40 years of the century. Not only were the textbooks of the first half of the century reprinted, but new ones were written and published, clearly showing an empiricist strand.

Among these was Thomas Lushington's *Logica analytica*, published in 1650 by Francis Bacon's great-nephew Nicholas.[1] Unfortunately only one of the two projected parts was published, even though the second was ready to be printed, as Bacon testifies. The work deals prevalently with the issues of Aristotle's *De interpretatione*. The most interesting part, entitled *De argumentatione*, has not survived, but we know its content from the author's brief summary in his dedicatory preface. Although Lushington declares himself to be an Aristotelian, one is immediately struck by the inversion between the analytic and synthetic methods. Unfortunately, the reasons for this inversion are unknown. It may reflect the earliest circulation of Cartesian works, or the adoption of theories from Digby, but the tone of the editorial and authorial introductions suggests an adherence to the mathematical idea of analysis and synthesis, rather than the Aristotelian one. In fact, synthetic method proceeds

[1] Cf. Thomas Lushington, *Logica analytica. De principiis, regulis, et usu rationis rectae* (London, 1650).

M. Sgarbi, *The Aristotelian Tradition and the Rise of British Empiricism*, Studies in History and Philosophy of Science 32, DOI 10.1007/978-94-007-4951-1_10,

from the given data, and by composition elaborates a universal proposition in relation to that data, while analytic method proceeds from the 'saying' and by resolution determines the degree to which the universal properties pertain to the particulars.[2] Lushington's work, perhaps because of its unfinished state, was not successful and never reprinted; this probably explains the non-appearance of the second volume.

More interesting is the Aristotelianism of Zachary Coke (b. 1618) in his *The Art of Logick*, published towards the end of 1653, but dated 1654.[3] Coke's textbook is heavily indebted to Airay's *Fasciculus* and Keckermann's *Systema systematum*.[4] In particular, those pages that Coke draws from Keckermann are full of quotations from Zabarella, once again the key reference in the field of logic and epistemology. There is no doubt that Coke's logic was the most complete logical handbook in English written before Locke's *Essay*. Coke's work clearly shows how Aristotelian logic was more interested in transforming epistemology from a mere consideration of syllogism to a careful examination of the intellect and its functions with respect to the objects of experience.

The entire structure of Coke's work is Aristotelian, even if it presents some eclectic elements. At first Coke states that man's greatest pleasure and perfection is conversing with intellect and reason, that is, understanding, knowing and judging things distinctly as they are.[5] To achieve this, three elements are necessary: (1) the object of knowledge, defined as all those things present in nature; (2) an innate faculty of the mind, which is the intellect; (3) a particular disposition through which the intellect is ordered in its operation, and which can be either immediate, i.e., infused by God, or acquired by knowledge.[6]

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[2] Cf. Ibid. *praefatio dedicatoria*: 'Sed quia sermo unus terminis duobus constat, nempe dato sive subjecto, et dicto sive praedicato, ideo exprimi enuntiari sive proferri potest et solet, ordine duplici. Unus qui a dato incipit, dicitur syntheticus sive componens et contexens; estque vulgaris et popularis; ut cum dicitur, equus omnis est quadrupes. Ordo alter qui a dicto incipit, dicitur analyticus sive resolvens et retexens; estque rationalis magis et artificialis, priori contrarius et adversus; ut cum dicitur, quadrupes inest omni equo. … Ordo tamen analyticus est dexterior et arti ratiocinatrici accomodatior; quae propterea vocatur analytica'.

[3] On the authorship of the work, many doubts have been raised, with some attributing it to the theologian Henry Ainsworth (1569–1622). Cf. James S. Measell, 'The Authorship of The Art of Logick (1654)', *Journal of the History of Philosophy*, 15 (1977), 321–324; Id., 'Variant Title-Pages in The Art of Logick (1654)', *The Library*, 33 (1978), 157–162.

[4] Serjeantson has suggested with good reasons that Coke's textbook is in many parts an abridgement of Keckermann's work. Cf. Richard W. Serjeantson, 'Testimony and Proof in Early-Modern England', *Studies in History and Philosophy of Science*, 30 (1999), 207.

[5] Cf. Zachary Coke, *The Art of Logick or the Entire Body of Logick in English* (London, 1654), 1: 'The prime perfection and pleasure in this life … consists in mans conversing according to understanding and reason: i.e. to understand, know and judge distinctly of things as they are in their natures'.

[6] Cf. Ibid.: 'To the attainment of such a knowledge, three things are necessary. 1. The object or thing to be known, viz. every thing in nature. 2. A natural faculty or power of understanding, which floweth from a reasonable soul, and is innate to every man. 3. A certain disposition whereby this power is ordinately and regularly, that is in order, and without error, led into act. Now this is either a. immediate, and by infusion of God … or it is acquired, and gotten by information and discipline, which is frequent and ordinary'.

The order and right arrangement of the intellect depend on logic, which is a directive discipline. By the latter, Coke does not mean those disciplines which deal with the things themselves, or those which provide the matter of knowledge, but those disciplines which prepare and structure the operations of the mind and reason in the cognition of things.[7]

The mental operations required for the knowledge of things: (1) the understanding and the thoughts of things; (2) the signification of these thoughts. Only logic, among directive disciplines, can correctly direct these two operations.[8]

Logic is thus primarily the art of ordering and directing the mind in its knowledge, and secondly the art of teaching the way of thinking and judging things distinctly. Thinking is thus the proper activity of the mind, that is, the reason and intellect insofar as they deal with things in the world.[9] Following this brief definition of logic, Coke expounds in detail its kind, subject and aims.

In kind, logic is an art. It cannot be wisdom, which concerns the knowledge of first causes; nor is it intellect, which is the habit of principles; it is not science, which is the true and universal knowledge of things; nor prudence, which teaches what must be done. It is an art, instead, because: (1) it imitates nature; (2) it presupposes a particular end towards which are directed instruments and means; (3) it is used not for itself, but for the sake of something else, that is the acquisition of knowledge; (4) it is characterized by an analytic or resolutive method, which proceeds from the object already known by specific means that arrange knowledge.[10]

The subject of logic, instead, is twofold—that which directs, and the means by which it directs. The first subject of logic is reason or intellect, while the means is discourse, which is the expression of reason. The subject that is directed by logic is the intellect, or reason, or mind, or human thought, which must be known preliminarly by its properties and degrees.[11]

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[7] Cf. Ibid. 2: 'Directive disciplines be such as handle not the things themselves to be known, nor do they inform or perfect the understanding of man in those things, but they prepare only some operation of man, and with framed rules and instruments do guide and direct it'.

[8] Cf. Ibid. 2–3: 'Now the operations of man requiring and needing such artificial rules, are chiefly two. The first is the understanding or cogitation of things. The second the signification either by word or writing of those cogitations … and that which thus directs the understanding or cogitations, is Logick only'.

[9] Cf. Ibid. 3: 'Logick is an art of ordering and directing mans understanding in the knowledge of things; or secondly, logick is an art that teacheth how to think and judge distinctly of all things. *The thought of mans mind is nothing else but his reason or understanding wholly occupate about things*'.

[10] Cf. Ibid. 3–4: 'The genus of logick is an art; for 1. It cannot be wisdom which teacheth and treateth of the hightest causes and things. 2. It is not understanding which containeth and consisteth of the habit of principles. 3. Nor is it a science which is made up only of such things as are real and universal. 4. Nor can it be prudence which teacheth things that are particular to be done and practiced. It remains therefore that it be an art. … First it imitates and perfecteth nature. 2. It presupposeth a certain end whereunto it directeth all the means. 3. It is to be known, not for its own, but for the sake of some other … 8. It is delivered by an analytical and resolutive method, proceeding from the object and end foreknown, unto the means which are to be ordinated'.

[11] Cf. Ibid. 4: 'The object of logick is two-fold. 1. That which it directeth. 2. That whereto the understanding is directed. *Also the primary object of logick is reason; the secondary, speech, the*

Within this framework Coke devotes a long section to the exposition of epistemological doctrines, the limits of the understanding and the use of logic as a corrective instrument for mental errors, likely following Keckermann.

For Coke, the first feature of the mind is that sensible objects are most knowable to us and only subsequently does the intellect acquire intellectual knowledge. Therefore, all knowledge begins and derives from experience. The second feature is that, because of the Fall, the intellect cannot understand and determine the specific nature of things in a distinct and ordered way; therefore, to discover the truth, artificial rules are required, just as the sailor needs a compass to reach his destination. Third, the intellect is directed to the thought of universals, while sensation is concerned with particulars; this implies the necessity of mediating between these two kinds of knowledge. Fourth, according to Coke, at any given time the intellect is occupied with the thought of only one thing, and this thought, amid a flux of other thoughts, is determined by a temporal order within the mind. Fifth, the object of knowledge must be proportionate to the finite capacities of the mind, and to the limit of the intellect: for instance, the infinity of God cannot be comprehended by the finite intellect of logic. Coke points out, furthermore, that the intellect can assent to conclusions which are not demonstrated in a necessary way, as with induction, for example. Finally, the instruments of mental operations must be pure, that is, the intellect should not be pathologically affected.[12]

The possible errors and defects of the intellect are what logic aims to prevent and what Coke thematizes, slavishly following Keckermann and Airay's treatment. There are three defects of the mind in the realm of epistemology. The first is aberration in the apprehension of things, which means that the mind grasps things

manifestation and utterance of reason. … The object which logick directeth is the understanding, reason, mind or thought of man, wherein two things are to be foreknown: 1. The properties of the understanding; 2. The parts and degrees thereof'.

[12] Cf. Ibid. 5: 'The properties of the understanding to preknowledge of logical precepts necessary are: 1. That those perceived of sense, be first and best known of the understanding; let the understanding deduce thence its original knowledge. 2. That since the defection of our first parents in Paradise, our under standing cannot faithfully and certainly determine to comprehend the natures of things with distinctness and order, and by its own acies and strength to discern the truth, unless by artificial and outward rules, directed and governed, unto which the under standing looks, as the mariner to the compass; in which respect and sense it is in worse case then the senses, which have conserved themselves sound and entire since the first apostacie, of their own force and vigour being still able to determine themselves faithfully to know their own objects. 3. That the understanding of it self, is rather carried to the cogitation of things (and such objects as are not determined either by will, place, time, etc. circumstances) then unto determinate things and singular, the effects and products of sense. 4. That the under standing acts not in a moment, but successively, in time, and by order. 5. It understands not the same independently, and of it self, but goeth from one thing to another … 6. That at one and the same time it is occupied about, and understandeth but one thing. 7. That the object must be proportionate to it self and finite; it cannot under stand God who is infinite. 8. That it may assent certainly to conclusions proved, even testimony (if authentique) be so as no distinct knowledge can be bigotte in the under standing, except there be a a mean from the nature of the predicate or subject; for that to know is by the cause. 9. That the instruments of its operation need be pure and composed, should be spirits void of affectuous humors, as anger, fear, malice, revenge, etc.'. Cf. Keckermann, *Systema systematum*, 67.

incorrectly. The second is obscurity in the nature of things and the difficulty of distinguishing their marks and properties. The third is negligence and confusion in the apprehension, which means that the mind grasps things correctly but confusedly. Logic has a cure for all these defects by means of the explanation, testing, order and arrangement of things.[13]

The degrees of the intellect correspond to the three main operations of the mind, that is, apprehension, composition and discourse.[14] Discourse is twofold, illative and ordinative: the former infers from premises to conclusion, while the latter systematizes the various parts of the discipline and judges if they are in conflict.[15]

The subject of logic, as we have previously said, is all the things present in nature. These can be of three kinds. Some are infinite, such as God, and no logical instrument is sufficient to understand them. Others are finite and created. Of these, some are spiritual, imperceptible and understood only with great effort; others are corporeal and known properly by the intellect. Logic is useful only for understanding this last class.[16] Following Keckermann in narrowing the field of logic to only corporeal and physical things, Coke deliberately defines the limits and boundaries of human understanding, just as Locke would do in his *Essay*. All that goes beyond experience and sensible knowledge is the object either of divine revelation, or of a confused understanding: distinct knowledge and the correct use of the intellect rely only on sensory experience. The intellect, however, does not act directly on sensible knowledge of particulars, but rather on their conceptual abstractions, which, as we shall see, are defined as *secundae notiones* following Aristotle. Of course Coke, like

[13] Cf. Ibid. 5: 'there are three defections in mans reason. 1. Aberration from the apprehending of things. 2. Obscurity and difficulty, either not being able to comprehend the natures of things, or to discern them with their notes and properties, as in glass. 3. Distraction and confusion in the apprehension of them. Logick now hath a medicine to cure these, which it doth 1. By the explanation of things. 2. By probation. 3. By ordination'. Cf. Keckermann, *Systema systematum*, 68; Airay, *Fasciculus praeceptorum logicorum in gratiam juventutis academicae compositus*, 3.

[14] Cf. Ibid. 6: 'The first degree of the under standing is simple, viz. the apprehension of a single term or theme … 2. Is the conception of two terms by way of composition as when we think … 3. Is when in order we think of more then two terms passing the thought from one to the other, till you come to a third.'

[15] Cf. Ibid.: 'Discourse now is two-fold. Illative. Ordinative. Illative is such a moving of our thoughts, as when by the repeating the co-ordination of things, that is, the third term with the two former, we judge the co-ordination of these two terms to be true or false. This discourse is that which is called syllogistical. Ordinative is a moving of our thoughts from one part of the doctrine to another, that so we may judge how they consist and hang together. This discourse is called methodical'. Cf. Keckermann, *Systema systematum*, 5.

[16] Cf. Ibid. 6–7: 'The object to which the understanding is directed and ordered, is every thing in nature; for the under standing and comprehending of which in our thoughts, the under standing needeth and seeketh rules of logick. Of this object there is a three-fold partition of things. 1. Some are infinite, as God, and hereunto the service of logical instruments is not sufficient for the eliciting of a perfect conception or knowledge. 2. Others are finite, and create; and of them some be spiritual and imperceptible by sense, and with much ado can the under standing conceive them. 3. Some also be corporal, and to know them and their instruments, logic instruments chiefly serve'. Cf. Keckermann, *Systema systematum*, 5.

