Acta Baltica Historiae et Philosophiae Scientiarum

Vol. 5, No. 1 • Spring 2017

Acta Baltica Historiae et Philosophiae Scientiarum is a semi-annual international scientific journal published by Estonian Association for the History and Philosophy of Science in close cooperation with Latvian and Lithuanian Societies on the History and Philosophy of Science and other scientific organisations.

Acta Baltica Historiae et Philosophiae Scientiarum sees its mission in offering publishing possibilities for both Baltic and non-Baltic scholars working in the field of the history and philosophy of science promoting thus international cooperation between the scholars of different countries working in these fields.

Publisher: Estonian Association for the History and Philosophy of Science;
Tallinn University of Technology, Department of Law
Editorial office: Akadeemia tee 3, 12618 Tallinn, Estonia;
E-mail: peeter.muursepp@ttu.ee, amirouche.moktefi@ttu.ee
Contact for back issues: peeter.muursepp@ttu.ee
Webpage: http://www.bahps.org/acta-baltica
Webmaster: tarmo.tuisk@ttu.ee

Copyreader and technical editor: Kait Tamm
Cover design and layout: Piret Frey

The journal is available in EBSCO Publishing Ltd, SCOPUS, ERIH Plus and DOAJ online databases

ISSN 2228-2009 (Print)
ISSN 2228-2017 (Online)

Printed in Estonia

ACTA BALTICA HISTORIAE ET PHILOSOPHIAE SCIENTIARUM

Vol. 5, No. 1 (Spring 2017)

Acta Baltica Historiae et Philosophiae Scientiarum
Vol. 5, No. 1 (Spring 2017)
DOI : 10.11590/abhps.2017.1.00

Goals Achieved, Challenges to Conquer

This is an interesting time for our journal. There are several important developments to be pointed out in this introductory note.

Shortly before completing the fourth volume of *Acta Baltica Historiae et Philosophiae Scientiarum*, we received the good news that our journal has been considered by Scopus as meeting its standards. Since this day, all the papers published in our journal, from the very first issue in 2013, have been included in the Scopus database. This is a very important development because it makes our journal much more visible. More colleagues will be reading it and discussing important issues with our authors. This will add citations and enable us to start the process of introducing an Impact Factor to the journal. As Editor-in-Chief, I am deeply grateful to our editors, the Editorial Board members and, most importantly, to our authors for providing us with high-quality work. These people are all known to our readers. However, there is a group of helpful colleagues whose names cannot be revealed to the public but whose contribution to the success of the journal is by no means less important—our peer-reviewers who have done a truly invaluable job. Needless to say, however, several of these colleagues have been active in different capacities while contributing to the journal.

Another important development concerns the position of the Executive Editor of the journal. I am very happy to welcome Dr. Amirouche Moktefi, my colleague at the Tallinn University of Technology and an active member of the Estonian Association for the History and Philosophy of Science. Amirouche took up the job of Executive Editor only a few months ago but already has successfully contributed to the process of completing the current issue.

I am also very pleased to welcome Professor Sven Ove Hansson, our colleague from the Royal Institute of Technology (KTH) in Stockholm, as the Editorial Board member of our journal.

A few words about the content of the current issue. As usual, we have tried to keep a balance between philosophy and history of science, and have succeeded in this task by and large. The current issue has expanded the range of authors as much as possible. None of the authors of the issue has contributed to our journal before. From the aspect of philosophy, you can find an interesting analysis of the Cartesian eternal truths by Danielle Macbeth and an insight into the development of Euler-type diagrams by Jens Lemanski. Amirouche Moktefi, our new Executive Editor, has contributed with a thrilling overview of logic books in the library of Lewis Carrol, the famous author of *Alice in Wonderland*, who was also a well-known mathematician and logician of his time publishing under his real name, Charles Lutwidge Dodgson. Obviously, all these articles have both philosophical and historical significance. In the current issue, the readers can also find an article by Ülle Pärl from the recent past and by Małgorzata Durbas from the more distant one. As the core of our editorial staff works at the School of Business and Governance of Tallinn University of Technology, it is quite important to cover interesting developments in teaching business, economics and management in Estonia. The paper by Dr. Ülle Pärl fulfils this task.

Last but not least, we offer our readers a review of an interesting book about Lewis Carroll's paradox of inference by Jean Paul Van Bendegem. Editors of the reviewed book are Amirouche Moktefi and Francine F. Abeles. We plan to publish at least one book review in each forthcoming journal issue from now on.

Enjoy reading the first issue of the fifth volume of *Acta Baltica Philosophiae et Historiae Scientiarum*!

Peeter Müürsepp
Editor-in-Chief

Acta Baltica Historiae et Philosophiae Scientiarum
Vol. 5, No. 1 (Spring 2017)
DOI : 10.11590/abhps.2017.1.01

Descartes on the Creation of the Eternal Truths

Danielle Macbeth

Department of Philosophy,
Haverford College
370 Lancaster Avenue,
Haverford, PA 19041, USA
E-mail: dmacbeth@haverford.edu

Abstract: On 15 April 1630, in a letter to Mersenne, Descartes announced that on his view God creates the truths of mathematics. Descartes returned to the theme in subsequent letters and some of his Replies but nowhere is the view systematically developed and defended. It is not clear why Descartes came to espouse the creation doctrine, nor even what exactly it is. Some have argued that his motivation was theological, that God creates the eternal truths, including the truths of logic, because and insofar as God is omnipotent and the creator of all things. I develop and defend a different reading according to which Descartes was led to espouse the creation doctrine by a fundamental shift in his understanding of the correct mode of inquiry in metaphysics and mathematics: by 1630, the God-created truths came to play the role in inquiry that until then, in the *Rules for the Direction of the Mind*, had been played by images.

Key words: *Descartes' creation doctrine, logical necessity, logical truth, mathematical truths, mathematical necessity, non-logical necessity*

On 15 April 1630, Descartes wrote to Mersenne that "the mathematical truths which you call eternal have been laid down by God and depend on him entirely no less than the rest of his creatures" (CSMK III 23; AT I 145).[1] This is the first

[1] I use the following standard abbreviations: AT for Adam, C. & Tannery, P., eds. (1964–1976), Oeuvres de Descartes, 12 vols., revised edition, Paris: Vrin/CNRS; CSM for Cottingham, J.; Stoothoff, R. & Murdoch, D., eds. (1984–1985), *The Philosophical Writings of Descartes*, 2 vols., Cambridge: Cambridge University Press; and CSMK for Cottingham, J.; Stoothoff, R.; Murdoch, D. & Kenny, A., eds. (1991), *The Philosophical Writings of Descartes,* vol. 3, Cambridge: Cambridge University Press.

we hear of what has come to be called Descartes' creation doctrine. [2] Descartes returns to the theme in subsequent letters to Mersenne, as well as in letters to More and Mesland, and in some of his Replies. Nowhere does he systematically develop and defend the view. [3] We do not know why Descartes came to espouse the creation doctrine, nor even what exactly it is.

Descartes claims that the eternal truths are freely created by God, that God could have done otherwise. But if so, in what sense are those truths necessary? Some, for example, Frankfurt (1977) and Van Cleve (1994), have argued that if God could have done otherwise, as Descartes repeatedly claims, then the created truths cannot be necessary, despite Descartes' claims to the contrary. Others, including Geach (1973), Curley (1984), Osler (1985), and Kaufman (2002), hold—as Descartes himself seems to indicate in a letter to Mesland written on 2 May 1644[4]—that the eternal truths that God creates are necessary but not necessarily necessary. But is it even coherent to claim that there are necessary truths that nonetheless depend for their truth on the free and indifferent will of the creator?

A second major interpretive challenge concerns the nature and ontological status of the eternal truths: when God created the eternal truths, what exactly was it that was created thereby? Kenny (1970), Wilson (1978), Schmaltz (1991), Bennett (1994), Nolan (1997), and Rozemond (2008) are among those addressing this question; six different answers are provided no one of which is clearly superior to the others.

A third issue concerns the *scope* of the creation doctrine. Although it is manifest that Descartes holds that the truths of mathematics and at least some metaphysical

---

2 The label is due to Wilson, 1978. As she points out, the doctrine appears to have two parts, first, that God creates the eternal truths (more exactly, the essences on the basis of which to determine what the eternal truths are), and second, that God implants in us ideas of these essences so that we may discover the eternal truths by reflection alone: "God has created our minds in such a way that we cannot directly conceive the opposite of things he has willed to be necessary or eternal" (Wilson, 1978, p. 127).

3 In that first letter to Mersenne, Descartes says that he will discuss the doctrine in his projected treatise on physics. Despite his intention, the doctrine is not so much as mentioned in any of Descartes' formally written works, perhaps because it turned out to be so very controversial. No one before Descartes had suggested such a thing, and as noted below, both Leibniz and Malebranche, among others, explicitly rejected it after it had been introduced by Descartes.

4 Descartes writes: "even if God has willed that some truths should be necessary, this does not mean that he willed them necessarily; for it is one thing to will that they be necessary, and quite another to will this necessarily, or to be necessitated to will it" (CSMK III 235; AT IV 118). Notice that Descartes does not here positively assert that this is how it is with the eternal truths.

truths depend on God's free decree, does he think the same about the necessary truths about God, for example, that God exists, is omnipotent, and is not a deceiver?[5] The truths of physics are also not obviously among the eternal truths that are within the scope of the creation doctrine; Broughton (1987) argues that, at least after the *Meditations*, Descartes held that they are not. And then there is the question of what is logically necessary: is what is true as a matter of pure logic, for example, that *a=a*, also freely created by God? Most—including Geach (1973), Frankfurt (1977), Wilson (1978), Alanen (1991), and Broughton (1987; 2002)—assume without question that Descartes does indeed intend that even the truths of logic are included within the scope of his creation doctrine. But there are dissenting voices, for instance, Funkelstein (1975).

And there is, finally, in addition to these questions about what the doctrine *is*, the question of Descartes' *motivation* in adopting the creation doctrine. Many cite God's omnipotence, arguing that it requires that there be no constraints on God and hence that God freely creates even the eternal truths. (See, for example, Curley, 1984; Broughton, 1987; Alanen, 1991.[6]) But God's simplicity has also been invoked to explain why Descartes espouses the creation doctrine, as has his physics.[7] None of these reasons are dispositive. Leibniz, for example, rejected the theological grounds; according to him, Descartes' creation doctrine unknowingly destroys "all the love of God and all his glory" (Leibniz, 1686, p. 304). And as Malebranche argues in his *Search After Truth*, physics and indeed all science would seem to be impossible if Descartes' creation doctrine were true; scientific inquiry is possible, Malebranche thinks, only if the eternal

---

5 In a letter to Mersenne written on 6 May 1630, Descartes writes that "the existence of God is the first and most eternal of all possible truths and the one from which alone all others proceed" (CSMK III 24; AT I 150), suggesting thereby (what one might in any case have suspected given that, according to Descartes, God is the only necessary being) God does not freely create the eternal truths about God. Pessin (2006) argues that Descartes holds "at least philosophically speaking" that all eternal truths, including those concerning God, are created.