Zabarella and Keckermann, narrows the philosopher's field of research to physics and natural philosophy, and he conceives logic as that through which it is possible to provide plausible and scientific descriptions and explanations of reality.

Natural things can be therefore considered in two ways according to Coke: (1) indeterminately, that is without any particular reference to the specific circumstances that determine their empirical nature; (2) determinately, with regard to certain circumstances, primarily space and time. The first way is specific to logical instruments,[17] the second to natural philosophy.

The aim of logic is to order and direct the thoughts and operations of mind in knowing things: logic is, to repeat an Aristotelian formula, a real τρόπος ἐπιστήμης.[18]

Indeed, logic has the merit, more than any other discipline, of aiding the 'wit'—namely, the ability to discern truth from falsehood—on which the faculty of judgment depends.[19] Logic in particular guides our thoughts about everything that is conceivable according to a rule, in such a way that the mind draws correct conclusions by means of an ordered process and avoiding any kind of confusion.[20] Moreover, according to Coke, logic is the ground of the reflective knowledge of the mind; that is, it makes intelligible to the mind not only things, but also itself, at the moment that it knows the things.[21] In this sense, through Keckermann, Coke is the first philosopher in the British Isles to introduce into the logical debates the problem of inner reflection as a specific act of the mind, which Zabarella had only briefly suggested. Last, but no less important for an Aristotelian, the mind, by means of logic, acquires the intellectual virtues; logic itself, following Zabarella, must therefore be considered as an instrumental habit with a characteristic nature, method and exercise.[22]

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[17] Cf. Ibid. 7: 'things in nature are considerable two ways. 1. Indeterminately, without respect or restraint to term, place, or other circumstances, as a man. 2. Determinately unto circumstances, as Peter and Paul etc. About the first (as about things universal) are logical instruments and directions primarily and principally used. About the latter (as about singular) they are used but secondarily'.

[18] Cf. Ibid.: 'The proper end of logick is the ordering and directing of mans cogitations (or the acts of mans understanding) in the knowledge of things … other disciplines do not so much direct the mind (physicks, mathematicks) as teach and minister the knowledge of things; whereas logick of it self is but τρόπος ἐπιστήμης'.

[19] Cf. Ibid. 7–8: 'No discipline more helpeth the wit, or contemplative sharpness … Unto the wit belongs: 1. The judgment, or judging faculty, i.e. a disposition soundly to think and perceive whats true, and whats false in things. 2. A faculty of learning. 3. Discipline. 4. A witty faculty quickly to find out the mean to prove the truth, and refute the falshood, all which logick helpeth, ordereth, directeth'. Cf. Keckermann, *Systema systematum*, 6–7.

[20] Cf. Ibid. 8: 'Logick is the directory of the thoughts, making them regular, that whatsoever is conceivable of a thing, may be drawn to a right summe, for an orderly process in them, and to avoid confusion'.

[21] Cf. Ibid.: 'It giveth a reflexive knowledge to a man, that is, it makes a man not only know (directly) but makes him know that he knoweth a thing'. Cf. Keckermann, *Systema systematum*, 6.

[22] Cf. Ibid.: 'By it is a man enabled to an apt and regular placing and acquiring of intellectual vertues … now unto logick (as unto every habit) are required three things, (as it were efficient causes of it) nature, method, exercise'.

The nature of logic follows the nature of the mind. The mind has a natural faculty, which consists in the bodily humors, dispositions and temperaments, and constitutes its physiological aspect.[23] More interesting is his treatment of the method of logic. Method is the set of all the logical precepts necessary for the acquisition of the logical habit. Logical precepts are mainly of two kinds: those which concern the discovery of new knowledge, and those which involve the constitution of a logical discipline.[24]

As far as invention is concerned, Coke states that logic was conceived as an instrument to correct the errors which occur in the mind as it attempts to know things directly and determinately. These errors are caused by the mind's inability to know the cause of things directly: it contemplates natural effects, according to Coke, with a kind of stupor which reveals its ignorance.[25] To remedy this incapacity, the mind requires the help of others' thoughts, which do not concern things directly, but rather the instruments which permit the knowledge of things, namely logical notions.

On inventive method, Coke follows Sanderson's exposition, demonstrating once again its lasting influence. The first means by which logic acquires new knowledge is through the senses, and mainly the eyes and ears. The second means is observation, which presupposes the use of the senses; observation, in Coke's definition, is a reflection on the data obtained by the senses. The third means is experience, i.e., the collection of the many observations and examples retained in the memory. The final means is induction, the real inventive instrument, which, from the judgment of the senses and from the experience of observations, generates a common universal notion on which the logical instrument can operate.[26] Logic is defined not only by the process of acquiring knowledge, but also by the material on which the

[23] Cf. Ibid.: 'φύσις or nature, that is, a natural faculty, which consists of the humors, disposition and temperament of the body, whereby a man is inclinable to this, more then to that discipline'.

[24] The part devoted to the constitution of logic, in fact concerns rather the coherence and systematization of the various parts of the discipline.

[25] Cf. Ibid. 9: 'Method (μέθοδος in the Greek) is a collection and frame of all logical percepts, needful to the acquisition or getting the habit of the art. About this frame two things are considerable. 1. Invention; 2. Conformation. Now the causes motive of men to invent this art, were first, the defect of mans nature, who out of a perception that the thoughts of man could not well determinate themselves to the under standing of things without the help of second thoughts, were forced to frame and devise such, and they call them logical notions … Admiration of natural effects, arising out of abstruseness of the causes, causing grief to ingenuous spirits (for wonder speaks ignorance) by which they were irritated to a serious enquiry after the causes, which without logical determinations was not feasable'.

[26] Cf. Ibid.: 'The means men used at first (I mean since the Fall) for the exploiting and adorning of the art of logick, is, first, outward sense, principally those of seeing and hearing. 2. Ιστωρία; observation; and this ever presupposeth remembrance (for nothing comes into the under standing, but that was some manner of way first in the sense), which is nothing but a reflexion upon something formerly taken notice of. 3. Εμπειρία, experience, that is, the collection of many observations and examples, and retaing them in memory. 4. Επαγωγή, induction (the third ἐνέργημα, that is, effect of the understanding, is invention) which from the judgment of the senses, and experience of observations, formeth in the understanding a common and universal notion, which as it were is a rule by which the knowledge and vertue of working are directed in the operation to come'.

method operates. This material is twofold: (1) primary; (2) representative or secondary. Primary material is either simple or composite. The former consists of logical terms, or words which represent concepts, also called *secundae notiones*. *Primae notiones*, meanwhile, are our concepts of things as they are. *Secundae notiones* do not refer directly to things themselves, but rather to intellectual rules by which the mind can deal distinctly and regularly with things—that is, they are mental concepts of things. For Coke, as for Zabarella, *primae notiones*, even if they are concepts, directly concern things as they are. Thus, Coke writes, whoever imposes names aims first of all to name the things themselves and only afterwards other concepts. For instance, the word 'man' expresses primarily the concept of human nature, and as such it is a *prima notio* or *intentio*, but when we consider the word 'man' as a species, or a kind, it becomes a *secunda notio*, which is not derived immediately from the things that constitute human nature, but rather from the intellect's way of conceiving 'man'.[27]

Coke's Aristotelianism also colours his treatment of the first operation of the mind—apprehension. This deals with singular and simple things, mediated by notions or logical instruments representing the thing in the mind, called *secundae notiones.*[28] What is apprehended can be expressed by words, which are the signs either of things themselves or of concepts—for Coke, unlike his predecessors, there is no priority in this matter. Of course it is true, he concedes, that the meaning of things is not intrinsic to them, but given by the mind, which imposes words on things. Words, like concepts, can be *primae* or *secundae intentiones*—the former if

[27] Cf. Ibid. 11–12: 'The material then of the frame of logick consists in that wherein the partition and conformation before handled is, and it is two-fold: (1) Primary. (2) Representative and secondary. The primary material also is two-fold. Simple. Compound. The simple material, be the logical terms, words made to represent the sense of the cogitations, so that the understanding is as it were limited and confined within it self in cogitating and thinking; they are called second notions. The first notions are the conceptions we have of things as they are things. Now these second notions do not directly and by themselves shadow out unto us the things themselves, nor any thing accidental or appendant unto them, but point unto certain intellectual rules, whereby we do with all distinctness and regularity form things, that is the conceits of things. … Those that primarily imposed names, intended to name first the things themselves and then secondly they added second notions, which we call mental and logical. As the word man, is to express primarily the conceit which we form of human nature, and is as the image thereof, and immediately founded therein; for mans nature is the immediate object, and this is a word of the first intention; but when we say a man is a species, or a genus, or difference, etc. these are words of the second intention, not desumed immediately from the thing, which is human nature, but from the manner of understanding, whereby we understand such terms to agree unto *Peter*, *John*, and every man'.

[28] Cf. Ibid. 14: 'Logick is an art which conducteth the minde in the knowledge of things. … The first [part] is, that which directs the first operation of the mind, which objecteth to it self only single or simple things, by the mediation of a single or simple term, which is a notion or instrument of logick, representing unto the under standing one thing … and it is called a second notion, as it is the minds image and pourtraict, shadowing to it self some outward thing. First notions are (as it were) the string or rule of a dial; second notions are (as it were) the ombre and shadow made by that rule or string: these both shew the hour but the string or stem first and fundamentally; the second (that is the shadow) but secondarily, as it configurateth to the other'.

they signify or co-signify the things without the intervention of the mind, while the latter if they signify a way by which the thing is understood.[29]

The second part of logic deals with the generation of propositions from two terms.[30] The third concerns discourse, the mental operation which proceeds from the known to the unknown,[31] and can be illative or ordinative, as Keckermann and Lushington suggested.[32]

Among illative forms of discourse is the syllogism,[33] but also induction. Coke's description of induction is quite simple and mainly relies on Keckermann. According to Coke, induction can be 'principal' or 'less principal'. The former infers a general conclusion from many particulars.[34] There are three precepts that guide principal induction. First, induction can be grounded on a complete enumeration of all the particulars and therefore lead to scientific knowledge, but only if these particulars are finite in number, and the mind can experience all of them. Second, if the particulars are infinite, it is sufficient to consider just some cases and to introduce a clause 'no other example can be extended to counter-check'. Third, induction can always be converted in a syllogism of the third figure.[35] Less principal induction, by contrast, is when one or two singular things are inferred, or one is proven by the other. This kind of induction has no epistemic value and does not guarantee any knowledge of the thing, not even probable knowledge.[36]

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[29] Cf. Ibid. 15–16: 'The term of a word is that whereby the naming of a thing is considered; a word is the sign of things or conceptions, pronounced or written with a certain frame of letters and syllables. In a word three things are remarkable: 1. The material. 2. The formal. 3. The imposition. The material is the sound … The formal is the signification of the word, and by consequence the relation to the conceit of *the minde* which it giveth knowledge of: now the efficient cause of this signification, is the imposition and institution … Words have their divisions either. Of the thing signified and of the manner and ordering of signifying … Significative words also are of the first intention which signifie of themselves without the help of the minde, and they are the things themselves, or of the second intention, which means not a thing (it self) but the manner of it, or word of art, whereby the thing is understood'.

[30] Cf. Ibid. 101: 'The second part of logick directeth a compounded conceit, which is done by precepts concerning a proposition. A proposition is a sentence wherein one thing is affirmed or denyed of another'.

[31] In giving this definition of discourse, Coke narrows it to syllogism and specifically to demonstration.

[32] Cf. Ibid. 129: 'The third part of logick is busied in directing the discourse. Discourse is an act of the minde of man, moving it self forward from a known thing to an unknown, by a fit collation of things former and latter. And it is either inferring or ordering'.

[33] Cf. Ibid. 130: 'Inferring discourse is an action of mans minde by certain premised propositions proving another proposition or improving by help of the precepts of a syllogism'.

[34] Cf. Ibid. 147: 'Induction is either principal or less principal. Principal is when form many singulars, or particulars, there is drawn a general conclusion'. Cf. Keckermann, *Systema logicum*, 255–256.

[35] Cf. Ibid. 147–148: 'An induction standing of particular propositions may bring all the particulars … when singulars are infinite, it is enough to alledge some chief with addition of this clause, *neither can an unlike example be shewen* … An induction may be made a syllogism of the first figure'.

[36] Cf. Ibid. 148: 'Less principal induction is when one or two singulars are induced, or when one is proved by another'.

The treatment of method clearly comes from Keckermann, showing still some pale traces of Ramism in its equation of order and method.[37] However, Coke, following Keckermann, recognizes two methods and not only one as the Ramists did. The method can be either compositive (synthetic) or resolutive (analytic). Compositive method proceeds from the universal to the particular, from the simple to the compound, while resolutive method proceeds from the effect to the cause.[38] However, Coke sustains that resolution is understandable only from its construction: that is, only if the mind knows how a thing is constructed can it resolve that thing into its correct parts. Thus every analytic process begins with the knowledge of thing to be analyzed, of the thing's construction.[39] This 'constructivist' perspective leads to the corollary accepted also by Locke, that we cannot know the essence or substance of natural things, because they are not generated by man. By means of resolution it is possible to know only some qualities of a thing, but not what it truly is. The knowledge of the thing, therefore, depends on the mind's capacity to resolve the object of knowledge into simple and elementary concepts, which usually coincide with what is apprehended by the senses. Coke therefore reaches the Aristotelian conclusion that logic does not deal with things in themselves, but with the elements that make possible the knowledge of things. Even if there is an isomorphism between things and *primae notiones*, from an epistemological standpoint it is impossible to know the essence of things, since they are not generated by the mind. Scientific knowledge concerns only mathematical and geometrical truths; in physical matter the mind can acquire scientific knowledge only if the observed effect or 'fact' can be reproduced from the causes. In this sense, British Aristotelianism could lead only to an empirical and experimental approach, using controlled experiments to determine the cause of given effects, causes which would have remained unknown by analysis alone.[40] Even if Coke's textbook cannot be considered as an original work, since it drew

[37] Cf. Ibid. 186: 'Let the proceeding on method imitate the natural proceeding and order of things; going on from things first and best known, to things after'. This translation of Keckermann is rather clumsy, in fact, Coke dismisses in the second sentence the expression 'by nature' (a natura) in characterizing what is 'first and best known'. This could give rise to the misleading conclusion that method and order proceed from what is best known by the mind, which is sensation, rather the cause and the universals. Cf. Keckermann, *Systema systematum*, 309.