6 Walski also traces the doctrine to God's nature, arguing that in Descartes we find a very untraditional conception of God, "a God who, while he has the traditional divine attributes, has them in a way conceived so uniquely that from them it follows that he created the eternal truths" (Walski, 2003, p. 23).

7 Broughton (1987) and Kaufman (2003) argue that God's simplicity, the fact that (according to Descartes) in God willing, understanding, and creating are one, provides Descartes with a reason for espousing the doctrine. Osler (1985) suggests that divine omnipotence is the ground for thinking that God freely creates the eternal truths, and divine simplicity the ground for thinking that they are nonetheless eternal and immutable. Kenny (1970) claims that the creation doctrine is required as a foundation for Descartes' physics. There is, however, a serious tension between the creation doctrine and Descartes' physics insofar as Descartes thinks that he can derive the basic laws of motion from God's essence. If God freely creates those laws it would seem to follow that they are not deducible from consideration of God's essence (see Nadler, 1987).

truths are *independent* of God's will—though not of his understanding. Of course, none of this shows that these were not Descartes' reasons, even if not very good ones.[8] Nevertheless, one would like to do better. I aim to show that we can, first, by coming to clarity about the role the creation doctrine was to play in Descartes' new science, and in light of that, by explicating what exactly the doctrine is.[9]

I further hope to make it clear that this doctrine is not merely of scholastic or academic interest, that it constitutes an important moment in our ongoing understanding of the nature of mathematical truth in particular. Descartes, I will argue, needs to give an account of mathematical truth as contrasted with logical truth precisely because he has seen that mathematical truths are necessary but not logically necessary. By contrast with Hume, Descartes does not think that the truths of mathematics are analytic in Kant's sense. They are, in Kant's terminology, synthetic a priori. Understanding why the founder of analytic geometry held this characteristically modern view of the truths of mathematics is an important moment in our overall understanding of the rise of modern mathematics and mathematical science.

The context

In the spring of 1630, Descartes discussed the creation doctrine in three letters to Mersenne. In the first, which introduces the idea, Descartes reports that he has made some new discoveries that have led him to abandon his earlier work, including the *Rules for the Direction of the Mind*, which Descartes had ceased to work on in 1628, and start fresh on a new and larger project. In particular, he reports, "I think that I have found how to prove metaphysical truths in a manner which is more evident than the proofs of geometry" (CSMK III 22; AT I 144). Seven months later, in a letter to Mersenne of 25 November 1630, Descartes is more specific: he has found a proof for the existence of God "which makes me know that God exists with more certainty than I know the truth of any proposition of geometry" (CSMK III 29; AT I 182). His plan is to write a

8 As will be explained in more detail below, we here need to distinguish between what Descartes says are his reasons and what actually are his reasons. As many have argued, if his reasons are as he says, grounded in the nature of God, then the view seems deeply incoherent.

9 My focus here can be only on the creation doctrine itself; I leave to another occasion the task of assessing the merits of the view developed here in relation to other accounts presented in the literature.

treatise on optics to test "whether I am capable of explaining my conceptions and convincing others of truths of which I have convinced myself," and if successful to "complete a little treatise on Metaphysics [...] in which I set out principally to prove *the existence of God and of our souls* when they are separate from the body, from which their immortality follows" (CSMK III 29; AT I 182). Descartes' treatise on optics, together with his *Geometry* and a treatise on meteorology, appeared as appendices to his *Discourse on Method* in 1637. The *Meditations on First Philosophy* "in which [according to the subtitle] are demonstrated the existence of God and the distinction between the human soul and the body" was published four years later, in 1641.

By 1630, Descartes had set aside, unfinished, the *Rules for the Direction of the Mind* and was embarked on what would become the *Discourse* and the *Meditations*, both of which, we are told, employ a new and very powerful method, one that enables a proof of the existence of God that is even more certain than demonstrations in geometry. In order to understand this new method we need to think first about the old, the method of the *Rules*, and in particular, about the role that images and the imagination play in it. Descartes writes in Rule Fourteen:

> Even if the intellect attends solely and precisely to what the word denotes, the imagination nonetheless ought to form a real idea of the thing, so that the intellect, when required, can be directed towards the other features of the thing which are not conveyed by the term in question, and so that it may never injudiciously take these features to be excluded. (CSM I 61; AT X 445)

Using the example of extension to illustrate his point, Descartes argues, first, that if one reflects on the notion of extension using only one's intellect and logic, one might well come to think that there can be extension in the absence of any body, "that it is not self-contradictory for extension *per se* to exist all on its own even if everything extended in the universe were annihilated" (CSM I 59; AT X 443). Nonetheless, Descartes continues, this would be "an incorrect judgment of the intellect alone" (CSM I 59; AT X 443). Because we cannot *imagine* extension except as the extension of some body, though we can *think* extension without body, we are able to recognize the necessity of the fact that all extension is of a body. Although the notion of extension does not include the notion of a body, nor the notion of a body that of extension (which is why it is not by logic and reason alone that we are able to discover their necessary relation), nevertheless the two notions *are* necessarily related one to the other, as is shown by our inability to imagine the one without the other.[10]

Because the notion of extension does not contain the notion of a body (nor the notion of a body that of extension), one cannot by reasoning and logic discover that all extension is of a body. It is not logically necessary that all extension is of a body. And yet, Descartes holds, it is necessary that all extension is of a body, and discoverably so. The way we discover this necessary but non-logical truth, according to the account in the *Rules*, is by trying to imagine extension without any body, by trying to form what Descartes describes as a "real idea" of it. What we discover when we do form a real idea of extension, when we not only think of extension but imagine it, is that extension is and must be of a body. It is in just this way that the intellect is directed by the imagination "towards the other features of the thing which are not conveyed by the term in question, and […] may never injudiciously take those features to be excluded" (CSM I 61; AT X 445). What is conveyed already by the term is what can be discovered independent of the imagination and is logically necessary; what requires also the imagination to be discovered is "other features of the thing" that are necessarily true of it despite not being contained already in the idea of it.

Descartes retained throughout his life the view that there is no extension without body. He did not, after 1630, maintain that we know this by employing our powers of imagination. That there is no extension without a body comes instead to have the status of an eternal truth that God creates and implants in us. We read, for example, in a letter to Arnauld, 29 July 1648:

> I would not dare say that God cannot make a mountain without a valley, or bring it about that 1 and 2 are not 3. I merely say that he has given me such a mind that I cannot conceive a mountain without a valley, or a sum of 1 and 2 which is not 3; such things involve a contradiction in my conception. I think the same should be said of a space which is wholly empty, or of an extended piece of nothing […] for wherever extension is, there, of necessity, is body also. (CSMK III 358–359; AT V 224)

[10] The distinction between what is logically necessary and what is necessary but not logically necessary is in essence this. What is logically necessary is what is required by the law of non-contradiction, that not (*p* and *not-p*). One and the same thing cannot both be the case and not the case. What is necessary but not logically necessary is what is required by virtue of the sorts of things involved. Given what it is to be square and what it is to be round, nothing could at once be both. (Compare what it is to be square and what it is to be blue; in this case it is perfectly possible for a thing to be both.) That something might be at once square and round is impossible, though not logically impossible, not impossible in the way it is impossible for something to be at once square and not square.

Although at first Descartes thought that one might know that extension is necessarily of a body by virtue of the fact that one cannot imagine or form a real idea of extension independent of any body, after 1630 he holds that it is by the intellect alone, reflecting on ideas that are implanted in us by God that we are able to discover such a necessary but not logically necessary truth. And this is especially important in this context because, as Descartes explains in a letter to Mersenne of 27 May 1638, some questions "like the questions of the existence of God and of the human soul" are "beyond the capacity of our imagination" but can be successfully addressed by the intellect: "our intellect can reach the truth of the matter" on such questions (CSMK III 103; AT II 138). Indeed, as Descartes remarks in a letter to Mersenne a year and a half later (13 November 1639), "the imagination […] is more of a hindrance than a help in metaphysical speculation" (CSMK III 141; AT II 622). As he further explains in the fifth Meditation, we would much more easily acknowledge God were we not besieged by images of things (CSM II 47; AT VII 69). Not only is the imagination unequal to the task of discovering at least some of the necessary but not logically necessary truths, it can be a positive hindrance in the discovery of such truths.

Already in November of 1630 Descartes had reported to Mersenne that he had a proof for the existence of God that was more certain than any demonstration in geometry, and that proof was, presumably, that which we find in the *Meditations*, either the third Meditation proof or the fifth Meditation proof. Such a proof does not rely on images but depends instead on ideas that are, according to Descartes, implanted in us by God. The proof is discoverable by the intellect acting alone, independent of the imagination and independent of the body on which the imagination appears to depend. (Descartes suggests in the sixth Meditation that imagination seems to involve a kind of turning "towards the body" (CSM II 51; AT VII 73). See also Descartes' letter to Gibieuf, 19 January 1942 (CSMK III 203; AT III 479).) The creation doctrine seems, then, to have been motivated by limitations of the method of inquiry that Descartes sets out in the *Rules*, by the fact that that method can be of no assistance in establishing such a necessary but not logically necessary truth as, for instance, that God exists. The role that is played in Descartes' early work by images and the exercise of the imagination in the discovery of necessary but not logically necessary truths is now to be played by the God-created eternal truths.

Necessary but not logically necessary

If, as I have suggested, the creation doctrine is motivated by limitations in the method of the *Rules* and in particular by problems with Descartes' appeal to the imagination, then it would seem that the eternal truths should be one and all necessary but not logically necessary. According to the *Rules*, what is logically necessary can be discovered by reason alone unaided by the imagination; only what is not logically necessary but necessary nonetheless requires the assistance of the imagination. We will see that all Descartes' examples of eternal truths that are created by God reinforce this point.

Consider, first, the truth regarding extension that Descartes first thinks is known with the help of the imagination and later takes to be a God-created eternal truth. We know that this is not logically necessary because, as Descartes explains in his letter to Gibieuf, 19 January 1642, one can mentally abstract extension from shape and body, that is, "consider shape without thinking of the substance or extension whose shape it is"; "one can think of the one without paying attention to the other" (CSMK III 202; AT III 475). Because one can coherently consider one of these notions without the others, can coherently mentally abstract one from the other, it is possible to know that none are contained in any of the others—though if they were, one could, by logic alone, discover this. But this is nonetheless an abstraction, not what Descartes describes as a "complete idea," which is an idea that can be conceived "entirely on its own" (CSMK III 202; AT III 475). As Descartes goes on in that same letter, the same is true of a mountain and a valley: although "by abstraction we can obtain the idea of a mountain, or of an upward slope, without considering that the same slope can be travelled downhill", "the ideas of these things cannot be complete when we consider them apart" (CSMK III 202; AT III 476–477). We can consider a mountain without thereby considering a valley as well, and can consider a valley without also considering a mountain. There is no logically necessary relation between being a mountain and being a valley. But there is a necessary relationship nonetheless insofar as a complete idea of a mountain involves that of a valley. We will return to the question what it is to have a complete idea.

In the third of the three letters Descartes writes to Mersenne in 1630 regarding the creation doctrine, he gives as an example of an eternal truth freely created by God that all radii of a circle are equal. This of course follows immediately, and by logic alone, from the definition of a circle, that all points on the circumference are equidistant to a center. But this definition is not logically necessary as is shown by the fact that it is not logically necessary that the radii of a circle are all equal in length. To be a radius of a circle is to be a straight line from the center of a circle to a point on its circumference. There is nothing in the very idea of a radius to suggest that any two radii of a circle are (and must be) equal in length. As the point can be put, although it follows from something's being a circle, circle's being what they are, that all its radii are equal in length, it is no part of *being* a circle that this is true. There could, as a matter of logical possibility, be a circle with radii unequal in length in a way there could not be a circle that was nonetheless not a circle (which would, of course, be a *logical* contradiction). God, Descartes suggests, could have made it to be the case that circles are very different from circles as we know them in mathematics, that the definition of a circle could have been different, without circles ceasing to be circles. The truth that all radii of a circle are equal is necessary without being logically necessary.

In the first Replies Descartes discusses another example, discussed also in the fifth Meditation along with the mountain/valley example, that of the three angles of a triangle, that they sum to two right angles, which is of course demonstrably true in Euclidean geometry. And here he does say that its three angles being equal to two right angles is "contained in the idea of a triangle" (CSM II 84; AT VII 117). But if that were true then one could know by logic alone that the sum of the angles of a triangle equals two right angles because it would in that case be a logical contradiction to deny it. Descartes immediately goes on explicitly to deny that there is any logical contradiction here:

> Even if I can understand what a triangle is if I abstract from the fact that its three angles are equal to two right angles, I cannot deny that this property applies to the triangle by a clear and distinct intellectual operation—that is, while at the same time understanding what I mean by my denial. (CSM II 84; AT VII 117-8)

Descartes makes three claims here. First, one can understand what a triangle is independent of the question of what its angles sum to; the notion of a triangle does not itself contain the idea that the sum-angle property (i.e., the property of having its angles sum to two right angles) holds. Second, there is a "clear and distinct intellectual operation" the performance of which makes manifest that the sum-angle property is a property of triangles—though just what operation this is remains obscure. And finally, Descartes claims that one can understand what it means to deny that triangles have the sum-angle property, which is to say it is not a *logical* contradiction to say that triangles do not have the sum-angle property. That triangles have this property is necessary but not logically necessary. One can coherently think of a triangle without thinking of such a property as belonging to it. As we are told in the sixth Replies, God did not "will that the three angles of a triangle should be equal to two right angles because he recognized that it could not be otherwise […] On the contrary, […] it is because he willed that the three angles of a triangle should necessarily equal two right angles that this is true and cannot be otherwise" (CSM II 291; AT VII 432).Consider, finally, the truth that one plus two equals three. Is this necessary without being logically necessary? Kant would say so on grounds that the concept of the sum of one and two, although it contains the idea that there is a number that is the sum, does not as such contain the idea of the number three. (See Kant's discussion of the sum of seven and five in the B Introduction of the *Critique of Pure Reason.*) No amount of analysis of the concept *sum of one and two* will yield the notion of three despite the fact that it is a necessary truth that the sum of one and two is three. It is necessary without being logically necessary; in Kant's terminology, it is synthetic a priori rather than analytic. Descartes similarly says that there is a "contradiction in my conception" to suppose that a sum of one and two not be three, though he "would not dare to say that God cannot […] bring it about that 1 and 2 are not 3" (CSMK III 358–359; AT V 224).

Perhaps it will be objected that there *is* a logical contradiction in denying that one plus two is three on the grounds that if you have one thing and add two more things then you have three things, whether or not anyone knows this. And certainly it is true that if you have one thing and add two more then you have three things. What this is not is a truth of mathematics. One can put together as many collections of one thing and two things as one likes, one will not thereby establish the *mathematical* truth that one plus two equals three. To establish this truth of mathematics requires, as in the case of the triangle, a clear and distinct intellectual operation, an act of recognition that the number that is the sum of one and two is the very same number as the number three. Because one can fully grasp what it is to be the sum of one and two in abstraction from the notion of the number three, it is not by logic alone that one knows the mathematical truth that one plus two equals three. This mathematical truth is necessary but not logically necessary, just as Kant would later argue.

The status of logical truths

As already noted, it is often thought that Descartes' creation doctrine applies to logically necessary truths as well as to the necessary but not logically necessary truths of mathematics and metaphysics. This is furthermore thought to follow from God's omnipotence. Certainly it is true that if the truths of logic are anything at all, and if all that is depends on the will of God, then the truths of logic depend on the will of God. But although it does seem to be true according to Descartes that all that is depends on the will of God, it is much less clear that the truths of logic are something (and hence in need of being created), that they exist in any sense that would include them in the class of things dependent on God's will. It rather seems to be the case, we will see, that what is logically impossible simply is not, that in no sense does it or could it exist. Indeed, this is a corollary of the fact that in a purely logical step of inference one does not really take a *step* of reasoning at all but cognitively stays in just the same place, affirming only what had been, perhaps only implicitly, affirmed already in one's starting point.

The passage most often cited as showing that logical truths are among the God-created eternal truths is in a letter to Mesland, 2 May 1644:

> I turn to the difficulty of conceiving how God would have been acting freely and indifferently if he had made it false that the three angles of a triangle were equal to two right angles, *or in general that contradictories cannot be true together*. It is easy to dispel this difficulty by considering that the power of God cannot have any limits, and that our mind is finite and so created as to be able to conceive as possible things which God has wished in fact to be possible but not to be able to conceive as possible things which God could have made possible but which he has nonetheless wished to make impossible. The first consideration shows us that *God cannot have been determined to make it true that contradictories cannot be true together, and therefore that he could have done the opposite.* The second consideration assures us that even if this be true, we should not try to comprehend it since our nature is incapable of doing so. (CSMK III 235; AT IV 118; emphasis added.)

Descartes clearly says in this letter that God is not determined to hold that contradictories cannot be true together, and if by 'contradictories' he means *logical* contradictories—such as that this S is P and that this (same) S is in addition not P, or more generally, that *p* and not-*p*—then the creation doctrine applies not only to truths of mathematics and metaphysics (which, we are supposing, are necessary but not logically necessary) but also to truths of logic. If, however, by 'contradictories' he means only *conceptual* or *metaphysical*, but not logical, contradictories such as being square and being round, say, or being extended but not a body, then the creation doctrine is limited to non-logical necessary truths.

Descartes nowhere says that God could make it the case that some one thing is both F and not F for some property F, or that it could have been true that both *p* and not-*p*. And all his examples are of conceptual or metaphysical impossibilities as such impossibility contrasts with logical impossibility. They give one no grounds for thinking that the creation doctrine applies to logically necessary truths as well as to truths that are necessary but not logically necessary. Positive grounds for thinking that Descartes does not apply the doctrine to what is logically true is that he holds that it is no constraint or limitation on God that God cannot do what it is logically impossible to do. Descartes writes to More on 5 February 1649: "we do not take it as a mark of impotence when someone cannot do something which we do not understand to be possible." For example, "we do not […] perceive it to be possible for what is done to be undone—on the contrary, we perceive it to be altogether impossible, and so it is no defect of power in God not to do it" (CSM II 363; AT V 273). It is logically impossible to make to have not been done what has been done because that is as much as to say that an object can both have and lack one and the same property, that it both is and is not, which simply cannot be. God's inability to do what is logically, or absolutely, impossible is not, then, an inability; it is not a mark of any sort of limitation or impotence.

In his Second Replies, Descartes further explores the notion of possibility. One sense of 'possible', he thinks, is "what everyone commonly means, namely 'whatever does not conflict with our human concepts'". And while we might think we can imagine another kind of possibility "which relates to the object itself […] unless this matches the first sort of possibility it can never be known by the human intellect" (CSM II 107; AT VII 150–151). Thus,

> all self-contradictoriness or impossibility resides solely in our thought, when we make the mistake of joining together mutually inconsistent ideas; it cannot occur in anything which is outside the intellect. For the very fact that something exists outside the intellect shows that it is not self-contradictory but possible. (CSM II 108; AT VII 152)

Descartes claims in this passage that the only notion of impossibility that is intelligible is that of the material incompatibility of concepts, "mutually inconsistent ideas". But if so, then, what is logically impossible is nothing at all. It simply *is not*, and hence, again, it is no limitation on the power of God not to be able to do what it is logically impossible to do. (This was also the scholastic view, the view of, for instance, Aquinas: what is logically impossible *cannot* be done and thus it is wrong to say that God cannot do what is logically impossible as if God were in some way limited or constrained by logic.[11])

The case of contradictions in one's *conceptions* of things is different. Here the contradiction is not logical but instead conceptual or metaphysical. And it is grounded, Descartes thinks after 1630, in the true and immutable natures that God has created. Because these are not logically necessary but depend on God's free decree there is a sense in which they could be otherwise. Thus Descartes writes to Mersenne on 27 May 1630 that "it is certain that he [God] is the author of the essence of created things no less than of their existence; and this essence is nothing other than the eternal truths [...] You ask also what necessitated God to create these truths; and I reply that he was free to make it not true that all the radii of the circle are equal—just as free as he was not to create the world" (CSMK III 25; AT I 152). In a letter written to Mersenne eight years later (again on May 27), we read that "even those truths which are called eternal—as that 'the whole is greater than its part'—would not be truths if God had not so established" (CSMK III 103; AT II 141). Further textual evidence is provided in Descartes' letter to Gibieuf of 19 January 1642. Descartes writes: "we cannot have any knowledge of things except by the ideas we conceive of them; and consequently [...] we must not judge of them except in accordance with these ideas, and we must even think that whatever conflicts with these ideas is absolutely impossible and involves a contradiction" (CSMK III 202; AT III 476). Then, in a letter to More, 15 February 1649, Descartes writes that "I boldly assert that God can do everything that I perceive to be possible but I am not so bold as to assert the converse, namely that he cannot do what conflicts with my conception of things—I merely say it involves a contradiction" (CSMK III 363; AT V 272). In both cases Descartes is clearly talking about conceptual rather than logical contradiction, and yet he describes it as "absolutely impossible" or simply as involving a contradiction. Again, there is an important sense in which there is *no* logical contradiction according to Descartes.