[38] Cf. Ibid. 187: 'Method also is either compositive, synthetical or resolutive, analytical. Compositive method is wherein the parts of a contemplative discipline are so disposed as the progress is made from the universal subject of contemplation unto the particulars, and so form simples to compunds. Resolutive method is wherein the parts of an operative discipline are disposed so as that from the knowledge of the end, the progress is made to the knowledge of the beginnings or means, by which that end may be brought into its subject'.

[39] Cf. Ibid. 217: 'Analysis (or resolution) is a logicall exercise whereby the artifices are recognized, by which the handling of any matter hath been instituted … Every resolution is understood by the construction; for with what artifices any thing is constructed or framed, with them it is also resolved or unloosed. … Every analysis consisteth in two things. 1. In the knowledge of the thing or work to be resolved. 2. In the weighing the manner or artifice whereby the work is framed'.

[40] On the role of the 'fact' in early modern experimental philosophy in its various facets cf. Richard W. Serjeantson, 'Proof and Persuasion', in Park and Daston (eds.), *The Cambridge History of Science. Volume 3. Early Modern Science*, 157–172.

most of its materials from Keckermann's writings, and was an abridged translation of them, nonetheless his choices are very revealing as to what was interesting in the British Isles in the 1650s.

In 1657 the famous English jurist Richard Zouch (1590–1660) published a short treatise of 16 pages, entitled *Eruditionis ingenuae specimina*, which contained a brief summary of the main logical, dialectical and rhetorical doctrines. The part devoted to logic is grounded on scientific method, while that devoted to dialectics chiefly concerns the theory of syllogism. Zouch re-asserts the instrumental value of logic in dealing with general notions of things common to many disciplines.[41] From this definition follows the distinction of notions either as names that designates things or as instruments through which things are known. Notions which designate things directly are called *primae intentiones*, while those that characterize the conditions of possibility of knowing things are called *secundae intentiones*.[42]

But Zouch's original perspective is evident in his definition of causes as heuristic instruments for knowing things; he focuses on the efficient and material causes, showing that British Aristotelians were not interested in metaphysical questions, but only in natural investigations and science. Efficient causes are those which produce an effect, and can be either principles, with their own capacity to generate the effect, or instrumental if they generate the effect in conjunction with a principle. With respect to logic, efficient causes act on *secundae intentiones*.[43] By contrast, Zouch's treatment of method is unoriginal; he follows Aristotle in distinguishing analytic from synthetic method, arguing that scientific method proceeds from what is known to what is unknown.[44] Even in so short a work as the *Specimina*, the Aristotelian doctrines remain at the core of logic.

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[41] Cf. Richard Zouch, *Eruditionis ingenuae specimina, scil. artium logicae dialecticae et rhetoricae* (Oxford, 1657), 2: 'Logica est disciplina, quae ad instruendam rationem, ex generalibus rerum notionibus, speciales quasdam conficit, quibus aliae disciplinae instituuntur'.

[42] Cf. Ibid. 2–3: 'Notiones sunt voces, quibus res et rerum conditiones innotescunt; suntque vel primae, vel secundae intentionis. Voces primae intentionis sunt, quae res aliquas immediate significant; ut animal, homo. Voces secundae intentionis, seu voces artis sunt, quibus modi, et conditiones quaedam rerum intelliguntur; ut genus, species etc.'.

[43] Cf. Ibid. 8–9: 'Causae sunt notiones quibus ea, quae ad rerum constitutionem concurrunt, designantur, suntque quatuor, efficiens, materia, forma et finis. Efficiens est, cujus vi effectus producitur, estque vel principia is, quae praecipuam agendi vim habet, vel minus principalis, ut procatartica quae extrinsecus, et proegumena, quae intus excitat efficentem principalem ad agendum, et instrumentalis, quae causae principali in producendo rem ad effectum inservit. … Materia est, ex qua res fit, et circa quam operatio versatur. … Artium ingenuarum sunt notiones, sive voces secundae intentionis'.

[44] Cf. Ibid. 15–16: 'Methodus est partium disciplinae a medio ad finem dispositio, estque vel synthetica, vel analytica. Methodus synthetica, sive compositiva est qua disciplinae partes ita disponuntur, ut a subjecti principiis, sive causis, ad ea quae ex istis principiis profluunt, procedatur, hocque primum in genere, deinde in specie, donec ad species infimas deventum est. Methodus analytica, sive resolutiva est in qua a fine, subiecto proposito, proceditur ad media, sive causas per quas finis in subiectum introducitur. Methodo synthetica traduntur disciplinae speculativae, sive scientiae; methodo analytica traduntur prudentiae sive disciplinae practicae, et artes ingenuae sive operativae. … 1. Methodus procedit a prioribus et notioribus ad posteriora et minus nota. 2. Partes omnes methodi sunt homogeneae'.

British Aristotelianism continued to exert its influence in the 1660s. An important case is the English edition of the *Manuductio ad logicam* of the Jesuit logician Philippe Du Trieu, published in Oxford in 1662 and subsequently reprinted in 1678. In itself, Du Trieu's work, originally published in 1614, does not show any innovation in the field of logic. More interesting is its appendix, which Locke undoubtedly read, and which contributed to the dissemination of Aristotelian ideas among the empiricists.[45]

The appendix is a short treatise entitled *Logica apodictica* written expressly for the English edition of the textbook. There are no clues in the main text or preface to make us doubt that its author is Du Trieu himself: it follows immediately without any new frontmatter, although with a new pagination. However, Anthony à Wood attributes the authorship to Thomas Tully (1620–1676), an ascription confirmed by MS Worcester College 4.17.[46] This treatise proves the extent to which Zabarellan ideas, mediated by the British Aristotelians, were disseminated in the logic of the second half of the century. Furthermore, the appendix reveals the importance of scientific method for contemporary logic, assuming that Tully was urged to add his short treatise on method to Du Trieu's respectable textbook.

Tully explicitly follows Zabarella's doctrines, probably by the mediation of Flavell's textbook, which was reprinted during the same period. Tully, like Zabarella, assigns a crucial role to perfect syllogistic demonstration (*demonstratio potissima*) in the acquisition of scientific knowledge. He argues that if the premises are causes of the conclusions, and they are known by sensation, then scientific knowledge is impossible without a direct reference to sensation or experience. Sensation is the only mental operation which provides direct and firm cognition of a given material body at the beginning of the cognitive process, and thus makes possible, indirectly by analogy or contrast, reasoning on intelligible entities.

Sensation becomes with Tully the efficient cause of intellectual knowledge.[47] Thus, in the second half of the seventeenth century, the main instrument of logic was no longer syllogism but sensation and this conception was at the foundation of

[45] Cf. William J. Kenny, *John Locke and the Oxford Training in Logic and Metaphysics* (Saint Louis, 1959); John W. Yolton, 'Schoolmen, Logic and Philosophy', in Lucy S. Sutherland and Leslie G. Michell (eds.), *The History of the University of Oxford. The Eighteenth Century* (Oxford, 1986), 567–591; John R. Milton, 'Locke at Oxford', in John G.A. Rogers (ed.), *Locke's Philosophy. Content and Context* (Oxford, 1996), 29–48. Gaukroger has recently suggested that Locke developed his empiricism not from the Aristotelian tradition, but from experimental philosophy, cf. Stephen Gaukroger, *The Collapse of Mechanism and the Rise of Sensibility. Science and the Shaping of Modernity, 1680–1760* (Oxford, 2010), 150–186.

[46] Cf. Anthony à Wood, *Athenae Oxonienses: An Exact History of All the Writers and Bishops Who Have Had Their Education in the University of Oxford* (London, 1817), vol. 3, c. 1055–1059.

[47] Cf. Du Trieu, *Manuductio ad Logicam*, 5–6: 'Q.7. Si praemissae sint *causae* conclusionis, quid tribuendum est sensibus externis, cum dicitur, *deficiente sensu deficit scientia?* R. Sensum esse omnis scientiae intellectivae januam verissimum est, *Nihil enim est in intellectu, quod non prius fuit in sensu*; vel scilicet *directe, primario, et per se*, ut Entia Materialia; vel *indirecte et per aliud*, ut Entia materiae expertia (puta *Deus*, *Angeli*, et *Animae rationales*). Hinc damus sensus esse causam Scientiae intellectivae *sine qua non* (utpote a quo originaliter dependet) non vero causam proprie dictam, ut sunt praemissae. Quod si quis sensum causam instrumentalem remotissimam esse contenderit, non altercabimur'.

the empiricist philosophy which developed some years later. Sensation is the core of logical inquiry in its connection to the operations of the intellect.

10.2 Aristotelianism of the 1670s and 1680s

The lasting impact of British Aristotelianism is evident also in the works of the 1670s and 1680s. In 1671, John Newton published his *Introduction to the Art of Logick*, explicitly intended for those who wanted to learn logic but lacked Latin.[48]

The work, as the author himself declares, is based on the handbooks of Smith, Sanderson, Airay and Burgersdijk; although he refers to Zabarella, Newton's objective is to expound in English what his predecessors had taught in Latin.

Newton agrees with his forebears that logic is the art of directing the mind in the cognition of things.[49] Logic derives from the Greek λόγος, which means 'discourse'. Following Aristotle, Newton delineates two kinds of discourse: internal or external. The former, which is central to logic, is conceived by the mind; the latter expresses its conclusions in language to others.[50] Newton, although his explicit reference is Aristotle, is undoubtedly summarizing Hobbes' ideas.[51] For Newton, then, as for Hobbes, there is a distinction between 'thinking' and 'saying', between concepts and words, and both philosophers' logical systems tend towards conceptualism. Concepts are the foundations of words, and in this sense it is possible to define logic as an 'internal and mental art'.[52]

The chief tasks of logic are: (1) to define obscure things; (2) to divide universal and general things; (3) to reason on doubtful things.[53] The subject and matter of logic are all those things that are conceivable by mind and that are expressible by words, not as things in themselves, but rather as the way in which these things are considered, namely as logical instruments for the acquisition of knowledge.[54]

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[48] Cf. John Newton, *An Introduction to the Art of Logick* (London, 1671).

[49] Cf. Ibid. 1: 'Logick is an art which conducteth the mind in the knowledge of things'.

[50] Cf. Ibid. 1–2: '*Logick* hath its *name* from this word λόγος, which signifieth *speech*, and according to *Aristotle*, *speech* is twofold, *internal*, and *external*. *Internal speech* he calleth that which is conceived in the *mind*: and that he calleth *external*, which is expressed by *words*; now *Logick* hath its name from both these kinds of *speech*, but chiefly from the *internal*, which is the *reason* or *ratiocination* of the *mind*, whereas the *external speech* is but the interpreter of the *internal*'.

[51] Cf. Ch. 9. Hobbes focused on the mental internal discourse of the concept as the ground of the external discourse of the words, namely that doctrine according to which to 'note' was the primary and foundational aspect in contrast to 'signify' by means of words.

[52] Cf. Ibid. 2: '*Logick* is *art* not a manual art, or hand-craft trade but an *internal* and *mental art*; for the mind hath its artificial workings as well as the body, as is manifest even in *Poetry*'.

[53] Cf. Ibid. 3: 'The last and principal end of Logick is, the knowledge of things, and its chief offices by which this end may be attained are these three. 1. To define things that are obscure. 2. To divide things that are general and universal. 3. To reason concerning things dubious'.

[54] Cf. Ibid.: 'And the *matter* or *object* about which it treateth is *all that we can possibly either conceive in our minds or utter with words*; but the manner how this *matter* is to be considered, is not as things are in their own nature, but as the *instruments* of *logick* may be applied unto them'.

In particular, according to Newton, following Burgersdijk and others, logic can be considered as thematic or organic. Thematic logic deals with themes or *secundae notiones*, which are logical instruments. Organic logic deals with how these logical instruments are applied.[55]

The theme is everything which is presented as knowable to the mind; knowledge, according to Newton, is kind of conception or representation of the things, namely the formation of a notion in the mind. The notion is thus defined as a representation of the thing in the intellect.[56] Notions, following the renewed Aristotelian tradition, can be either first or second. A *prima notio* represents the thing as it is in itself, while a *secunda notio* represents how the mind conceives the thing or explains it to another.[57]

The 'theme' can be either simple or composite. A simple theme is apprehended by the first operation of the mind without any composition.[58] A composite theme, on the other hand, is a proposition.[59] As for Pace and Hobbes the proposition is a composite of two terms that asserts the truth or falsehood of a thing.[60]

The thematic part of logic ends with an analysis of notions and propositions, leaving to the organic part the treatment of instrumental logic, which for Newton, as for Burgersdijk, has four parts: (1) definition; (2) division; (3) syllogism; (4) method.[61]

Among these instruments, the most important role is played by induction, which is an imperfect syllogism, that is, a syllogism which is defective either in the number of premises, or in their arrangement.[62]

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[55] Cf. Ibid.: 'The parts of *logick* therefore are these two; *thematical* and *organical*. The *thematical* part is that, which treateth of *theams* with their various affections, and second notions, as of the *matter* of which *logical instruments* are composed. The *organical* part is that which treateth of those *instruments*, and their composition'.

[56] Cf. Ibid. 4: 'A theam is any thing propounded to the understanding that it may be known. 1. To know is to form a conception or notion of the thing proposed; and a notion is the representation of a thing in the understanding'.

[57] Cf. Ibid.: '2. Notions are of two sorts primary or secundary. A primary notion is that which represent the thing as it is in it self. A secundary notion is that which together with the first notions represents the manner how the mind doth either under stand a thing or explain its own understanding unto other'.

[58] Cf. Ibid.: 'Theams are either simple or compound. … Simple theams are such theams as are apprehended without any composition of notions; as a man, a house'.

[59] Cf. Ibid. 52: 'I come now to speak of *compounded theams* and *compounded theam* is by some called an *enuntiation* by others a *proposition*'.

[60] Cf. Ibid.: 'An enunciation, or a proposition is an indicative, congruous and perfect oration signifying true or false without any ambiguity'.

[61] Cf. Ibid. 85–86: 'Having done with the *first* part of logick … come we now to the *second* called the *organical*, or that which treateth of *logical instruments* and their composition. *Logical instruments* are these four, *definition*, *division*, *syllogism*, and *method*'.