[11] See, for example, Aquinas' *Summa Theologica*, Q. 25, Art. 3.

Descartes does not claim in the creation doctrine that God can do even what it is logically impossible to do. The claim is rather that God could have made the essences and necessary (but not logically necessary) relations of mathematical and metaphysical entities different from what they are. When Descartes talks of impossibility, he does not mean logical impossibility, which, he thinks, is nothing at all, but instead what is impossible given our conceptions of things, given, that is, the God-created essences and God-created relations among things. As Descartes remarks in the Second Replies, all impossibility is what I am here calling conceptual impossibility: "All self-contradictoriness or impossibility resides solely in our thought, when we make the mistake of joining together mutually inconsistent ideas" (CSM II 108; AT VII 152).

Creating the eternal truths

After 1630 Descartes holds that God creates the eternal truths of mathematics and metaphysics. Such truths, I have argued, are necessary without being logically necessary. And I have further argued that what is logically necessary needs no creative act because it, like what is logically impossible, is nothing at all. Interestingly, Descartes indicates that even God's existence is not logically necessary insofar as both the third Meditation proof for the existence of God and the fifth Meditation proof rely on necessary but non-logical truths. The third begins from one's own contingent existence as a finite being with doubts and takes as a crucial premise the necessary but non-logical truth that the cause of an idea must have at least as much formal reality as the idea has objective reality; it is this premise that enables one to infer that only God could be the cause of one's idea of God and hence must exist. But, again, this is not a logical truth: there is nothing about objective and formal reality in the very idea of a cause of an idea. Nevertheless, Descartes claims, "it is manifest by the natural light that there must be at least as much <reality> in the efficient and total cause as in the effect of that cause," from which it follows, he thinks, that the cause of an idea must have as much formal reality as the idea has objective reality (CSM II 28; AT VII 40).

The third Meditation proof of God's existence begins from one's own existence as a finite being with questions and doubts. The fifth Meditation proof begins directly from the concept of God: because God has, must have, all perfections, and existence is a perfection, God must then exist. This proof may seem to be analytic, merely a matter of unpacking, making explicit, what is contained already in the concept *God*. The text of the fifth Meditation suggests otherwise. Descartes writes:

> Since I have been accustomed to distinguish between existence and essence in everything else, I find it easy to persuade myself that existence can also be separated from the essence of God, and hence that God can be thought of as not existing. But when I concentrate more carefully, it is quite evident that existence can no more be separated from the essence of God than the fact that its three angles equal two right angles can be separated from the essence of a triangle, or that the idea of a mountain can be separated from the idea of a valley. Hence it is just as much a contradiction to think of God (that is, a supremely perfect being) lacking existence (that is, lacking a perfection) as it is to think of a mountain without a valley. (CSM II 46; AT VII 66)

Existence is not contained in the essence of God any more than it is contained in any other essence. It is not logically necessary that God exists. Still, Descartes argues, one cannot form a real or complete idea of God (to use terminology he employs elsewhere) without thinking also that God exists. Just as one cannot form a real or complete idea of a mountain without a valley or of a triangle without the angle-sum property so one cannot form a real or complete idea of God without existence. That God exists is necessary but not logically necessary. According to Descartes, then, God created us with the capacity to discover by reason alone that God exists and did so by implanting in us ideas on the basis of which to infer that God exists. Only because we are able to discover God-created necessary but not logically necessary truths that are innate in us can we come to know of God's existence.

According to Descartes, logically necessary truths have no content just because they are logically necessary. Their negations are absolutely impossible, nothing at all, and hence they are likewise nothing. Logically necessary truths do not, then, need to be created. Contingent truths also do not need to be created, though for a very different reason. There is no need for God to create any contingent truths (in a separate act of creation) because having created the world, that is, all the bodies and minds there are with all their various properties and relations, God thereby makes it true (as a matter of fact) that this and that are thus and so. In order to make it true that I exist, for example, it is enough that I am brought into existence. To create objects with their properties and relations just is to create thereby the relevant truths about them. But that takes care only of contingent truth. It is not by creating the bodies and minds there are, together with their properties and relations, that one creates the necessary truths. Suppose, for example, that God created the world in such a way that wherever there was extension there was also body, that nowhere was there extension that was not the extension of a body. That would not be sufficient to establish that all extension *must* be the extension of some body but only that, as a matter of fact, all extension *is* the extension of a body. Because they are necessary rather than contingent, and yet not logically necessary, the eternal truths require a separate act of creation over and above the creation of the world, bodies and minds together with their properties and relations.

But how exactly is an eternal truth to be created? In particular, how might such a truth be created if not by creating that about which it is a truth? And if one does create a necessary truth by creating the thing about which it is a truth, how does one, even an omnipotent being such as God, create something to have the relevant property *necessarily*? It is easy to see that this approach to the question of how the eternal truths are created, modeled on the creation of contingent truths, cannot be right. In the first place, we know that there are necessary truths about, say, triangles (and other mathematical and metaphysical entities) that hold independent of the existence of any triangles (or other mathematical or metaphysical entities). "Even if perhaps no such figure exists, or has ever existed, anywhere outside my thought, there is still a determinate nature, or essence, or form of the triangle which is immutable and eternal, and not invented by me or dependent on my mind" (CSM II 45; AT VII 64). There are necessary truths about things independent of the existence of those things. It furthermore cannot be right that God creates the eternal truths simply by creating our minds to have, as a matter of fact, a propensity to think that there are such necessary truths. Insofar as God is not a deceiver, what we perceive clearly and distinctly to be true must actually be true; it cannot merely be something we have, as a matter of fact, been caused to think.

Although the creation of the contingent truths is effected through the creation of the things of which they are true together with the relevant properties and relations, necessary truths cannot be created in the same way. So how are they created? To answer that question we need first to know *what* it is that is created in creating the eternal truths. Descartes' answer is clear: laws, more exactly, laws of the mind, that is, rules governing acts of inference. As we read already in the letter to Mersenne in which Descartes first announces the creation doctrine,

> It is God who has laid down these laws in nature just as a king lays down laws in his kingdom. There is no single one that we cannot grasp if our mind turns to consider it. They are all †inborn in our minds† just as a king would

> imprint his laws in the hearts of all his subjects if he had enough power to do so. (CSMK III 23; AT I 145)

In the letter of 27 May 1630, in response to Mersenne's asking what God did in order to produce the eternal truths, Descartes explains that "†from all eternity he willed and understood them to be, and by that very fact he created them†. Or, if you reserve the word †created† for the existence of things, then he †established them and made them†" (CSMK III 25; AT I 152–153). That the eternal truths are not themselves things, objects, and are not created through the creation of things, (whether minds or bodies) is indicated also in Descartes' fifth Replies. He writes in response to Gassendi's concerns about the mathematical essences of things:

> you say that you think it is 'very hard' to propose that there is anything immutable and eternal apart from God. You would be right to think this if I was talking about existing things or if I was proposing something as immutable in the sense that its immutability was independent of God [...] I do not think that the essences of things, and the mathematical truths we can know concerning them, are independent of God. Nevertheless I do think that they are immutable and eternal, since the will and decree of God willed and decreed that they should be so. (CSM II 261; AT VII 380)

The creation of the eternal truths is not a matter of creating things, bodies and minds. The eternal truths are instead laws that are decreed. The point is reinforced in the sixth Replies in which Descartes compares God's creation of "truths, both mathematical and metaphysical" to a king's laying down the law of the land. God is the efficient cause of the eternal truths "in the sense that a king may be called the efficient case of a law, although the law itself is not a thing which has physical existence, but is merely what they call a 'moral entity'". "The eternal truths [...] depend on God alone, who, as the supreme legislator, has ordained them from eternity" (CSM II 294; AT VII 436). Again, these are not laws of things, as we know given that they are binding even were there no triangles or material bodies at all. They are laws of the mind, of inference, of the passage from one thought to another.

To say that As are necessarily B, though being B is not contained already in the very idea of A, is to say, at least, that one can infer from something's being A that it is B. And by contrast with a law of logic, that is, with a case in which being B is contained already in the concept of A, such a license really is a license, something that permits one to do something that one could not otherwise do. It governs the passage from the judgment that a thing is A to the judgment that it is B, where this is not merely a matter of making explicit something that is contained already in the judgment that the thing is A but is ampliative, a real extension of our knowledge. What God creates in creating the eternal truths are rules of inference, not logical or merely formal rules (which we have seen need no act of creation because they are not inference licenses at all but only a means of making things explicit), but material rules, rules that govern the passage from one claim to a different claim, one that is entailed by the first but not contained already in it. And much as creating the empirical world is sufficient for the creation of all the contingent truths, so creating such material rules of inference as there are is sufficient for the creation of all the necessary but non-logical truths, what Descartes calls the eternal truths. The mere fact that being A entails being B, that there is an inference license to that effect, is sufficient to explain the (non-logical) truth that all As are and must be B. And now we can understand what it is to have a complete, or real, idea. Such an idea comprises not only what *is* the case given the concept in question (say, that of a mountain), but also what *follows*, namely, that there is a valley as well.

To create the eternal truths of mathematics and metaphysics it is sufficient to decree certain laws of thought, rules permitting one to infer something not contained in what one already knows and extending thereby one's knowledge. In the case of a triangle, for example, "it is necessary that I attribute to it the properties which license the inference that its three angles equal no more than two right angles" (CSM II 47; AT VII 67–68). Although the conclusion is not contained already in one's starting point, nonetheless everything that is needed in order to draw the conclusion is available. It is the inference, the mental act of reasoning that Descartes describes in the first Replies as a "clear and distinct intellectual operation," that enables an extension of one's knowledge. And Descartes is quite explicit about this, even in the *Rules*. Deduction as described in Rule Three is "the inference of something as following necessarily from some other propositions which are known with certainty" (CSM I 15; AT X 369). It is an act of mind that extends one's knowledge. And much as one cannot see or know what is not so, so one cannot deduce what is not so—although of course one can seem to. "Deduction […] is not something a man can perform wrongly" (CSM I 14; AT X 368).

In the second Replies, Descartes distinguishes two methods of demonstration, by analysis and by synthesis. Analysis, "which is the best and truest method of instruction" (CSM II 111; AT VII 156),

> shows the true way by means of which the thing in question was discovered methodically and as it were *a priori*, so that if a reader is willing to follow it and give sufficient attention to all points, he will make the thing his own and understand it just as perfectly as if he had discovered it for himself. But this method contains nothing to compel belief in an argumentative or inattentive reader; for if he fails to attend even to the smallest point, he will not see the necessity of the conclusion. (CSM II 110; AT VII 155–156)

Analysis, on Descartes' account, is ampliative; it reveals new things and does so, as Descartes thinks of it after 1630, by utilizing the inference licenses that are laid down by God and underwrite the eternal truths of mathematics and metaphysics. But once having discovered some chain of reasoning to such a truth it is possible then to formalize the reasoning in such a way that each step of inference is governed not by a rule of material inference but instead by a rule of formal inference, a law of logic. Where there had been a step governed by a rule to the effect that, say, being A entails being B—a rule that licenses a move from the fact that some object is A to the conclusion that it is B—now there is an added premises stating that all A is B. Where before one was able to infer, given that some object is A, that it is B, now one's premises contain already this information. All that one's inference (now only so-called) does is to make that information explicit. This strictly formal, strictly logical method is what Descartes calls synthesis: "it demonstrates the conclusion clearly and employs a long series of definitions, postulates, axioms, theorems and problems, so that if anyone denies one of the conclusions it can be shown at once that it is contained in what has gone before, and hence the reader, however argumentative or stubborn he may be, is compelled to given his assent" (CSM II 111; AT VII 156). In the formal proof, unlike the original, materially valid one, the conclusion is contained already in one's premises; all the proof does is make that explicit. But because it only makes explicit what was implicit already in one's premises, such a formal proof, although it compels assent, is actually more liable to error than the original, materially valid proof. As Descartes explains in Rule Ten of the *Rules*, in formally or logically valid inferences "the conclusions follow with such irresistible necessity that if our reason relies on them, even though it takes, as it were, a rest from considering a particular inference clearly and attentively, it can nevertheless draw a conclusion which is certain simply in virtue of the form" (CSM I 36; AT X 405–406). Not only can we learn nothing new from a logically valid inference, because it is valid in virtue of form—because one does not need to attend to the content, what is actually being asserted—formal reasoning can easily lead one astray. One thinks that one's conclusion is true because it follows logically from one's (apparently true) premises but perhaps it is instead the case that one or more of one's premises are false, something that one is liable to notice only if one is actually thinking about what those premises mean and what follows if they are true. Thus, Descartes concludes, "ordinary dialectic [that is, pure, formal logic] is of no use whatever to those who wish to investigate the truth of things" (CSM I 37; AT X 406).

Conclusion

Descartes' creation doctrine, his claim that God freely creates the eternal truths of mathematics and metaphysics, is almost universally regarded as an extremely bizarre and unfortunate idea. I have tried to show that it is not. And we see that it is not when we consider the fundamental changes, right around the time Descartes first espouses the doctrine, in Descartes' view of how inquiry in mathematics and metaphysics works. Once Descartes came to see that images are not needed in mathematics and first philosophy, he needed some other way to explain how we achieve knowledge of the necessary but not logically necessary truths of mathematics and metaphysics, how we achieve such knowledge using only the pure intellect. Given his conception of intuition and deduction in the *Rules*, and of clear and distinct perceptions in later works, it would suffice if God were to *create*, that is, decree, the non-logical inference rules that govern our thinking, at least when we are engaged in the analytic method of demonstration. And this, I have argued, is just what Descartes did come to think. God is the author of the necessary unities of conceptual contents that are exhibited in non-logical rules of inference concerning what entails and is entailed by what. And we come to grasp such rules through our clear and distinct grasp of the relevant concepts; we come to see what follows in light of things we already know. And because these inferences are not strictly logical, not merely a matter of making explicit something that is implicitly contained already in our starting points, to make such an inference is to discover something new, something enabled by one's starting point but not contained already in it. It was Descartes' transformed practice, his discovery that images are not needed in mathematics and metaphysics, that directly explains *why* Descartes came to think that God freely creates the eternal truths of mathematics and metaphysics, and also thereby *what* it is to think that.

References

Alanen, L. (1988), 'Descartes, omnipotence, and kinds of modality,' in P. H. Hare (ed.) *Doing Philosophy Historically*, Buffalo, NY: Prometheus Books.

—— (1991), 'Descartes, conceivability and logical modality,' in T. Horowitz & G. J. Massey (eds.) *Thought Experiments in Science and Philosophy*, Savage, MD: Rowman and Littlefield.

Aquinas, T. (2006), *Summa Theologiae, Questions on God*, ed. by B. Leftow & B. Davies, Cambridge & New York: Cambridge University Press.

Ariew, R. (2006), 'Descartes, the first Cartesians, and logic,' in *Oxford Studies in Early Modern Philosophy*, vol. 3, pp. 241–260.

Bennett, J. (1994), "Descartes' theory of modality," *Philosophical Review*, vol. 103, pp. 639–667. https://doi.org/10.2307/2186100

Bréhier, É. ([1937]1967), "The creation of the eternal truths in Descartes's system," in W. Doney (ed.) *Descartes: A Collection of Critical Essays*, London & Basingstoke: Macmillan and Co Ltd. https://doi.org/10.1007/978-1-349-15265-0_9

Broughton, J. (1987), "Necessity and physical laws in Descartes' philosophy," *Pacific Philosophical Quarterly*, vol. 68, pp. 205–221.

—— (2002), *Descartes's Method of Doubt*, Princeton & Oxford: Princeton University Press.

Curley, E. M. (1984), 'Descartes on the creation of the eternal truths,' *Philosophical Review*, vol. 93, no. 4, pp. 569–597. https://doi.org/10.2307/2184828

Descartes, R. (1984), *The Philosophical Writings of Descartes*, vol. II [CSM II], transl. by J. Cottingham, R. Stoothoff & D. Murdoch, Cambridge: Cambridge University Press.

—— (1985), *The Philosophical Writings of Descartes*, vol. I [CSM I], transl. by J. Cottingham, R. Stoothoff & D. Murdoch, Cambridge: Cambridge University Press.

—— (1991), *The Philosophical Writings of Descartes*, vol. III: The Correspondence [CSMK III], transl. by J. Cottingham, R. Stoothoff, D. Murdoch & A. Kenny, Cambridge: Cambridge University Press.

Frankfurt, H. (1977), 'Descartes on the creation of the eternal truths,' *Philosophical Review*, vol. 86, no. 1, pp. 36–57. https://doi.org/10.2307/2184161

Funkenstein, A. ([1975]1991), 'Descartes, eternal truths and the divine omnipotence,' in G. J. D. Moyal (ed.) *René Descartes: Critical Assessments*, vol. 3, London & New York: Routledge.

Gaukroger, S. (1992), "Descartes's early doctrine of clear and distinct ideas," *Journal of the History of Ideas*, vol. 53, no. 4, pp. 585–602.
https://doi.org/10.2307/2709939

Geach, P. (1973), 'Omnipotence,' *Philosophy*, vol. 48, pp. 7–20. https://doi.org/10.1017/S0031819100060381

Hacking, I. ([1973]2002), 'Leibniz and Descartes: proof and eternal truths,' in *Historical Ontology*, Cambridge, MA: Harvard University Press.

Ishiguro, H. (1986), 'The status of necessity and impossibility in Descartes,' in A. Rorty (ed.) *Essays on Descartes' Meditations*, Berkeley & Los Angeles: University of California Press.

Kant, I. ([1781/1787]1998), *Critique of Pure Reason*, transl. by P. Guyer & A. W. Wood, Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511804649

Kaufman, D. (2002), "Descartes' creation doctrine and modality," *Australasian Journal of Philosophy*, vol. 80, pp. 24–41. https://doi.org/10.1080/0960878032000160235

—— (2003), 'Divine simplicity and the eternal truths in Descartes,' *British Journal for the History of Philosophy*, vol. 11, pp. 553–579.

Kenny, A. (1970), 'The Cartesian circle and the eternal truths,' *Journal of Philosophy*, vol. 67, pp. 685–700. https://doi.org/10.2307/2024588

Leibniz, G. W. ([1686]1956), 'Discourse on metaphysics,' in L. E. Loemker (ed.) *Philosophical Papers and Letters*, Dordrecht, Boston & London: D. Reidel.

Malebranche, N. ([1674/5]1980), *The Search after Truth*, transl. by T. M. Lennon & P. J. Olscamp, Columbus: Ohio State University Press.

Marion, J.-L. (1992), 'Cartesian metaphysics and the role of simple natures,' in J. Cottingham (ed.) *The Cambridge Companion to Descartes*, Cambridge: Cambridge University Press. https://doi.org/10.1017/CCOL0521366232.005

Miller, L. G. (1957), 'Descartes, mathematics, and God,' *Philosophical Review*, vol. 66, pp. 451–465. https://doi.org/10.2307/2182744

Nadler, S. M. (1987), 'Scientific certainty and the creation of the eternal truths: A Problem in Descartes,' *Southern Journal of Philosophy*, vol. 25, pp. 175–192. https://doi.org/10.1111/j.2041-6962.1987.tb01615.x

Nelson, A. (1993), 'Cartesian actualism in the Leibniz-Arnauld correspondence,' *Canadian Journal of Philosophy*, vol. 23, pp. 675–94. https://doi.org/10.1080/00455091.1993.10717341

Nelson, A. & Cunning, D. (1999), 'Cognition and modality in Descartes,' *Acta Philosophica Fennica*, vol. 64, pp. 137–153.

Nolan, L. (1997), 'The ontological status of Cartesian natures,' *Pacific Philosophical Quarterly*, vol. 78, pp. 169–194. https://doi.org/10.1111/1468-0114.00034

Normore, C. (1991), "Descartes's possibilities," in G. J. D. Moyal (ed.) *René Descartes: Critical Assessments*, vol. III, London & New York: Routledge. https://doi.org/10.1007/BF01064011

—— (1993), 'The necessity in deduction: Cartesian inference and its medieval background,' *Synthese*, vol. 96, no. 3, pp. 437–454.

Osler, M. J. (1985), "Eternal truths and the laws of nature: the theological foundations of Descartes' philosophy of nature," *Journal of the History of Ideas*, vol. 46, no. 3, pp. 349–362. https://doi.org/10.2307/2709472

Pessin, A. (2006), 'Descartes on the divine eternal truths,' *Yeditepe' de felsefe*, vol. 5, pp. 133–166. https://doi.org/10.1007/s11406-009-9189-1

—— (2010), 'Divine simplicity and the eternal truths: Descartes and the scholastics,' *Philosophia*, vol. 38, pp. 69–105.

Rozemond, M. (2008), "Descartes's ontology of the eternal truths," in P. Hoffman, D. Owen & G. Yaffe (eds.) *Contemporary Perspectives on Early Modern Philosophy: Essays in Honor of Vere Chappell*, Peterborough, Ontario: Broadview Press.

Schmaltz, T. (1991), "Platonism and Descartes' view of immutable essences," *Archiv für Geschichte der Philosophie*, vol. 73, pp. 129–170. https://doi.org/10.1515/agph.1991.73.2.129

Van Cleve, J. (1994), 'Descartes and the destruction of the eternal truths,' *Ratio*, vol. 7, pp. 58–62. https://doi.org/10.1111/j.1467-9329.1994.tb00153.x

Walski, G. (2003), 'The Cartesian God and the eternal truths,' in D. Garber & S. Nadler (eds.) *Oxford Studies in Early Modern Philosophy*, vol. I, Oxford: Clarendon Press.