[62] Cf. Ibid. 101: 'An imperfect syllogism is a syllogism that hath some defect, either, in the number of the premises, in the disposing them, or in the inference from them; and is fourfold: 1. Enthymem; 2. Induction; 3. Example; 4. Sortites'.

In the process of induction the mind infers universal conclusions from many particulars. Following Brerewood and Crakanthorpe, Newton states that there are four important features of induction. The first is that 'particulars' are not only individuals in the absolute sense, but also those things which are relatively less universal. The second concerns the epistemological value of induction. If the enumeration of particulars is not complete, according to Newton, the conclusion of the induction is not even probable, but completely false. The third is that induction is the most adequate instrument for discovery, in particular for the various arts, among which are logic and the scientific method. Finally, Newton states that induction can be reduced to a hypothetical syllogism.[63]

Scientific knowledge, however, is guaranteed only by demonstration. In the strictest sense, science is the assent to a proposition from a knowledge of effects by their causes.[64] This infallible scientific knowledge derives both from sensation, concerning the particulars, and from the intellect, concerning universals. Knowledge of universals is acquired with or without syllogistic reasoning. Knowledge without reasoning is what Aristotle calls intelligence, and comes not from demonstration, but from an immediate assent to a proposition for its intrinsic clarity and distinctness. Science, however, is always and only demonstrative, producing assent by an explanation of effects by means of causes. It is grounded always on reasoning and never on faith.[65]

Following the Aristotelian tradition, demonstration can be of two kinds, 'that something is' and 'what it is'. Only from the union of these two is scientific knowledge possible. The first proceeds from the effects, usually known by sensation, to the individuation of the remote cause.[66] The latter proceeds from the cause and explains the particular effects.

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[63] Cf. Ibid. 102: 'An induction is imperfect syllogism, in which from many singulars some universal conclusion is inferred; … In an induction, four things are to be observed. 1. By singulars we are not only to understand individuals, but less universals … 2. If the enumeration of all the singulars be not full, the conclusion will be false. 3. Induction is the most convenient instrument to find out arts. 4. An induction may be reduced to an hypothetical syllogism'.

[64] Cf. Ibid. 106: 'This word *science* may be taken three ways, *largly*, *strictly*, and *most strictly*. 1. *Largly*, for every *cognition* or *true assent*. 2. *Strictly*, for *firm* and *infallible assent*. 3. *Most strictly*, for the *assent* to such propositions, as are known by causes and effects'.

[65] Cf. Ibid. 106–107: 'For *firm* and *infallible cognition* is either by *sense*, and so we know that the *sun doth shine at noon*, or by *understanding*, as when the question is concerning *universal propositions*, concerning the truth of which *sense* is not able to judge; but, the *cognition* of *universal propositions* is attained by or without a *syllogism*. *Cognition* is begotten without a *syllogism*, when full assent is given to proposition for the clearness of it in its self without any proof. Thus we know that the *whole* is *greater* than any part thereof, that *God must be worshipped*, and such like. This kind of *cognition*, *Aristotle* calls *intelligence*, and saith it is distinguished from *science* by this, that *science* doth proceed from *ratiocination*: but for as much as *reason* may be brought from several heads, that *cognition* is here called by the name of *science*, which is begot either by the *cause* or by the *effect*. And this is the most strict acception of science, and proper to this place. Or thus, science *is a certain knowledge of conclusions, to which we assent for our preceding knowledg of the premisses*'.

[66] Cf. Ibid. 119–121.

Newton deals with correct demonstration in his section on method, which is the last logical instrument. He does not distinguish order from method because, like the Ramists and unlike the Aristotelians, he does not include the inventive part of method in science. In fact, he characterizes method as the arrangement of things in such a way that they are more easily understood and memorized.[67] Therefore, unlike the Ramists, Newton insists that arrangement depends not on the order of nature, but on the order of the mind. If scientific method does not include an account of discovery of new things, but deals only with the arrangement of things (which is not however according to nature, but according to the mind), then those things must be presupposed or at least more easily knowable than the others to be subject of the method itself.[68] In this respect he supports a Zabarellan position, as he admits himself. The various controversies on method, in his view, have arisen from a disagreement on what must be considered 'first'—those which are most fundamental in nature, or those which are most easily knowable. On this he is definitely Zabarellan, arguing that what is 'most knowable by us' is in a broad sense what is first by nature, and that even if there is a discrepancy between them, Zabarella is correct that the mind must deal primarily with the problem of knowledge.[69] Furthermore, like Zabarella, Newton distinguishes synthetic from analytic method: the former proceeds from first principles to particulars, while the latter proceeds from the effects to what is first by nature.[70]

Newton's logic is very different from that of Coke, which, following Keckermann, seems to be already tending towards a facultative logic similar to that later elaborated by Locke. Newton's work is a summary of the British Aristotelian positions of the first half of the seventeenth century and shows how deeply Zabarella's ideas had become rooted in British logic.

Newton's Latin counterpart is Obadiah Walker's *Artis rationis libri* published in 1673.[71] Walker classifies his Aristotelian position as nominalist, in the wake of the long tradition of Oxford nominalism. However, his work does not represent the

[67] Cf. Ibid. 170: 'Method is the disposing of things belonging to the same matter or subject, so, as that they may be best understood, and easiest remembered'.

[68] Cf. Ibid.: 'That the limitations of this definition may be observed; such things must be premised which do conduce to the knowledge of those that follow; or those things at least must be spoken of first, which are more easie to be understood than the rest'.

[69] Cf. Ibid. 170–171: 'Some controversie there is here amongst writers, whether in the writing of any subject, it be fit to speak of those things first, which are first in nature; or those things with which we are best acquainted. And I think that for the most part, we are best acquainted with that which is first in nature; but if at any time it happens otherwise, then I concur with *Zabarel.*, that those things are to be spoken of first, which come first under our cognizance, and not those that are first in their own nature'.

[70] Cf. Ibid. 172: 'A synthetical or compositive method is that which begins with the first and most simple principles, and so proceeds to those which do arise from or are composed of these first principles … An analytical or resolutive method is that which begins with the end and so proceeds still lower and lower till we come to the first and most simple beginnings'.

[71] Cf. Obadiah Walker, *Artis rationis, maxima ex parte ad mentem nominalium, libri tres* (Oxford, 1673).

nominalist doctrines of the fourteenth century, but explores philosophically the nature of concepts and the operations of the understanding.

Logic is for Walker an intellectual habit that directs the mind in argumentation and discourse.[72] Two aspects of discourse must be considered: the first concerns what is known, that is, the principles by which the mind acquires new knowledge; the second is the *modus deducendi* or the rules of inference from the known to the unknown. Logic deals principally with this second aspect that concerns definition, division and argumentation.[73] Intellect is the faculty that supersedes and executes these operations; it is directed by logic to reason correctly according to specific rules. These rules do not concern the subject itself, but only the mind—they are not natural principles, but heuristic, inferential and explicative.[74]

According to Walker, every argument is comprised of syllogisms, which in turn comprise propositions and simple terms. Terms, propositions and syllogisms are the matter on which the three mental operations—apprehension, enunciation and discourse—act.[75]

The basic element of logic is the term, which is a sign of the concept.[76] Thus, concepts always precede terms and, from a logical point of view, are the modes of representation and signification of things.[77] Therefore we can say that concepts are prior to terms and signify things. This does not mean, as it does for Kant, for instance, that concepts are in the mind before any experience of the object. Rather, it means that the first experience of a thing generates in the mind a corresponding concept or idea, which has no prior determinate meaning.[78]

Walker explains this process of formation in a very Aristotelian way as a kind of reflection. The concept is generated in the mind when the latter receives it by means

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[72] Cf. Ibid. 1: 'Ars dicitur *habitus intellectus recta cum ratione effectivus. Logica* vero ars argumentandi sive discurrendi: et acquiritur … *praeceptis* et *exercitatione*'.

[73] Cf. Ibid.: 'In *discursu* duo considerantur. 1. *Nota*, sive principia, unde deducitur cognitio ignoti. 2. *Modus deducendi* sive inferendi ignotum ex notis. … modum vero inferendi docet *logica*: quae proinde principaliter non definit, dividit, aut argumentatur, sed regulas tradit definiendi, dividendi et argumentandi'.

[74] Cf. Ibid. 2: '*Facultas ratiocinandi* est *intellectus*; et ex se quidem arguit et discurrit naturaliter, absque auxilio cujusvis artis … sed non accurate, nec in omnibus materiis, nec confidenter: imo quotidie experimur naturaliter tantum arguentes plurimis erroribus, fallaciis et verisimilitudinibus implicari et decipi; et proinde necessarium esse, eum, qui velit perfecte et accurate discurrere a *logica* dirigi. … Factae autem sunt *regulae logicae* ab intellectu proprias operationes, quae recte et quae secus fiant, considerante'.

[75] Cf. Ibid.: 'Omnis argumentatio fit per syllogismos: syllogismi vero constant ex propositionibus et propositiones ex vocibus semplicibus sive terminis. Quare secundum tres operationes intellectus: 1. Conceptionem, sive apprehensionem; 2. Enunciationem eorum quae concepit; 3. Discursum'.

[76] Cf. Ibid. 3: 'Est autem vox signum constans ex literis vel sillabis, per quod devenimus in cognitionem conceptuum, qui sunt in anima'.

[77] Cf. Ibid.: '*Logicus* vero significationem solam, et modum repraesentandi conceptus; et per eos, res ipsas'.

[78] Cf. Ibid. 3–4: 'Formantur scilicet in intellectu *conceptus*, intentiones, similitudines, notiones, sive ideae rerum extra animam'.

of the senses. If the concept conforms to the object, then it is true. True concepts acquired by the senses always represent the things themselves as images. If the concept does not conform to the object, then it is false and its knowledge is deceptive. Terms derive primarily from those concepts which serve to express and explain what the mind conceives. Mental concepts can therefore generate propositions, first in the mind and then communicated by language.[79] Furthermore, Walker distinguishes concepts following the classical Aristotelian distinction between *primae* and *secundae intentiones*, but without making a programmatic use of this distinction in his logic,[80] as his predecessors had done. Instead it seems to be supplanted by another distinction between things themselves as the objects of experience, and concepts. Concepts are then either mental signs of real things, or, from a logical standpoint, *modi repraesentandi* by which things can be explained or described.[81] Walker's Aristotelianism encompasses the conceptualist position, leaving ontology in the background to become only the starting point of experience, from which, however, the logician must abstract in order to elaborate an epistemological theory in describing how the mind knows things.

The third book of Walker's logic is devoted entirely to epistemology. He characterizes the cognitive act of the mind as twofold: apprehension and assent (or adherence).[82] Apprehension is the act (of the intellect or of sensation) by which the mind thinks simple and complex things without any judgment on their truth or falsehood. Apprehension is therefore the operation of the mind that generates concepts and ideas.[83] Assent, instead, is the act of the mind that judges and considers the truth of things by means of a proposition; this always presupposes apprehension.[84]

Knowledge is acquired by sensation and intellect. In particular, sensation provides the original knowledge and produces in the mind a simple idea of the object passively

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[79] Cf. Ibid. 4–5: 'Quarum scilicet *species* per *sensus* exteriores in intellectum intromittuntur; sive immediate a rebus ipsis per visum, v.g. vel alium quemvis sensum, vel ab aliorum informatione per voces, sive loquela et sono sive scriptis communicatas. Si *conceptus* quoquo modo productus fit objecto conformis, *verus* est, et cognitio objecti est vera; si objecto dissimilis est, conceptus *falsus* et *error*. *Voces* fiunt primo ex *conceptibus* (anima, quod intra se continet, aliis exprimere et explicare conante) … *conceptus vero per sensus* sunt in omnibus aeque capacibus et aequalem diligentiam adhibentibus iidem et naturaliter res ipsas repraesentant; eo modo, quo pictura vel imago archetypum. … E conceptibus in anima quoquo modo productis fiunt propositiones *mentales*; quibus correspondent *vocales*, et *scriptae*'.

[80] Cf. Ibid. 5–6.

[81] Cf. Ibid. 6: 'Cum, ut diximus, *voces conceptibus* correspondeant, per eas in rerum notitiam devenimus; et logici est *modum repraesentandi* sive significandi, ut exinde in rerum notitiam deveniatur, describere'.

[82] Cf. Ibid. 91: 'Et cognitionem duplicem esse notandum est, apprehensivam et adhaesivam'.

[83] Cf. Ibid.: 'Notitia *apprehensiva* est actus intellectus vel sensus, quo aliquid complexum vel incomplexum cogitamus absque judicio veri vel falsi, i.e. quo alicujus ideam sive conceptum habemus, non judicando, an sit verum vel falsum. Non est enim idem habere perfectam ideam alicujus objecti et credere illud esse verum'.

[84] Cf. Ibid. 91–92: 'Notitia *judicativa* sive adhaesiva est actus intellectus, quo assentit vel dissentit alicui propositioni, i.e. credit eam esse veram vel falsam. Praesupponit apprehensivam, sed nec statim eam sequitur'.

received by the senses, as if the idea were a mirror image in the mind—a summary of Hobbes' view. To the passive reception of the object is added the act of the intellect in generating the corresponding idea. The difference between what is received and what is generated, i.e., between the sensible object and the intellectual object, is that the former is always particular, corporeal and present, while the second is universal, incorporeal and not necessarily present to the senses. The greater one's experience of the object, the firmer his intellect's formation of the idea.

Experimental knowledge (or experience), in Harvey's wake, is therefore necessary for judging if a thing is true or false. Experience helps to clarify knowledge of doubtful and obscure things. The formation of the ideas must be subsequent to the experiential accumulation of observations.[85] The role of experience and sensation is therefore decisive for Walker in determining the genesis of ideas and so for the acquisition of universal knowledge in the mind.

Knowledge, as we have just said, presupposes sensation, and cannot be based on irrational or extra-experiential elements.[86] Intellectual apprehension is of two kinds, one which concerns what the intellect conceives in itself; its operation is a form of intuition. The other concerns its relation with objects, and this is a form of abstraction, finding the common properties of objects by a process of contrast and comparison. Such processes do not take place without experience, by which it is possible to determine which aspects are similar and dissimilar.[87] Walker seems to have learned

[85] Cf. Ibid. 92–93: 'Cognitio *apprehensiva* fit per sensum et per intellectum. *Sensatio* fit per receptionem similitudinis sive ideae objecti in sensorium, eo modo scilicet, quo recipitur species in speculum, et haec est passio. Sed praeter hanc est aliqua etiam actio ipsius facultatis in speciem receptam, cujus, sive sit alterius ideae fabricatio, vel facultatis ad objectum strictior quaedam unio, vel actio sui generis, nullique naturali operationi similis (quod verisimilius est), magnos certe effectus percipimus; eo quod species in memoria diu conservatas, et exinde habitus in anima formatos, motusque omnes externos et actiones inde ortos, cernimus. Sensatio omnis est singularium, praesentium et corporeorum; et horum aliqua (quae scilicet sunt alicujus sensus objecta propria) per unam ideam cognoscuntur, alia per plures. Nam etsi color per unum sensum, coloratum tamen … per plures sensus et plures ideas percipitur. Et quod per plures, melius i.e. certius; et plus ejus cognoscitur. Et haec est cognitio, quam experimentalem sive experientiam vocant; sine qua praevia in rebus maxime dubiis et obscuris judicium fieri non debet. Adaequata enim et perfecta notitia objecti non habetur nisi perceptis omnibus Ideis, per quas sensuum alicui repraesentatur … Sensus autem externi apprehendunt tantum objectum per ideas, ipsas vero ideas non considerant; sensus vero interni aliquo modo dijudicant. Primo enim diversorum sensuum objecta et ideas conferunt … 2. Ex frequenti repetitione et incursu ejusdem ideae in eundem sensum dijudicat idem esse objectum. … 3. Non assentiunt antequam omnes istius objecti ideas per quemvis sensum cognoscibiles spectarunt'.

[86] Cf. Ibid. 94: 'Cognitio *intellectus* apprehensiva supponit sensationem, sed non eam tantum, qua nituntur irrationalia, sed et aliam, qua ista vel omnino, vel maxima ex parte destituuntur'.

[87] Cf. Ibid. 95–96: 'Objecta autem intellectum, vel nude et prout repraesentantur a sensibus, accipit, et intuetur; eo modo, quo visus objectum suum; hoc modo non cognoscuntur nisi ea, quorum species in intellectum recipiuntur, et actus ipsius voluntatis, intellectus, vel affectuum; scio enim intuitive me intelligere, irasci etc; et ab hac cognitione procedit omnis cognitio experimentalis et intellectio singularium. Vel ex iis alios conceptus format, contemplando scilicet aliquod vel aliqua, non autem omnia, alicujus objecti; v.g. considerando unum objectum esse alteri aliquo modo simile, non considerato, in quo sunt dissimilia: inde abstrahit conceptum et ideam unam utrisque communem; vel unum objectum e diversis partibus essentialibus componi; inde alios conceptus format …

Bacon's lesson that experience must be examined by means of comparisons, that is, by assessing the presence and absence of specific aspects.

Assent proceeds from intellectual apprehension and determines whether ideas and concepts are true or false in relation to things. There are several levels of assent. One concerns propositions knowable *per se*; on this is grounded the various arguments from which true assent proceeds.[88] Specifically, there are three causes of assent. First there are the senses, whose repeated action generates experience and strengthens assent. Second, there are testimonies which are accepted as true by faith. Last, there are rationally demonstrated arguments to which the mind gives its maximum assent. However, from demonstrations can derive: (1) evident and firm conclusions that the mind considers true; (2) probable conclusions that the mind considers doubtful; (3) fallacious conclusions that the mind considers false.[89] What characterizes the assent of the mind are evidence and certainty, which are the foundations of all possible knowledge.

Demonstration is therefore defined as an argument grounded on an intellectual assent to evident and necessary principles, and deducing equally evident and necessary conclusions.[90] All demonstrations are based on these principles, which are axioms, postulates or the conclusions of other arguments. Walker, however, devotes little space to explaining how these principles are acquired, nor does he detail the various kinds of demonstrations. His primary interest is rather in the theory of epistemic knowledge, and the various degrees of probability to which the mind can give assent.

Verum quidem est hanc cognitionem in intuitiva altera fundari, et eam praesupponere, et exinde ideas recipere, quas comparando, abstrahendo, variisque modis contemplando multa alia reperit, quae illis ideis repraesentari, vel in iis nisi confuse contineri, non videbantur. Hinc ortum ducunt scientiae, artesque omnes, quibus per experientiam inveniendis et perficiendis multae aetates non sufficerent. Et hic est modus noster cognoscendi in hoc, quo sumus, status; alium vero speramus, in quo etiam ea, quae nunc non nisi laboriosa abstractione apprehendimus, clare et manifeste intuebimur. Abstractio autem, cum sit actio intellectus naturalis, supponit omnes homines eodem modo abstrahere, et per abstractionem cognoscere, nec opus esse ut abstractiones recte fieri probentur; abstractionem non esse negationem; abstracta, licet per intellectus operationem fiant, significari tamen per voces, quae in propositiones formantur etc. acsi res ipsas immediate significarent'.

[88] Cf. Ibid. 97–98.

[89] Cf. Ibid. 101: 'Probationes sive causae assentiendi sumuntur: 1. A sensibus, cujus repetitae actiones experientiam producunt et quo plures istiusmodi actiones, eo firmior est assensus: plurimis autem opus est et multa cautione, ut inde fiat universalis aliqua propositio; et sensibus, secundum regulas operandi naturales nos informantibus credatur. 2. A testimonio, assensus iste dicitur fides. … 3. A ratione et huiusmodi probatio est a. Evidens, quae producit scientiam per demonstrationem; b. Dubia, producens opinionem per syllogismum Topicum. c. Falsa, producens errorem per fallacias'.

[90] Cf. Ibid. 102: 'Notitia evidens est assensus verus sine formidine alicui propositioni a principiis intellectum necessitantibus causatus; adeo ut non sit possibile naturaliter eum non assentire, aut in assentiendo decipi. Causatur autem 1. A notitia intuitiva vel abstractiva terminorum; ut assensus principiis primis, qui ex sola apprehensione terminorum producitur. 2. A connexione vel illatione a principiis certis indemonstrabilibus. 3. A demonstratis propositionibus aliam conclusionem directe et logice, hoc est per *demonstrationem*, inferentibus. Est autem *demonstratio* argumentatio constans ex praemissis a ratione certis et necessario veris facientibus sciri conclusionem'.

Walker's treatment of scientific method is also of scarce interest; once he has explained the cognitive process and the provision of assent to what is known, little is added to define scientific method.[91]

Nonetheless, he does make a few interesting remarks on the subject. He states that scientific knowledge is given by the assent to the conclusions of a demonstration. Science, however, cannot involve assent to only a single proposition; only by a number of propositions can we generate an articulated knowledge of a given subject. These propositions, which constitute the conclusions of many demonstrations, must be universal and valid in every case. Knowledge formed in this way is fixed in the mind and generates the habit of science. Such a habit does not require systematic conclusions, only the aggregate of a sufficient number, and supported by experience. In fact, for Walker, following Aristotle, we need not demand that everything be demonstrated in an ordered manner, but mind can give its direct assent to some things if they are clear and evident.[92] He abandons the humanistic idea of the harmonious arrangement of knowledge as a criterion of truth and certainty, being interested more in the acquisition of knowledge than in its systematic organization.

Walker, therefore, more than his Aristotelian predecessors, emphasizes the importance of the theory of knowledge in scientific method, neglecting the intricate methodological issues that had animated the philosophical debate of the first half of the seventeenth century. In this further shift, in many ways foreshadowed by Coke, we can see an anticipation of the topics developed some years later by the empiricist Locke.

An interesting conceptualist perspective on logic is sustained by Richard Burthogge (1638–1705). His work *Organum vetus et novum, or a Discourse of Reason and Truth*, published in 1678,[93] explicitly refers to Aristotle and Bacon, even if there are few traces of the latter, and marks a decisive step toward Locke's facultative logic. The modern editor of his philosophical works, Margaret W. Landes, has given a bizarre picture of him as a precursor to Kant and a follower of the Cambridge Platonists, taking into account his early writings[94]; but Michael R. Ayers' careful recent assessment shows clearly his similarity to Locke and we can recognize his debts to the Aristotelian tradition.[95]

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[91] Cf. Ibid. 137: 'Binae sunt methodi argumentandi, prima a principiis ad conclusiones, estque ordinaria et dicitur synthetica; secunda a conclusionibus ad principia, diciturque analytica; fitque vel affermando et asserendo, vel negando et destruendo principia. Methodus analytica inservit magis inveniendae veritati, synthetica docendae; analytica quaestionibus dissolvendis, synthetica scientiae tractandae'.

[92] Cf. Ibid. 140.

[93] Cf. Richard Burthogge, *Organum vetus et novum or a Discourse of Reason and Truth* (London, 1678).

[94] Cf. *The Philosophical Writings of Richard Burthogge,* edited by Margaret W. Landes (Chicago-London, 1921), xi–xxiv.

[95] Cf. Micheal R. Ayers, 'Richard Burthogge and the Origins of Modern Conceptualism', in Tom Sorell and John G.A. Rogers (eds.), *Analytic Philosophy and History of Philosophy* (Oxford, 2005), 179–200.

In Ayers' words the *Organum* 'focuses on what it is to be 'reasonable', an inquiry leading into the sketch of a fairly comprehensive epistemology that leaves Platonism behind.'[96] In fact, Burthogge investigates the natural logic common to all mankind, frequently mixing logical considerations with theological reflections. Burthogge proceeds to show that reason, broadly speaking, coincides with the mind or the understanding and is characterized by three operations: (1) apprehension; (2) composition; (3) discourse. Strictly, reason is what issues from the third operation of the mind, namely the faculty of argument, inference and discourse. In an appropriate sense, Burthogge adds, reason is opposed to faith and revelation.[97]

Reason is the faculty for which the man is called reasonable and intelligent, or rather is said to *act* reasonably and with intelligence. Therefore reason serves primarily to define action. There are two acts of reason: apprehension and judgment. Apprehension is the act of perceiving a thing as it is in itself or as it is noted by the mind. Things can be noted either by simple terms or by propositions as they are signified by the mind. In fact, according to Burthogge, indirectly following Hobbes, apprehension, as the first operation of the mind, is what signifies things, and meaning is the proper, adequate, immediate object of the mind.[98] To signify means to conceive in the mind a notion which stands for an object, a word or an entire proposition. Knowledge of things is possible only by analogy to the knowledge of these notions formed in the mind in the act of signifying. This means that things are nothing to the mind but as they are known *by* the mind. Furthermore, Burthogge adds that things are known not as they are in themselves, but as they are in sense, imagination and reason, that is, in the faculties of the mind.[99] In this respect, according to Landes, Burthogge was a forerunner of Kant, but unlike the philosopher of Königsberg, the British author adds that things are in 'our *faculties* not in their *realities as* they be without them, no nor so much as *by picture* and proper representation, but only by certain *appearances* and phaenomena, which *their* impressions on the faculties do

[96] Ibid. 181.

[97] Cf. Ibid. 9–10: 'Reason *largely* taken, is the same with minde or understanding, and so is commonly affirmed to exert it self in three acts; the *apprehension* of *simple* terms, the *composition* of those terms by way of affirmation and negation, and *discourse*, or illation of one thing from another. Reason *strictly* taken, is the understanding as it issues out in its third act … But reason is *appropriately* taken, or most strictly, as it is opposed to *faith* and *revelation*'.

[98] Cf. Ibid. 11: 'Apprehension is that act of understanding whereby it is said to see or perceive things … Apprehension is conversant with *things* either as in themselves, or as they are *noted*; and they are noted etiher by simple *words*, or else by *propositions*, which are words joyned by way of affirmation or negation; *both* which the minde sees or apprehends *but* as it hath the *sense* of them. Sence or meaning is the *motive* and immediate *object* of apprehension'.

[99] Cf. Ibid. 12: 'to us men, *things* are nothing but as they stand in our *analogie*; that is, are nothing to us but as they are known by us; and they are not known by us but as they are in the sense, imagination, or mind, in a word, as the are *in our faculties*'. Cassirer and Nuchelmans suggest Arnold Geulincx's *Logica* (1662) as a possible source of Burthogge's work, cf. Cassirer, *Das Erkenntnisproblem in der Philosophie und Wissenschaft der neueren Zeit*, vol. 1, 543; Gabriel Nuchelmans, *Judgment and Proposition: From Descartes to Kant* (Amsterdam, 1983), 117–119.

either cause or occasion in them'.[100] Burthogge seems to suggest therefore that there would be no reality without the mind—an idealism closer to Berkeley than to Kant, who maintained the existence of a reality independent from the mind.

The objects of the understanding, as we have said, are notions, which are thoughts or properly *entia cogitationis*, and these are all appearances, which are not properly and formally in the things themselves conceived under them, and therefore conceived as if they had them, but only as they are in the mind and according to its cognitive faculties.[101] Therefore all *entia cogitationis* are either in the senses as colours or sounds, in the imagination as images or fictions, or in the reason as notions and concepts. And even if they seem to be in the things sensed, imagined and understood, they are nothing if not in mind.

According to Burthogge, these *entia cogitationis* are grounded on sentiments,[102] and in this sense they have no direct foundation or ground in reality, but only in the mind. However, sometimes we can say that these notions have their grounds in things that exist, and so we call them 'real', but not formally, but rather in the sense that they exist in the things inchoately and occasionally. However, they exist always and primarily in relation to the faculties of mind, not as things but objects of knowledge.[103]

In Burthogge's conceptualism these mental notions are what give meaning to things. The meaning of a thing is expressed by a word or a proposition, which serves to frame and articulate a notion of the mind. Therefore it is impossible to express a word or a proposition without a notion.[104]

To understand a proposition or a discourse it is not enough to know the meaning of the various words; one must also understand the relation between the words. The meaning of the proposition or discourse lies precisely in this relation.

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[100] Cf. Ibid.

[101] Cf. Ibid.: 'All immediate objects of humane cogitation (to use the word in its largest sence) are *entia cogitationis*, all *appearances*, which are not *properly* and (may I use a School-term) *formally* in things themselves conceived under them, and consequently conceiv'd as if they had them, but so onely in the cogitative faculties'.