Wilson, M. (1978), *Descartes*, London, Henley & Boston: Routledge and Kegan Paul. https://doi.org/10.4324/9780203167670

Danielle Macbeth is T. Wistar Brown Professor of Philosophy at Haverford College in Pennsylvania, USA. She is the author of *Frege's Logic* (Harvard UP, 2005) and *Realizing Reason: A Narrative of Truth and Knowing* (Oxford UP, 2014), as well as many essays on a variety of issues in the philosophy of language, the philosophy of mind, the history and philosophy of mathematics, and other topics. She was a Fellow at the Center for Advanced Study in the Behavioral Sciences in Palo Alto in 2002–2003, and has been awarded both an American Council of Learned Societies (ACLS) Burkhardt Fellowship and a Fellowship from the National Endowment for the Humanities (NEH).

Acta Baltica Historiae et Philosophiae Scientiarum
Vol. 5, No. 1 (Spring 2017)
DOI : 10.11590/abhps.2017.1.02

Are Other People's Books Difficult to Read? The Logic Books in Lewis Carroll's Private Library

Amirouche Moktefi

Ragnar Nurkse Department of Innovation and Governance,
Tallinn University of Technology
Akadeemia tee 3,
Tallinn 12618, Estonia
E-mail: amirouche.moktefi@ttu.ee

Abstract: It is well known that Charles L. Dodgson (alias Lewis Carroll, 1832–1898) worked on a logic treatise that would popularise the subject of symbolic logic. The first part appeared in 1896 but the next parts never appeared. It has been claimed that Carroll worked in isolation and did not read the main works of his time. The object of this paper is to inquire what Carroll's private library teaches us on his readings. The content of this library is known thanks to the sale catalogues that were issued when the library was auctioned at Carroll's death. This paper provides an overview of the logic books owned by Carroll. Then, it investigates the extent to which Carroll was acquainted with the main logic works of his time. Finally, the paper considers some methodological issues related to the use of 'library arguments' in intellectual history.

Keywords: *history of logic, Lewis Carroll, library argument, private library*

A Dutch proverb states that "Other people's books are difficult to read". Yet, reading others' work is an indispensable part of scientific activity. Hence, bibliographies, reading lists and library catalogues can provide valuable information for the historian of science. This study explores a case based on Lewis Carroll's (1832–1898) private library. Carroll (whose real name was Charles L. Dodgson) was a mathematical lecturer at Christ Church, University of Oxford (Wilson, 2008). In the last decade of his life, he actively worked on a treatise that would make symbolic logic accessible to a wide audience (Bartley, 1986; Moktefi, 2008; Abeles, 2010). A study of the logic books in Carroll's library is expected to evidence the extent to which he read the work of his contemporaries, especially the promoters of the new algebraic logic that developed in Victorian

Britain (Grattan-Guinness, 2011). In this study, we first describe Carroll's library. Then, we inspect the sale catalogues to track the presence and dispersal of the logic books. Finally, we consider what the collection of logic books in Carroll's library teaches us on his logical work and acquaintances.

The library

At Carroll's death on 14 January 1898, his personal effects had to be quickly removed from his rooms at Christ Church, Oxford. Many of his belongings were dispersed or destroyed. In particular, the books he owned were offered for sale in an auction and were dispersed. Carroll's nephew and first biographer, Stuart D. Collingwood, recalled this episode with bitterness:

> His library has now been broken up and, except for a few books retained by his nearest relatives, scattered to the winds; such dispersions are inevitable, but they are none the less regrettable. It always seems to me that one of the saddest things about the death of a literary man is the fact that the breaking-up of his collection of books almost invariably follows; the building up of a good library, the work of a lifetime, has been so much labour lost, so far as future generations are concerned. Talent, yes, and genius too, are displayed not only in writing books but also in buying them, and it is a pity that the ruthless hammer of the auctioneer should render so much energy and skill fruitless. (Collingwood, 1898, pp. 135–136)

It seems that Carroll himself kept a register of his books but, unfortunately, it has not survived (Lovett, 2005, p. 8). The best source we have to reconstruct the content of his library is the sale catalogue of the auction that was organised on 10 May 1898. The auctioneer M. J. Brook organised the books in about a thousand lots that were only partly described in the catalogue. For instance, lot 585 was described as follows (Stern, 1997, p. 31):

> **585** Todhunter's History of the Theory of Probability, Tait's Quaternions, Halsted's Elements of Geometry and 6 others.

This entry provides sufficient information to identify three books in the lot but leaves six other items undescribed. Since lots evidently gathered books that belong to the same area (here, mathematics), it is reasonable to infer that the six items that were left undescribed were also mathematical volumes. Even the described items are not detailed as editions and dates of publication are seldom given. Also, many descriptions contain serious typos which suggest that the catalogue was dictated and hastily prepared for the auction.

Fortunately, several secondary sale catalogues have been issued by major booksellers who bought large amounts of books at the Brooks auction. Three such catalogues are of particular interest to our purpose. The first was issued by H. H. Blackwell in June 1898, one month after the auction, and contained about 360 volumes. Another catalogue was issued by J. Parker in October 1898 and described about 250 volumes. Finally, a catalogue was issued on 1898 by the Art and Antique Agency and contained more than 400 books. Interestingly, these secondary catalogues were prepared with more care and provide further information about the books than the primary catalogue prepared for the initial auction. In addition, they reveal new items that were left undescribed in the Brooks catalogue.

The primary and secondary catalogues have been first collected and reproduced by Stern in 1981 without an index (Stern, 1981). Then, in 1997, Stern provided an index of 2,231 titles that were found in the sale catalogues (Stern, 1997). More recently, Charlie Lovett prepared a catalogue of 2,365 titles that Carroll owned or read (Lovett, 2005). In addition to the books found in the library, Lovett included "any book which evidence indicates that Dodgson read, even if there is no evidence he owned a copy and even if we can only prove that he read part of it" (Lovett, 2005, p. 2). Carroll, evidently, owned many more books that are not found in any of these catalogues: prior to the auction, his family kept some books, offered some as gifts and sold some without record (Lovett, 2005, p. 3). Among the books left undescribed in the primary catalogue, many were not re-offered for sale and do not appear in secondary catalogues. It is also obvious that Carroll may have owned books that were not part of his library at his death. Although it is difficult to make a confident estimation of the total number of titles he owned in his library, it is safe to state that Carroll owned several thousand volumes, which make it a respectable private library for a Victorian intellectual of his status (Pearson, 2006). In addition to purchases, many books were gifts or presentation copies from their authors. Also, several volumes were books that Carroll used in his early school years or that previously belonged to his parents and were given to him.

The library apparently contained books for Carroll's use rather than for mere collection, but exceptions are certainly found. The content of the library evidences the variety of subjects that interested Carroll. It is with no surprise that we find large quantities of literary works but scientific books, especially medicine, are also well represented (Smith, 1984–1985). Further study of the content of the library should be carried out with great caution. If the presence of a title in the library reasonably indicates Carroll's knowledge of it, more investigation is needed to claim familiarity. One has notably to inquire the date of acquisition and the extent to which Carroll read or used that title. The absence of a title from the library should also be carefully considered. It should be first reminded that our incomplete knowledge of the contents of the library does not allow us to make definitive statements as to the absence of a given title from it. Then, one should not take the absence from the library as evidence of ignorance. For instance, Eric T. Bell stated that the presence of "mediocre" works by James Wood and Miles Bland in Carroll's library rather than George Peacock's was "indicative of [his] low mathematical taste and poor aptitude for mathematics" (Lennon, 1972, p. 407). But Carroll did actually refer to Peacock's algebra in the preface of his treatise on determinants (Dodgson, 1867, p. v). In line with Bell, it has often been stated that Carroll worked in isolation and "read comparatively little of the works of other mathematicians or logicians, preferring to develop his theories out of his own mind" (Hudson, 1976, p. 132). However, several recent historians argued that Carroll actually knew the main British mathematicians of his time: he met or corresponded with some of them, and referred to the work of others (Seneta, 1993, p. 182; Abeles, 1994, p. 16; 2010, p. 6; Wakeling, 2015, pp. 117–151).

It seems to some extent appropriate to claim that Carroll was not "what could be described as an active research mathematician. Indeed, he did not belong to any mathematical or scientific societies, nor did he subscribe to the major mathematics research journals of the day" (Rice & Torrence, 2007, p. 93). However, one needs to keep in mind that Carroll was primarily a mathematics teacher, and most of his writings concerned educational issues. His library sale catalogues show that he owned copies of mathematical journals (such as the *Messenger of Mathematics* and the *Quarterly Journal of Pure and Applied Mathematics*) that were primarily aimed for teachers, students and junior mathematicians (Despeaux, 2007; Moktefi, 2007b, pp. 20–21).

Yet, it should not be inferred that Carroll worked in isolation. He actually cultivated a network of mathematical friends in Oxford with whom he regularly exchanged on various issues that occupied him. He also regularly appealed to the local professors, such as Henry J. S. Smith (mathematics) and John Cook Wilson (logic). Moreover, Carroll asked on several occasions for the opinion of his colleagues in Cambridge and beyond (Abeles, 1994; Wakeling, 2015). Even though he was not an avid and regular reader of the general mathematical literature of his time, Carroll certainly inquired on the advancement of the mathematical subjects that he specifically explored. The debate on the geometrical teaching that occurred in his time offers a good illustration of Carroll's effort to acquire and read the books that others wrote on a subject that was of high interest to him. Euclid's dominance was challenged by the late 1860s when several textbooks were offered to replace the *Elements* for teaching purposes (Moktefi, 2011). Carroll collected the main books that were offered as substitutes and reviewed them in *Euclid and His Modern Rivals* (Dodgson, 1879). Many of the books he discussed there are found in the sale catalogues of his library. It is the object of the next sections to inquire to what extent Carroll worked likewise in logic and to what extent he read the works of his time.