[102] Cf. Ibid. 17–18: 'Notions of the Minde are *bottomed* on *Sentiments* of Sense; so that as Realities are Grounds to Sentiments, so Sentiments are Grounds to Notions … And Sentiments (again) impressing of the Fancy, and so the Minde and Understanding, beget or occasion it those higher Cogitations which we call Notions: apprehensions of Reason, or Ideas. Idols or Fantoms are in the Fancy, Ideas in the Minde'.

[103] Cf. Ibid. 14: 'But *such* as have foundation in realities, are called *real*, not that in their own nature they are in realities themselves, but that they have their grounds in those that are; they are real (as School-man would express) not formally, but fundamentally; they are inchoately and occasionally in the things; but not consummately and formally but in the faculties; not in the things, but as the things relate to our faculties; that is, not in the things as they are *things*, but as they are *objects*'.

[104] Cf. Ibid. 14–15: 'Those words or propositions any one hath a sence of, those things to which the words or propositions relate, he hath a notion of. Sence is notion; onely it is called *sence* as it relates to the words or propositions, and *notions* as it relates to the things; but *indeed* sence is notion, and to have the sence of a word or proposition, is to frame a notion of it, or of the things signified by it'.

In a very Aristotelian way, Burthogge states that objects nearer to the senses generate a clearer and more distinct sensation; the more sensible notions are, the more clear and distinct our knowledge of them is. The closest objects to the mind are those which are most effective on the sentiments and these Burthogge calls first notions. First notions are founded immediately on things, while second notions concern the first notions—they are thus notions of notions and less effective on the sentiments.[105] Burthogge therefore rephrases the traditional Aristotelian distinction between the various notions according to their effectiveness on the sentiments. Effectiveness is considered according to two factors, clearness and distinctness of the apprehension. Clearness presupposes an intellectual light or a light of reason, through which the intellect apprehends and understands its objects.[106] Distinctness, instead, concerns the formation of a notion and the conception of it in such a way that the mind can distinguish it from all other notions.[107] To achieve distinctness of apprehension the mind applies the act of distinction and the act of definition. The former concerns words, while the latter concerns things. To make a distinction means to determine how many meanings a word has, while definition means finding the proper description of a thing. To describe means primarily to mark, to notify, to represent a things by its attributes, that is, by means of the impressions that the thing itself makes on the mind. Therefore what the mind knows is not something that concerns the thing itself, but only the modifications produced by the attributes of the things. In this way, according to Burthogge, the mind never knows the essential definition of a thing, which is nonsense, for things are not explicable in themselves but only in relation to the cognitive power of the mind.[108] Burthogge is denying the possibility of knowing the substance of things—things are nothing other than an aggregate of their attributes that affect the mind.

In order to form a clear and distinct idea of an object, according to Burthogge, the mind requires: (1) a due illustration of the object; (2) a right disposition of the faculty; (3) a due distance from the object; (4) a due attention to it.

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[105] Cf. Ibid. 18: 'Hence knowledge and apprehension of things is better both acquired and conceived by *first notions*, which are next to sentiments, than *second* which are more remote: the knowledge which is had of things by first notions, is more real, evident, cleer, distinct, than that which is by the second. First notions are founded immediately on things; second notions are notions concerning notions. There are not so impressive and affective as the first'.

[106] Cf. Ibid. 19: '*Cleerness* of apprehension, which is in the minde the same that cleerness of seeing is in the eye, is opposed to obscurity and darkness, and presupposes *light*'.

[107] Cf. Ibid. 25: 'And to apprehend a thing distinctly, is to form such a notion and conception of it, and to have such a sence as doth distinguish it from all things else'.

[108] Cf. Ibid. 25–26: 'Distinctness of apprehension is acquir'd by distinction, and by definition. Distinction, as I take it, is of words; definition of things. To make a *distinction* is, when a word hath many significations, to determine, fix, or define the sence it is taken or us'd in, and by certain marks and tokens to distinguish it and circumscribe it from all the others (it hath). *Definitions* of things are properly descriptions. To descrive, is to notifie, mark, and represent a thing in and by its attributes, that is, according to the impressions that it makes upon our faculties, and conceptions it occasions in them. Essential definitions are non-sence. Things are not explicable, but as they are to us in our faculties'.

A due illustration of the object means a plain and suitable representation of it in the mind through a word (in language), according to a plain and instructive method. A right disposition of the faculty is a rectitude of the mind and consists in the exemption of all prejudices of education, custom, temperaments or false reasonings. A due distance from the object means considering it from not too near or too far. A due attention is necessary to frame a clear and distinct conception of it without inferring hasty conclusions.[109]

Once the mind has acquired clear and distinct ideas, it can elaborate judgment, which is a comparison or consideration of further ideas to which the intellect gives its assent or dissent. On the judgment are grounded all of the mind's reasonings.[110] Reasoning is the revealing or showing of reason, which produces the final assent or dissent to the judgment.[111] The method of reasoning to produce assent or dissent is what we mean by logic, which is artificial or natural. Artificial logic is for Burthogge that of the universities, and most importantly the logic of Aristotle; this it is useful for sharpening the wit and rendering the mind more sagacious in its reasonings. Natural logic, instead, is common to all men, according to which, given the same premises, all men will infer the same conclusions. Just as a person, by frequently seeing and attending to something, acquires a method of seeing and expecting it, so by frequent reasoning the mind acquires the method of using reason in the best way.[112]

Reasoning can be either speculative or practical, from which issue speculative and practical judgments respectively. Speculative judgments concern the truth or falsehood of a proposition, while practical judgments concern whether something is to be done or not. In particular, the judgments of logic are speculative, aiming to prove or disprove a statement about something. To prove a statement is to reveal its truth, which for Burthogge exists only in the mind; in this respect he is in agreement with other conceptualists like Hobbes and Coke.

In particular Burthogge recognizes two kinds of truth. Metaphysical truth is the conformity of things to their original ideas in the divine intellect. But this kind of truth does not concern logic. Instead, logical truth is the truth of things as standing in the human mind *in analogy with* the divine intellect, and which forms the grounds of assent. Burthogge criticizes all ancient and modern theories of truth, from Cicero to Descartes and Herbert of Cherbury.[113] He states that truth, as the

[109] Cf. Ibid. 27–29.

[110] Cf. Ibid. 29–30: 'Judgement is that act of the understanding whereby it having compared and considered things (presented to it, and apprehended by it) comes in the end and upshot, either to assent, or dissent. So that judgement is a compunded act, and (as it were) made up of two; one of which is mediate and inchoate, the other ultimate and compleat; the first is comparing and considering; the second, resolving and decreeing: that the premisses; this, the conclusion. The former properly is *reasoning*; the later, resolving according to reason'.

[111] Cf. Ibid. 30: 'Reasoning is producing or shewing of reason. Reason is the ground of intellectual judgement; or the cause why the understanding either assents, or dissents'.

[112] Cf. Ibid. 31.

[113] Cf. Ibid. 33–38.

ground of assent, is the objective harmony, 'congruity, even-lying, answerableness, consistence, proportion, and coherence of things each with other, in the frame and scheme of them in our mindes'.[114] On the other hand, falsehood, as the ground of dissent, is objective disharmony, 'incongruity, inequality, unanswerableness, inconsistence, disproportion, and incoherence of things, in the frame and scheme of them in our mindes'.[115] Therefore, Burthogge seems to suggest that truth is the agreement among the internal formal conditions of the mind in knowing things, while falsehood is the disagreement among these.

Having defined truth and falsehood, Burthogge aims to explain how we reason in reference to them, and the nature of reasoning in the acquisition of scientific knowledge.

The nature of reasoning is harmonic and systematic because, in a scheme and frame of notions founded on things, it shows the things to be proven, avoiding and confuting error.[116] The best way of reasoning correctly is to show the truth of something. The effect of reasoning is primarily assent, which is the judgment of the mind on the evidence of truth, namely that the thing is true. The evidence of truth can be either certain or probable. In the first case the mind gives its full assent, while in the second the assent is only partial. If the evidence of truth is certain, firm and of immutable nature, the mind acquires science; when the assent is weaker the mind acquires only opinion.[117] All other kinds of assent or dissent lead not to any feasible knowledge, but only to illusions and appearances.

However, to emphasize his empiricist and conceptualistic standpoint, Burthogge states that the mind can give reasonable assent only to the evidence of senses, which is nonetheless circumstanced and conditioned.[118] However, the evidence of the senses can be firm knowledge, while the assent to anything else is only belief. Therefore, Burthogge ultimately defends the thesis that only sensible knowledge pertains to the human mind, even if not all knowledge comes from sensation. In fact, firm knowledge is based on the assent of the intellect's judgment, which rests on mental notions, relations, schemata and constructions. Firm knowledge issues therefore from the combined work of sensation, which provides the matter of knowledge, and of the intellect, which provides truth and assent.

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[114] Ibid. 41.

[115] Ibid.

[116] Cf. Ibid. 44: 'And natural speculative reasoning is systematical, and harmonical; it is a shewing, and evincing the truth or falsity of a thing, by conferring and comparing thing with thing; it is a shewing of a notion to be true or not true, by representing of it in a frame, a scheme of real notions, with all its relations in it; and so by comparing, evidencing how it squares, agrees, and harmonizes, or otherwise'.

[117] Cf. Ibid. 47: 'Firm assent in matters in themselves *mutable* and of contingent nature, may be called *confidence*; but in matters of a necessary, firm, and immutable nature, it is *science*. Infirm assent, or assent with dubitation, is called *opinion*'.

[118] Cf. Ibid.: 'Assent on evidence by the testimony of our own senses rightly circumstanced and conditioned, is as firm can be, and is called knowledge. Assent to a thing upon anothers knowledge and not our own, is called belief'.

Burthogge's logical framework is reiterated in his late *Essay upon Reason*,[119] published in 1694, which recalls many passages of his earlier work. In this book, however, Burthogge explicitly reveals his debt to Hobbes and to the Aristotelian tradition in his theory of mental notions as *modi concipiendi*, and in his doctrine of reasoning and truth.

A more conservative Aristotelianism is propounded by Narcissus Marsh in his 1679 *Institutio logicae*. Marsh comments directly on the Greek text of Aristotle in Pace's edition, although we also find implicit references to authors such as Digby and Sanderson.

Marsh defines logic, or dialectic, as an instrumental art that directs the mind in cognition. Logic is thus divided, as usual, according to the three operations of the mind, apprehension, judgment and discourse, which have as their respective objects simple terms, propositions, and arguments.[120] Unlike the other Aristotelians, however, Marsh defines the simple term not as what is merely apprehended, but as what is obtained from an analysis of the proposition; this view gives his logic a linguistic perspective that recalls some ideas of the Oxford nominalism of the fourteenth century.[121] In Marsh's textbooks we can find important traces of the theories of connotative terms, *suppositio*, *ampliatio*, *restrictio* and *appellatio*. Therefore Marsh's position is linguistic and nominalist rather than conceptualist. This is proven by the fact that terms have a value only within propositions, and specifically within *oratio*. In fact, the name is defined as a constituent part of a phrase, along with the verb. The name signifies by convention. In this context, to signify by convention means the free imposition of a name upon a thing to which it does not naturally pertain.[122] The phrase, meanwhile, is defined as a signifying linguistic unit, whose parts individually have meaning as words, but not as propositions.[123] Herein lies its difference from the proposition, which is a species of phrase or sentence which affirms or denies, that is, signifies the truth and falsehood.[124] Marsh, from this idea of the proposition, sustains a correspondence theory of truth according to which the true is that which conforms to reality, while the false is what does not conform to reality.

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[119] Cf. Richard Burthogge, *An Essay upon Reason, and the Nature of Spirits* (London, 1694).

[120] Cf. Marsh, *Institutio logicae*, 1: 'Logica (seu dialectica) est ars instrumentalis, dirigens mentem nostram in rerum cognitione. Unde pro triplici mentis operatione, (scilicet. apprehensione simplici, judicio et discursu) tres sunt partes logicae: 1. De termino simplici; 2. De enunciatione; 3. De argumentatione'.

[121] Cf. Ibid.: 'Terminus est, in quem resolvitur propositio, ut praedicatum et id de quo praedicatur. *Itaque in omni propositione sunt duo termini*, scilicet subjectum et praedicatum'.

[122] Cf. Ibid. 62: 'Nomen est vox significativa ex instituto sine tempore, cujus nulla pars significat separata … *Est significare ex impositione libera et non naturaliter*'.

[123] Cf. Ibid. 65–66: 'Oratio est vox significativa ex instituto, cujus aliqua pars separata significat ut dictio, sed non ut affirmatio vel negatio … Quid est significare ut dictio? R. est significare sine vero et falso'.

[124] Cf. Ibid. 67: 'Enunciatio est oratio quae verum vel falsum significat; … *Verum significat*, quae est conformis rei significatae, sive quae dicit id esse, quod est, et non esse, quod non est … *Falsum*, quae est difformis rei significatae, sive, quae dicit id esse, quod non est, vel non esse, quod est'.

The proposition is the basis of every argument, and specifically of every syllogism, which is defined as an inference composed of two premises and a conclusion.[125] Another form of argumentation is induction, and Marsh's treatment is based on that of Sanderson.[126] Induction always proceeds from what is inferior to what is superior, from the species to the genus, from the parts to the whole. But, Marsh adds, the specific task of induction is to discover the first and universal principles of science, whose validity is grounded on the knowledge of the particulars and whose confutation is possible by means of the examination of counter-examples.[127]

Induction of the first principles serves demonstration, which is the kind of syllogism that leads to scientific knowledge.[128] Science is a certain knowledge of causes and differs from opinion by the certainty of its conclusions.[129] Marsh then distinguishes demonstration τοῦ ὅτι, demonstration τοῦ διότι and demonstration *potissima*.[130] For Marsh, unlike Zabarella, demonstration *potissima* does not coincide with τοῦ διότι. Like Zabarella, however, Marsh focuses on the processes of analysis, regressus and conversion of the conclusions into definitions. Analysis is the resolution of an effect into its first causes, in particular its efficient and final causes. Such analysis can be carried out on two levels: in search of a thing's definition, or of the means to achieve the end. In the first case, according to Marsh, it is not to find that the cause for all living beings to grow up and feed themselves is the vegetative soul but rather the first cause is the universal and ultimate cause, which is the soul in general, which is the real cause of the vegetative soul itself.[131] Likewise, when we look for the cause

[125] Cf. Ibid. 127: 'Syllogismus est oratio, in qua quibusdam positis, aliud quiddam ab iis, quae posita sunt, necessario accidit, eo quod haec sunt, i.e. in qua ex duabus enunciationibus rite dispositis et concessis, altera eo ipso necessario inferat, propter legitimam earum dispositionem'.

[126] Cf. Ibid. 200–201: 'Inductio est a singularibus ad universalia progressio, i.e. argumentatio, in qua universale distributum aut totum infertur ex omnibus minus communibus aut partibus. Quae vel expresse numerantur, et dicitur *inductio explicata*; vel numeratis aliquibus reliquae adjecta clausula, *et sic de caeteris*, vel alia consimili significantur, et *implicita* vocatur'.

[127] Cf. Ibid. 202: '*Inductionis* praecipuus usus est ad probandum *prima et universalissima scientiarum principia*, quorum non dantur causae seu priora et notiora, per quae possint demonstrari; adeoque cum veritas eorum in singularium veritate fundetur, quam adductis in medium singularibus, melius probari non possunt. Et evertitur *inductio* cum datur … *instantia* in contrarium, seu *exceptio*'.

[128] Cf. Ibid. 205: 'Demonstratio est syllogismus scientiam pariens. Scientia vero est duplex, *quod sit* et *quid sit*. Scientia *quod sit* est quaevis certa et evidens rei cognitio, non per causam proximam comparata. Scientia *quid sit* est cognitio rei per causam proximam; *quae sola est proprie dicta scientia et ab Arist: sic definitur*'.

[129] Cf. Ibid. 205–206: 'Scire putamus unamquamque rem simpliciter, cum putamus causam cognoscere, propter quam res est, quod illius rei causa est, nec posse rem aliter se habere. Hinc oritur duplex scientiae certitudo, altera objecti seu scibilis, quando res per proximam causam cognoscitur; altera subjecti seu scientis, quando sciens certus est rem non posse aliter se habere, quia scit se per causam proximam illam cognoscere. Per illam scientia distinguitur ab errore; per hanc etiam ab opinione, quae includit formidinem oppositi'.

[130] Cf. Ibid. 217–218.

[131] Cf. Ibid. 221–222: '*Analysis* est resolutio effectus in causas suas primas (*efficientes* aut *finales*) ad pariendum perfectam ejus scientiam. Cum enim fit quaedam series et subordinatio *causarum* et

of an effect, we must not stop at the proximate cause, but consider all the causes up to the absolute first cause.[132]

Regressus, by contrast, is the mutual demonstration of the effect and the cause. It is grounded on the progress from a confused knowledge of the effect's cause, which is the knowledge of the cause's existence without any determination of its nature. Such progress is mainly based on sensation. Once the existence of the cause has been established, the mind determines through a regressive process if that cause is in fact the true cause of the effect and if it provides a distinct and specific knowledge of it.[133] The first (progressive) part of the *regressus* is characterized by the demonstration τοῦ ὅτι, while the second (regressive) part of the *regressus* is characterized by demonstration τοῦ διότι. *Regressus* coincides for Marsh with the demonstration *potissima.*[134] Like many other British Aristotelians, Marsh is concerned to explain why *regressus* is not a circular process: at the beginning the knowledge is confused and indistinct, while at the end it is clear and distinct.[135] Moreover, Marsh states that *regressus* is mainly used for physical investigations, which proceed from sensible knowledge of the effects to the scientific knowledge of the effects by means of the causes.[136]

Marsh examines scientific method in the *Appendicula de usu logicae* at the end of his textbook. The proper use of logic lies in method, that is, the arrangement of things in such way that they are easily known and remembered.[137] In his treatment of method Marsh follows Zabarella and Pace, but most of all Sanderson. There are two main rules of method. The first establishes that the progress of knowledge must proceed from what is 'most knowable by us' to what is 'most

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effectuum; si posterior effectus per priorem, tanquam per causam, demonstretur, mens in eo non acquiescet; sed causam ejus inquiret atque ulterius hujus causam et sic inceps, donec tandem ad primam … perveniatur; in qua sola, quia non datur prior, mens tandem quietatur'.

[132] Cf. Ibid. 222: 'Consimili modo fit *analysis* in causis *finalibus* et *mediis*, donec ad ultimum finem in quo solo sistendum est perveniatur … in qua mens quietatur et sistitur *analysis*'.

[133] Cf. Ibid. 222–223: '*Regressus* est reciproca demonstratio effectus per causam, quae per ipsum prius demonstrabatur. Nam postquam *progrediendo* per effectum *confuse* cognitum demonstravimus de causa: *Quod sit*; intellectus de ea varie discurrens (*ex sensu, simili, contrario, concomitante,* etc.) tandem *perfectam* ejus cognitionem acquirit … qua cognitione habita, iterum *regredimur* per eandem causam, jam *distincte* cognitam, ad demonstrandum de effectu*, propter quid sit*, quod fit *convertendo* majorem, ac minorem et conclusionem *transponendo*'.

[134] Cf. Ibid. 223: 'Itaque *progressus* fit per demonstrationem τοῦ ὅτι, quae confusam cognitionem *causae per effectum* parit. *Regressus* vero per demonstrationem τοῦ διότι, quae distinctam cognitionem *effectus per causam* producit'.

[135] Cf. Ibid. 223–224: 'In quo *regressus* differt à *circulo*, cujus utraque demonstratio reciproca debet esse *propter quid*; qui, ut *impossibilis*, merito rejicitur ab *Arist*. … Nam hoc posito, idem esset *prius* et *posterius*, *notius* et *ignotius* eodem, respectu ejusdem; imo seipso. Esset enim *causa suae causae* et tamen *effectus sui effecti*; quia utraque demonstratio esset *a priori*'.

[136] Cf. Ibid. 224: '*Regressus* maximum habet usum in *physica*, in qua ex *sensibilibus effectis* eruimus aliqualem cognitionem *causae* ignotae: unde iterum *regredimur* ad distinctam et scientificam *effectus* cognitionem'.

[137] Cf. Ibid. 258: 'Usus logicae consistit in methodo ordinanda. Methodus (seu ordo) est apta dispositio rerum eodem pertinentium, ut facilius intelligantur et memoriae mandentur'.

knowable by nature'. The second establishes that individual items of knowledge must not contradict each other.[138]

Marsh divides scientific method into the method of research or invention and the method of teaching. The former follows an ascending process, the latter a descending process.[139]

Marsh's method of invention draws on Sanderson's empiricist method. The means by which we acquire scientific knowledge are the usual four: sensation, 'experiment' (a term which Sanderson never uses explicitly), experience, and induction.[140] It is clear, then, that by 1680 Aristotelianism, and one with a Paduan slant, offered the predominant theory of knowledge and scientific method in the British Isles. Sanderson was undoubtedly the chief point of reference for this approach. Marsh's distinction between 'experiment' and 'experience' must not be given too much significance; in fact, as for Sanderson and Flavell, 'experiment' means a singular sense experience or 'fact' which, collected together with others, constitutes a more general experience, from which, by means of induction, it is possible to infer universal conclusions. Only from these universal conclusions is a scientific knowledge possible. In this sense the approach of experiential empiricism does not vary much from that of experimental empiricism, as both positions rely on facts to find general conclusions, but the former demands a better systematization supporting induction with a deductive reasoning, which, however, plays no part in finding new knowledge, but only in its arrangement.

This is the reason why Marsh still emphasizes the role of teaching and the system of knowledge. When discussing the method of teaching, Marsh draws on Digby's example—even if the road from Thebes to Athens is the same as the road from Athens to Thebes, it is not the same to walk in each direction. The main method is to follow nature, which proceeds from what is *a priori*, the causes and the universals, to what is posterior, that is the effects and what is less universal.[141] The order of nature, however, has two aspects: one concerns generation and is dealt

[138] Cf. Ibid.: 'Regulae ejus sunt duae. A facilioribus ad difficiliora fiat progressus … singulae partes inter se consentiant'.

[139] Cf. Ibid. 258–259: 'Methodus alia est inventionis alia doctrinae. Diversa etenim via ad *disciplinas indagandas*, et ad indagatas *docendas* incedimus. Prior inventio; doctrina nobilior; utraque a *notioribus* nobis ad *ignotiora* procedit: sed alio atque alio modo, nempe *ascendendo* illa; haec *descendendo*'.

[140] Cf. Ibid. 259: 'Methodus inventionis est, in qua servatur ordo inveniendis disciplinis aptissimus; seu, quae a singularibus et sensibilibus (quae sunt notiora nobis simpliciter) ad universalia et intelligibilia (tanquam minus nota) ascendit. Ejus 4 sunt *media*, velut gradus, per quos ascendimus. 1. Sensus, cujus adminiculo aliquam rei singularis notitiam haurimus. 2. Experimentum quod est observatio (seu historia) qua colligimus, et mente collocamus, quae sensu aliquoties hausimus. 3. Experientia, qua collecta plura *experimenta*, seu observationes ad certum usum applicamus. 4. Inductio, qua collectas plures *experientias* ad universalem conclusionem constituendam adhibemus. Hac methodo usi sunt veteres in omnibus disciplinis *inveniendis*'.

[141] Cf. Ibid. 259–260: 'Methodus doctrinae est, in qua servatur ordo tradendis *disciplinis* aptissimus. … Methodus conspicitur: in illa rebus texendis; in hac retexendis (nam in eadem resolvitur unumquodque, ex quibus componitur) sicut eadem via itur *Thebis Athenas*, et *Athenis Thebas*. … Methodus naturalis est, in qua servatur ordo *naturae*. … *A prioribus ad posteriora natura*, sive, *ab universalioribus ad minus universalia fiat descensus*'.

with by synthetic method, while the other concerns the comprehension and is dealt with by analytic method.[142] Nonetheless, from his extensive treatment of the order and arrangement of knowledge, it is evident that Marsh's chief interest is the method of discovery grounded on sensation and induction, although this acquires a scientific status only with the regressive process. Far from being a mere survival of Renaissance Aristotelianism, *regressus* arrives at the turn of the eighteenth century as a logical process capable of ensuring scientific knowledge acquired through experience and induction.

In contrast with the empiricism of the British Aristotelians is the *Summa logicae* of the archbishop Richard Sterne (1595/1596–1683), published posthumously in 1685.[143] The work is mainly devoted to a theory of syllogistic argumentation. Logic is still defined as dialectic or the art of arguing correctly and it is divided in two parts, invention (or topics) and arrangement.[144] His treatment of the methodological issues, especially concerning induction, is puerile and rudimentary and reveals a scanty knowledge of the relevant arguments.[145]

John Wallis' 1687 *Institutio logicae*, the last important logical textbook published before Locke's *Essay*, is not much better, despite Wallis' standing as one of the most important mathematicians and scientists of his time. Wallis' logic, although more articulate and complex than that of Sterne, is similarly focused on syllogistic theory, and all logical instruments are reduced to syllogism.

Logic is the art of reasoning, that is, it directs the mind in argumentation and in discourse.[146] For Wallis, words are names of things and signs of concepts,[147] which are conceived by the first operation of the mind, namely apprehension.[148]

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[142] Cf. Ibid. 261–262: 'Cum vero ordo *naturae* duplex sit; alius naturae *generantis*; alius *intendentis* (quoad ordinem naturae *generantis* priora sunt, quae prius fiunt; ut, *partes toto*, *causa effectu*, *media fine*, quia haec ex illis fiunt: at ordine naturae *intendentis* ea contra, sunt priora, quae prius intenduntur; ut, *totum partibus*, *effectus causa*, *finis mediis*). Methodus *naturalis totalis* quoque duplex est, synthetica et analytica. Methodus synthetica est, in qua servatur ordo naturae *generantis*, sive quae a principiis simplicibus ad ea progreditur, quae ex illis sunt composita. … Methodus analytica est, in qua servatur ordo naturae *intendentis*, seu, quae facto initio a fine ad media proxima, et ab his ad alia remotiora, procedit; donec tandem ad prima et semplicissima perventum sit'.

[143] Cf. Richard Sterne, *Summa logicae* (London, 1685).

[144] Cf. Ibid. 1: 'Logica (quae eadem et dialectica) est ars bene disserendi; id est, ratione utendi. Logicae partes duae sunt: inventio et dispositio'.

[145] Cf. Ibid. 229, 267: 'Inductio est argumentatio ab omnibus partibus ad totum. Estque vel a membris ad integrum, vel a speciebus ad genus. … Methodus est variarum propositionum homogenearum, (id est, ad unum aliquem scopum pertinentium) juxta naturae ordinem dispositio'.

[146] Cf. Wallis, *Institutio logicae*, 1: 'Logica est *ars* (sive peritia) *ratiocinandi*, (seu commode utendi ratione). Mentem (seu intellectum) dirigit, in debito commodoque usu rationis; quod *ratiocinium* dicitur sive *discursus*. … *Discursus* autem vel *mentalis* est et *mente* peragitur … quo res mente concipimus, invicem comparamus, aliasque ex aliis colligimus. Vel *vocalis* … quo mentis cogitata et ratiocinia *voce* proferimus et explicamus'.

[147] Cf. Ibid. 1–2: 'Voces seu verba … sunt rerum nomina, signaque (seu indicia) cogitatuum, sive conceptuum mentis; quibus cogitata nostra alii aliis indicamus'.

[148] Cf. Ibid. 71: 'Cum mente concipimus *notionem* sive *conceptum* aliquem qualem *vocibus simplicibus* solemus indicare; ut sunt *equus, homo, animal*, etc. hanc vocamus *semplicem apprehensionem*, dicique solet *prima operatio intellectus*'.

The combination of several concepts generates a sentence, which is the result of the second operation of the mind. The combination and division of two concepts produce affirmations and negations, which are mental explanations, and are true or false by virtue of how things are in reality.[149] The third operation of the mind is discourse, which concerns argumentation and method more generally. Wallis characterizes argumentation as that mental operation by which several propositions are connected to infer a necessary conclusion.[150] The most important form of argumentation is syllogism, to which both induction and demonstration can be reduced.