The catalogues

In the following, we refer to the existing catalogues and indexes with the letters attributed to them by Stern and Lovett as shown in Table 1:

Table 1. The list of catalogues and indexes

Catalogue A	Issued by M. J. Brooks, 1898
Catalogue B	Issued by H. H. Blackwell, 1898
Catalogue D	Issued by J. Parker, 1898
Catalogue E	Issued by the Art and Antique Agency, 1898
Catalogue S	Issued by J. Stern, 1997
Catalogue L	Issued by Lovett, 2005

In order to identify the logic books in Carroll's library, one faces an inevitable difficulty: to define the scope of logic. Indeed, especially in the nineteenth century, logic refers to a multitude of subjects and areas, including what would more likely find place today on the shelves of methodology, philosophy of science or philosophy of mind. For our purpose, we restricted the inquiry to works on deductive or formal logic because it was the area of logic that Carroll himself investigated. Hence, we excluded works on inductive logic and on chances. We also did not include several books in what was called mental philosophy and in religious thinking, even when they may be of interest to the logician. These restrictions explain the absence from our study of important works that Carroll actually owned, such as Dugald Stewart's *Elements of the Philosophy of the Human Mind* (whose first volume first appeared in 1792), William Whewell's *Philosophy of the Inductive Sciences* (first published in 1840), and John Venn's *Logic of Chance* (first published in 1866). Insofar as we are concerned with formal logic, there are eight lots in primary Catalogue *A* that describe relevant titles (Stern, 1997, pp. 25–26):

> **505** Jevon's Principles of Sciences (2 vols.), Keyne's Formal Logic, Laws of Thought, and 4 others.
>
> **506** Picton's Mystery of Matter, Minto's Logic, Man and his Dwelling Place and 8 others.
>
> **508** Bosanquet's Logic (2 vols.) De Morgan's Formal Logic, Kynes' Formal Logic and 3 others.
>
> **509** Sir Wm. Hamilton's Lectures (4vols.)
>
> **510** Mill's Logic (2 vols.), Mansel's Prolegomena, second edition, Mill's Examination of Hamilton, morocco, extra
>
> **515** Bradley's Principles of Logic, 8vo.
>
> **516** Newman's Grammar of Assent, Sidgwick's Falacies, Picture Logic and 8 others
>
> **517** Welton's Manual of Logic (2 vols.), Venn's Logic of Chance, Venn's Symbolic Logic and 4 others.

These 8 lots reveal 15 (deductive) logic titles, among which one appears twice (Keynes' *Formal Logic* in lots 505 and 508). All books can be easily identified as both author and title are given, except *Picture Logic* (in lot 516) and *Laws of Thought* (in lot 505). The former evidently is Swinburne's *Picture Logic* (first published in 1875). The latter most likely stands for either Boole's *An Investigation of the Laws of Thought* (published in 1854) or William Thomson's *An Outline of the Necessary Laws of Thought* (first published in 1849). Stern listed both Thomson and Boole in his index (Stern, 1997, pp. 115, 155), while Lovett included Thomson alone (Lovett, 2005, p. 314). In addition to the described volumes, the lots indicate the presence of additional items which are likely to be logic books but are left undescribed.

Among the 15 titles found in catalogue *A*, 10 are also found in the secondary catalogues: 7 in catalogue *B* and 3 in catalogue *D*. No title of catalogue A is found in catalogue *E*. The titles described both in the primary catalogue and in one of the secondary catalogues give useful indication on the routes of dispersal of the volumes. Since the books were sold by lots, it is expected that all the books that were part of a given lot, including the undescribed items, will be found in the same secondary catalogue. Figure 1 condenses information gathered on the sale of the lots.

In addition to the 15 titles previously described in catalogue *A*, secondary catalogues reveal 8 titles that were not previously described: 2 are revealed in catalogue *B* (*Studies in Logic* by the Members of Johns Hopkins University, and Richard Whately's *Logic*), 3 are revealed in catalogue *D* (Augustus De Morgan's *Proposed System of Logic*, James William Gilbart's *Logic for the Million*, and Rudolph H. Lotze's *Logic*), and finally 3 are revealed in catalogue *E* (Henry Holman's *Questions on Logic*, J. P. Hughlings' *The Logic of Names*, and W. Stanley Jevons' *Pure Logic*). These titles, evidently, were among the undescribed items mentioned in the lots of catalogue *A*, likely one of the lots identified above, but possibly in some other unidentified lots. To determine the provenance of these new titles, one has to keep in mind that the books revealed in a given secondary catalogue could not have been part of a lot which is known to have been bought by another purchaser. For instance, the three books revealed by catalogue *D* evidently were not part of the lots (509, 510, and 517) which were sold to the bookseller who issued catalogue *B*. They might well correspond to the three items left undescribed in lot 508, which is known to have been purchased by the bookseller who issued catalogue *D*.

This method of profiling can give valuable information about undecided items. For instance, it has been stated that Stern and Lovett disagreed as to the identification of the *Laws of Thought* volume described in lot 505. Stern attributed it to Boole, while Lovett favoured Thomson. The latter's has the advantage of being described in secondary catalogue *B*, while Boole's never appears in subsequent catalogues. Tracking the disputed volume after the sale may help in determining the authorship. First, it has been seen that Keynes' *Formal Logic* appeared twice in primary catalogue *A* (in lots 505 and 508), but only once in secondary catalogues (in *D*). Since lot 508 was purchased by the bookseller who issued catalogue *D*, it follows that the copy of Keynes found in catalogue *D* likely came from that lot. Hence, the copy of Keynes from lot 505 was apparently not re-offered for sale. Jevons' volume from the same lot 505 also

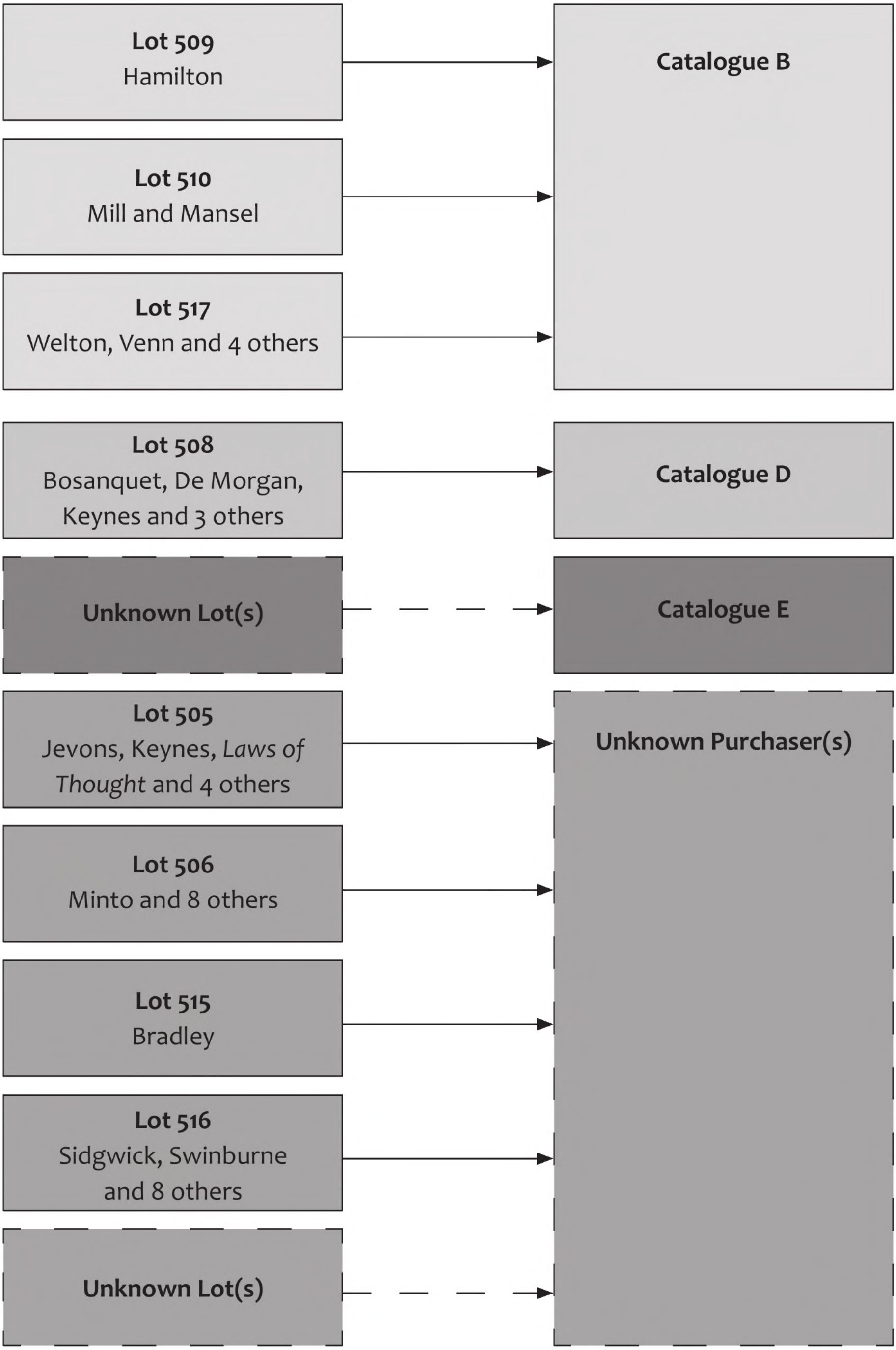

Figure 1. The dispersal of logic books

is not found in any secondary catalogue. It follows that lot 505 likely was not sold to any of the three major booksellers who issued catalogues *B*, *D*, and *E*. But Thomson's *Laws of Thought* was found in catalogue *B*. So, the presence of Thomson ironically suggests that it was *not* the disputed title described as *Laws of Thought* in lot 505 of Catalogue *A*. This argument based on the sale catalogues rather supports Boole as the most likely candidate.

In addition to the 23 titles revealed in catalogues *A*, *B*, *D* and *E*, further titles have been added by Stern and Lovett. Stern included the disputed Boole as stated above. Lovett added two titles: Thomas Fowler's *Elements of Deductive Logic* and John Huyshe's *A Treatise on Logic*. However, he held both to be "uncertain" because their identification was questionable. Finally, we can safely add William Renton's *Analytic Theory of Logic* (published in 1887) to the contents of Carroll's library, even though one cannot tell if it was there at Carroll's death. Indeed, a letter dated 6 September 1888 from Renton to Carroll reveals that the former sent a copy of his book to the latter (Weaver, 1980, p. 154). These various sources provide appropriate information to compile a list of logic titles that were present in Carroll's library, as shown in Table 2:

Table 2. The logic titles revealed in the catalogues

Titles revealed in Catalogue A	15
Titles revealed in Catalogue B	2
Titles revealed in Catalogue D	3
Titles revealed in Catalogue E	3
Titles revealed in Catalogue S	1
Titles revealed in Catalogue L	2
Titles not found in above catalogues	1
Total	27

Hence, we have a list of 27 titles identified in Carroll's library, among which 3 are uncertain. This list is appended to this note. It is hoped that other titles will appear in sale catalogues, descriptions of private collections or in other sources.