The interesting aspect of Wallis' treatment of induction is his attempt to derive all forms of it from syllogistic form.[151] If the enumeration of the cases in an induction is complete, the syllogism is perfect, albeit expressed in a contracted form. The conclusion is not a real universal, but a collective universal, that is a singular concept which encompasses all the particulars.[152] This kind of induction is particularly useful in mathematical demonstrations.[153] If the enumeration of cases is not complete, the conclusion is not only uncertain, probable and conjectural, but it can always be refuted by a counter-example.[154] This particular kind of induction is particularly used in experimental philosophy where the mind discovers causes from effects.[155] And induction degenerates into the example, which is useful only in ethical matters; for instance, a brave man can claim to be a universal symbol of courage.

Demonstration, on the contrary, is an apodictic syllogism and is characterized by the certainty and evidence of its premises. There are two forms of demonstration,

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[149] Cf. Ibid.: 'Quando autem hujusmodi plures in *sententiam* aliquam (prout nos loqui solemus) seu *orationem* redigimus, sive *componendo* sive *dividendo* id fiat; (hoc est, *affirmando* seu *negando* unum de altero); … Dici solet *compositio* et *divisio*; (prout vel *conjuguntur* vel *separantur* illi *simplices termini*) quae *secunda operatio intellectus* censeri solet'.

[150] Cf. Ibid. 121: 'Tertia pars logicae, prout dividi solet, tertiam (quam vocant) operationem intellectus spectat: quem *discursum* vocant. Ut enim intellectus operatio prima spectare dicitur *terminos semplices*; secunda, hos semplices terminos (aut qui ut tales considerantur) in *propositiones* compingit; sic tertia ex propositionibus *discursum* componit. Ad discursum referunt *argumentationem* et *methodum*'.

[151] Cf. Ibid. 168: 'Inductio est argumentationis seu syllogismi forma, qua probatur quid verum esse de generali quopiam, ex eo quod verum sit de particularibus omnibus sub eo generali contentis; saltem de tot horum enumeratis, ut credibile sit de reliquis item esse verum'.

[152] Cf. Ibid.: 'Dicendum erit, hanc universalem (qualis qualis est) esse *universalem collectivam*; quae *singularis* est'.

[153] Cf. Ibid. 170.

[154] Cf. Ibid.: 'Verum si particularium enumeratio sit imperfecta, aut adjuncta particula collectiva (quae caetera comprehendat) sit ex probabili tantum conjectura, adeoque incerta, (quae est plurimarum inductionum conditio). Conclusio conjecturalis tantum est, aut probabilis, non omnino certa. Atque per unam (quam vocant) *instantiam* in contrarium, evertitur'.

[155] Cf. Ibid. 172: 'Investigationis, praecipuum est instrumentum; ubi particularia examinando et observando, pervenimus ad universalium cognitionem, quam inde colligimus. Atque huc tendit (quae dicitur) *experimentalis philosophia*. Quanquam enim, in ordine naturae, processus sit a causis ad effecta'.

τοῦ ὅτι or *quod sit* and τοῦ διότι or *cur sit*,[156] to which is added the demonstration *potissima*, the only one capable of providing scientific knowledge.[157]

The final part of logic is method, which concerns discovery or teaching. The method of discovery proceeds from particulars to universals and is grounded on observation. By contrast, the method of teaching proceeds from universals to particulars.[158]

Neither Sterne nor Wallis offer an original or thorough exposition of the epistemological issues of British Aristotelianism. Sterne's interests were primarily theological, and Wallis' mathematical. In the latter's discussion of logic is a peculiar attention to mathematics, but no attempt to mathematize logic, nor to expound it in a mathematical-geometrical order as did his German contemporary Leibniz. The relation between these two disciplines is completely extrinsic.

Beyond Sterne and Wallis, the works of the British Aristotelians of the last four decades of the century show an unequivocal tendency to deal with epistemological problems from an empirical perspective. Empiricism, which at the end of the sixteenth century was connected mainly with scientific method, has become, one century later, part of a broader epistemological shift in the history of logic toward a facultative logic.[159]

The old humanistic dialectics have disappeared completely, replaced first by thorough studies on methodology and then by facultative logic, which would have its culmination with the publication of Locke's *Essay*, the natural development of the British Aristotelian empiricism of the seventeenth century.

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[156] Cf. Ibid. 196: 'Syllogismus *apodicticus* sive demonstrativus … talis appellari consuevit syllogismus … qui ex certis principiis certam infert conclusionem. Adeoque non tantum probabilem conjecturam, sed absolutam certitudinem rei probatae facit. … Est quae dici solet *demonstratio* τοῦ τι (*quod sit*), quae ostendit rem *esse*, et *demonstratio* τοῦ διότι (*cur sit*), quae ostendit unde fit quod ita est; verasque rei causas aperit'.

[157] Cf. Ibid. 197: 'Ad eam autem quam vocant *demonstrationem potissimam* (utpote omnium excellentissimam et perfectissimam) plura adhuc postulant tanquam necessaria'.

[158] Cf. Ibid. 213–214: 'Investigandi methodus, a particularibus ad universalia procedit. … Ubi autem, investigando, ad horum notitiam pervenitur; tradendi methodus, seu instituendi et docendi, plane est contraria. Quippe hic (quum oporteat, quod aiunt, discentem credere) docentur primum generalia indeque ad particularia descenditur'.

[159] On this shift cf. John W. Yolton, *Perceptual Acquaintance from Descartes to Reid* (Minneapolis, 1984), 105–123; Lorne Falkenstein and Patricia Easton, *Preface*, in Lorne Falkenstein and Patricia Easton (eds.), *Logic and the Workings of Mind: The Logic of Ideas and Faculty Psychology in Early Modern Philosophy* (Atascadero, 1997), 1–3.

Chapter 11
Conclusion

With the research carried out in this volume I have attempted to emphasize a neglected aspect of early modern philosophy, that is, the strong presence of the Aristotelian tradition in the British Isles, and its empirical strand, which could have influenced the genesis of British empiricism. It is not the task of this study to examine the Aristotelian traces in empiricist authors such as Locke, Berkeley and Hume, but to reconstruct the philosophical background and framework in which their thought originated; some aspects of their empiricism can be explained only in reference to the academic Aristotelian tradition, even if these authors established themselves as anti-scholastic, anti-Aristotelian philosophers outside the official institutions. From the present investigation, for instance, it should be clear that the emphasis on sensation as the source of knowledge can no longer be conceived as Locke's innovation: the British Aristotelian tradition had dealt with it already, pushing the mind's reliance on sensation to the forefront of epistemology and natural philosophy.[1]

This book grew out of my dissatisfaction with the traditional historiography of early modern philosophy, which consistently denies Aristotelianism and scholastic or academic philosophy any share in the rise of empiricism. If we consider the most important histories of early modern philosophy, we find no reference to British Aristotelianism; occasionally a few Aristotelian authors are mentioned as a reminder that their textbooks were widespread in the universities and read by 'important' philosophers, such as Locke, but without assessing their originality and impact on those philosophers. For instance, the *Cambridge History of Seventeenth-Century Philosophy* entirely neglects the British Aristotelian movement, mentioning only Sanderson as an eclectic follower of Zabarella.[2] Still more seriously, the volume of the *Grundriss der Geschichte der Philosophie*

[1] Cf. Gaukroger, *The Collapse of Mechanism and the Rise of Sensibility. Science and the Shaping of Modernity, 1680–1760*, 164–165.

[2] Cf. Gabriel Nuchelmans, 'Logic in the Seventeenth Century: Preliminary Remarks and the Constituents of the Proposition', in Daniel Garber and Michael Ayers (eds.), *The Cambridge History of Seventeenth-Century Philosophy* (Cambridge, 1998), 103–117, esp. 106.

M. Sgarbi, *The Aristotelian Tradition and the Rise of British Empiricism*,
Studies in History and Philosophy of Science 32, DOI 10.1007/978-94-007-4951-1_11,

devoted to seventeenth-century philosophy in Britain completely ignores British Aristotelianism, as if all early modern British philosophy were alien to, or even developed in opposition to Aristotelianism, perhaps in favour of Platonism. There are sporadic references in the reconstruction of the cultural context of some Aristotelian authors, but they are considered first of all as writers of textbooks without any philosophical dignity.[3]

Neither of the two most important histories of logic—those of Karl Prantl and Wilhelm Risse—not to mention those of Bochenski and Blanché, touches this topic, but instead attribute the development of empiricism and facultative logic in early modern philosophy to Locke.[4]

My investigation, by contrast, has tried to show the historical and philosophical importance of British Aristotelianism from the late sixteenth century to the end of the seventeenth, and the role that Scholastic philosophy played in the university curricula. Many scholars have claimed that the universities did not contribute to the genesis of early modern philosophy, and that their failure to embrace the 'new philosophies', as well as their lingering commitment to an Aristotelian framework, are evidence enough of their professors' ignorance. On the contrary, in my study I have shown that certain paradigm shifts in early modern philosophy were possible only within the Aristotelian framework of the universities. Underpinning this book is the belief that the universities played a crucial role in the preparation of empiricism, fostering a generation of schoolmen able to grasp the implications of this empiricism, which were becoming increasingly apparent at the end of the seventeenth century. There is a significant body of evidence showing that students and scholars were largely exposed to empiricist doctrines from their very early university studies. Of course not all professors were involved in empiricist philosophy and many were conservative, but the circulation of empiricist ideas in the universities was wide and far-reaching.

I have first traced the progress of this movement towards an elaboration of epistemological doctrines and a theory of knowledge different from the humanistic and Ramist positions. Second, I have shown the extent to which Aristotelian logic was embedded in British philosophy, far more than Platonism or Ramism. I have also shown that the Aristotelianism which emerged in the British Isles at the end of the sixteenth century was heavily influenced by the Paduan school, and in particular by Zabarella, who elaborated a methodology stressing the empirical aspect of the cognitive process. The early British Aristotelians Digby and Case tended in Zabarella's direction in their attempt to develop a doctrine of scientific method that could justify the importance of the empirical, inventive aspect of knowledge. In particular, early

[3] Cf. Jean-Pierre Schobinger (ed.), *Grundriss der Geschichte der Philosophie. Die Philosophie des 17. Jahrhunderts. Bd. 3. England* (Basel, 1988), 6–25.

[4] Cf. Karl von Prantl, *Geschichte der Logik im Abendland* (Munich, 1855–1870); Wilhelm Risse, *Logik der Neuzeit* (Stuttgart-Bad Cannstatt, 1964–1970); Józef M. Bocheński, *A History of Formal Logic* (Notre Dame, Ind., 1961); Robert Blanché, L*a logique et son histoire d'Aristote à Russell* (Paris, 1970).

British Aristotelianism is characterized on the one hand by its break with humanistic logic, which favoured rhetorical and dialectical arguments, and on the other by its opposition to Ramist logic, which did not take into account the subjective side of knowledge. The aim of the British Aristotelians was to elaborate a method that would guarantee scientific and objective knowledge beginning from the subjective condition of the mind.

The development of this scientific methodology was strengthened by the dissemination of the works of Zabarella and Pace, which had a great impact on the British and Irish academic world, both in logic and in natural philosophy. Following Zabarella, a second generation of Aristotelian logicians, including Powell and Flavell, produced new theories of method, which focused on the problem of sensation and induction, as the central issues in the process of discovery.

Meanwhile, in the first decade of the seventeenth century, the work of Continental Aristotelians influenced by Zabarella also became popular in the British Isles. Therefore the impact of the Paduan school was both direct and indirect. Authors such as Keckermann, Smiglecki, Burgersdjik, Isendoorn were regularly read and debated in universities across the Channel.

From the Paduan and Continental Aristotelians a third generation of British Aristotelians arose. Logicians such as Smith, Brerewood, Sanderson and Crakanthorpe developed an empiricist theory of scientific method, emphasizing sensation, observation, memory and induction for scientific discovery, and downplaying the role of syllogism as a methodological instrument.

The powerful influence of this third generation is recognizable also in the reformers of Aristotelian logic such as Bacon, Harvey and Hobbes. Although much of their philosophy seems to have been conceived in opposition or at least as an alternative to Aristotelianism, many of their theories reflect the latest developments of British Aristotelianism. For instance, Bacon revises the theory of induction, Harvey recapitulates the process of forming knowledge from experience, and Hobbes reassesses the methodological distinction between analysis and synthesis.

The emergence of experimental philosophy marked not the defeat of British logical Aristotelianism, but a strong empiricist turn in the elaboration of a new epistemology. The heirs to this tradition were Locke's precursors, who made of sensation and induction the real instruments of logic: British Aristotelians no longer indulged in hypothetical and metaphysical speculations that were often untestable or inexplicable, rather emphasized the fact that experience, acquired by observation and experiment, was the ground of science.

Aristotelianism was therefore a dominant movement of the British and Irish philosophical landscape, especially in the field of logic, and it enjoyed a long life that was equalled only in Germany. British Aristotelian doctrines were strongly empiricist in nature, both in the theory of knowledge and in scientific method; this character marked and influenced further developments in British philosophy at the end of the century, and eventually gave rise to what we now call empiricism.

Schmitt has wisely written that 'to go beyond Aristotle one had first to understand him or, at least, to understand some rudiments of his thought. Copernicus, Ramus, Telesio, Bruno, Patrizi, Galileo, Gassendi and Descartes all did. So too did

Bacon, Harvey and Newton. For that reason, if for no other, the Aristotelian revival in England was so important'.[5]

Without the Aristotelian tradition, without its doctrines, and without its conceptual elaborations, British empiricism would never have been born, especially as scholarship often describes seventeenth-century British philosophy as Platonic. The most important basis for an empiricist opposition to Platonism can be found in the Aristotelian tradition.

Put simply, without the legions of forgotten British Aristotelians, there would have been no Locke, no Berkeley, no Hume. We ought to keep in mind that philosophy is made not only by the 'great names', but also by minor authors who determine the intellectual milieu from which the canonical names emerge.

The history of seventeenth-century philosophy in the British Isles should be rewritten, and an important part should be assigned to its Aristotelian tradition.

[5] Schmitt, *John Case and Aristotelianism in Renaissance England*, 28.

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