The logic books

A first look at the list of logic books in Carroll's library shows that he owned much of what one would expect a British logician of the time to read. It is true that a modern reader will immediately notice the absence of Gottlob Frege's *Begriffsschrifft* (published in 1879), commonly considered as one of the most important books in the history of logic. But one can hardly blame Carroll for not owning it, if he did not, for this book did not get recognition before the beginning of the twentieth century. In Britain, and especially in Oxford, a student of logic would rather read other classical texts. A guide-book for Oxford students from 1861 recommends a thorough knowledge of Aldrich's compendium:

> The Oxford system has always, in accordance with the plan pursued in its other branches of study, required a thorough knowledge of a certain text-book as a foundation for Logic. This text-book, the shorter Compendium of Aldrich, is indeed miserably deficient, even when read (as it must be by the Class-man) in Professor Mansel's edition with notes and appendix. It is a compendium of a compendium, the meager fare on which Oxford had been content to subsist till Archbishop Whately and Sir William Hamilton recovered for the study some portion of its ancient consideration; but until something better is provided to take its place, it must be got up, a great deal of it by heart, and the rest with the greatest care. (Burrows, 1861, p. 82)

Mansel, Hamilton and Whately are all found in Carroll's library, as is found Mill's *System of Logic* (first published in 1843, Carroll's copy was of the 1851 edition). Carroll likely was familiar with these texts since his early years in Oxford. On 13 March 1855, he recorded in his journal a reading plan where Mill's logic is listed (Wakeling, 1993, p. 74).

Evidently, Carroll was also familiar with De Morgan's logic works. De Morgan has been a lifelong companion to Carroll's mathematical investigations. In addition to the first editions of *Formal Logic* (1847) and *Syllabus of a Proposed System of Logic* (1860), Carroll's library contained six other works by De Morgan on various mathematical subjects. One of them, *An Essay on Probabilities* (first published in 1838) was apparently bought by Carroll on 23 February 1858 (Wakeling, 1995, p. 158). Later, Carroll appended to his defence of Euclid large passages from a text by De Morgan with whom he shared admiration for Euclid (Dodgson, 1879, pp. 221–226). Finally, Carroll referred to several problems by De Morgan in the projected second part of his *Symbolic Logic* (Bartley, 1986,

p. 477). De Morgan can be seen as a major contributor to both traditional and symbolic logic, both directions being well represented in Carroll's library.

Indeed, one finds several traditional logic textbooks and treatises among Carroll's books. Some of them are the work of Oxford logicians with whom Carroll regularly exchanged: William Thomson, Thomas Fowler, Bernard Bosanquet and Francis H. Bradley. Others were minor texts that enjoyed some success in Carroll's time by William Minto, Alfred Sidgwick and James Welton (with whom Carroll exchanged some correspondence in 1894). Finally, one might include in this tradition Keynes' essential work: *Studies and Exercises in Formal Logic* (first published in 1884, with subsequent editions in 1887, 1894 and 1906). This work was viewed as the culmination of non-mathematical formal logic in its time. Carroll owned at least two copies of it, including a copy of the third edition inscribed "Rev. C. L. Dodgson, with the Author's kind regards" (Stern, 1997, p. 67). He referred to both copies in his journal (Wakeling, 2005, pp. 152, 180) and in his *Symbolic Logic* (Bartley, 1986, pp. 235, 478).

Two minor logic works from Carroll's library deserve a special notice: Gilbart's *Logic for the Million* (first published in 1851, Carroll's copy from the 1865 edition) and Swinburne's *Picture Logic* (first published in 1875). Indeed, both were books that aimed at popularising logic and, as such, seem to contradict Carroll's claim that his *Symbolic Logic* was "the very first attempt (with the exception of [his] own little book, *The Game of Logic*, published in 1886, a very incomplete performance) that has been made to *popularise* this fascinating subject" (Carroll, 1897, p. xiv). Carroll's ownership of Gilbart and Swinburne's popular books suggests that it was symbolic logic specifically that Carroll had in mind when he claimed priority for the popularisation of this 'fascinating subject' (Moktefi, 2015).

The last set of books that will be described assembles the works that were developed within the symbolic tradition that originated in Boole and was subsequently pursued in Britain by Jevons and Venn. All three authors are found in the library. Even though it is uncertain, Carroll likely owned a copy of Boole's *Laws of Thought* (1854). However, it is undisputed that Carroll knew Boole's logical work, either from the latter's writings or through other sources. On 25 May 1876, he reported in his journal using a notation after "Boole's plan but with an addition which occurred to [him] the other day" (Wakeling, 2001, pp. 463–464). On 20 November 1884, he recorded "getting to a simpler notation than Boole's" (Wakeling, 2004, p. 153). Finally, Carroll also referred to Boole's *Laws of Thought* in his projected *Symbolic Logic* where he devoted a chapter to the solution of problems set by other writers (Bartley, 1986, pp. 477–478). In addition to De Morgan, Keynes and Boole, Carroll also cites W. B. Grove, Jevons, Venn and the Members of Johns Hopkins University.

It is unclear when and to what extent Carroll discovered Venn's logic work. There are certainly many resemblances between their works, notably the title of their books and the invention of original diagrams. But there is no direct reference to Venn in Carroll's writings prior to 1894. That year, Carroll spread among logicians a problem known as the barbershop paradox to collect their opinion (Carroll, 1894; Moktefi, 2007a). Interestingly, Carroll first contacted Henry Sidgwick, Professor of Philosophy at the University of Cambridge, and asked him "who *is* the chief Logician in your University?" (Dodgson, 1894). It is likely that it was through Sidgwick that Carroll was introduced to Venn. In the second edition of his *Symbolic Logic* published that year (1894), Venn addressed the barbershop problem and renamed it the "*Alice* problem" because "the proposer is, to the general reader, better known in a very different branch of literature" (Venn, 1894, p. 442). Carroll later referred in his own *Symbolic Logic* to both editions of Venn's (Carroll, 1897, p. 175; Bartley, 1986, p. 478).

Even though Carroll and Venn might not have got in contact prior to 1894, it is evident that they knew of each other earlier. Indeed, Venn reacted in 1887 to a review of Carroll's *Game of Logic* because he was unhappy with the reviewer's claim that Carroll's scheme handles particular propositions better than Venn's (Venn, 1887; Moktefi & Pietarinen, 2015). Also, Carroll is known to have worked in 1890 on a logic problem about "shareholders and bondholders" that was first published by Venn in 1876 (Abeles, 2010, p. 16). However, Carroll might have discovered it in other sources as logic problems circulated among the logicians of the time. Venn's problem is notably found in the collection of *Studies in Logic* (Peirce, 1883, pp. 51–52) that Carroll already knew in 1890. Indeed, his logic notebook preserved at Princeton University shows that he was working that year on logic problems from Jevons' *Principles of Science* and the volume of *Studies in Logic* that gathered essays by Charles S. Peirce and his students. Both titles are found in Carroll's library and are cited by Carroll in his chapter, alluded to earlier, of problems set by other writers (Bartley, 1986, p. 478).

There are some important omissions from Carroll's library, insofar as it has been possible to reconstruct it. Among British symbolic logicians, the only notable omission seems to be Alexander Macfarlane's *Principles of the Algebra of Logic* (published in 1879), although one cannot tell for sure whether it was absent from the library. Naturally, Hugh MacColl and William E. Johnson are also absent since they did not publish logic books in Carroll's lifetime. Although both were contemporaries of Carroll and exposed their logical theories in articles, they only published their treatises in their late years, MacColl in 1906 and Johnson in three volumes in 1921, 1922, and 1924. It is interesting to note that both logicians addressed Carroll's barbershop problem in their writings. In addition, MacColl certainly was familiar with Carroll's *Symbolic Logic* as he reviewed the book for the *Athenaeum* (MacColl, 1896; Abeles & Moktefi, 2011). A more severe omission from Carroll's library, if confirmed, would be Ernest Schröder. However, this would hardly be a surprise as Carroll's intellectual life seems to have been essentially centred on the British scene. In particular, several instances in his writings attest to his defiance of ideas from the Continent, especially from Germany. There are also few noteworthy traditional logic works that are absent. The most notable is Alexander Bain's *Logic* (first published in 1870). But one might also mention E. E. Constance Jones' works published in the 1890s.

It has been previously argued that absence from the library should not be confused with ignorance. John Cook Wilson, the Wykeham Professor of Logic at the University of Oxford, offers a good illustration of this principle. It is true that Cook Wilson did not publish a logic treatise in his lifetime. His logic papers were posthumously edited and published by A. S. L. Farquharson (Cook Wilson, 1926). But Cook Wilson already published several titles in Carroll's time, notably a lecture *On an Evolutionist Theory of Axioms* in 1889 that would have highly interested Carroll. That none of Cook Wilson's works is found in the sale catalogues of Carroll's library certainly should not be interpreted as evidence of ignorance. Indeed, Carroll and Cook Wilson already knew each other in the mid-1880s and continued to regularly exchange on various subjects in geometry, chances and logic until Carroll's death (Marion & Moktefi, 2014). In particular, the two men engaged in the period 1892–1894 in a long dispute on the nature of hypotheticals which led to the publication of the barbershop paradox alluded to earlier. It is actually reasonable to claim that Cook Wilson was the logician with whom Carroll was the most familiar, and yet, he seems absent from his library. In contrast, Carroll owned three books by Venn, and yet, it is unclear the extent to which he was familiar with him. This example demonstrates the caution that is necessary to interpret the contents of a library and what lessons it teaches us on its owner.

Conclusion

This study shows that Carroll owned the main logic books that circulated in Britain at that period. In particular, he clearly had access to most of the symbolic logic books that were published in the English-speaking world. Like most of his British contemporaries, he seems to have paid little attention to the works that were developing on the Continent. It is more difficult to state to what extent Carroll was familiar with the books he owned, especially as he seldom refers to them in the exposition of his logic theory. It is true that Carroll wrote his treatise as to be accessible to a large audience and might thus have intentionally avoided exegesis and critical discussions, even omitting to include a definition of logic. However, Carroll's private writings, notably his journal, also lack reference to other authors. Although many elements of Carroll's logic are found in earlier authors, they are introduced in his journal as discoveries of his own. Another difficulty to assess Carroll's familiarity with the achievements of symbolic logic in his time is that much of it was published in journals which are not found in his library. Even for the authors he mentions, Carroll mainly referred to problems they set rather than to their methods of solution. An exception to this remark is his discussion of Euler's and Venn's diagrammatic methods which he described in order to demonstrate the superiority of his own method (Carroll, 1897, pp. 173–183).

Symbolic logicians in the nineteenth century certainly compared their notations and tackled similar problems to exhibit the power of their methods (Durand-Richard & Moktefi, 2014). In this respect, Carroll unquestionably belonged to that rising community. In particular, he was convinced that symbolic methods of solution were superior and will ultimately supersede traditional methods, as he explained it to his publisher Macmillan in a letter dated on 19 October 1895:

> I have no doubt that Symbolic Logic (not necessarily *my* particular method, but *some* such method) will, *some* day, supersede Formal Logic, as it is immensely superior to it: but there are no signs, as yet, of such a revolution. (Cohen & Gandolfo, 1987, p. 323)

Carroll was conscious that important changes were happening in the realm of logic, even though symbolic logic did not acquire yet the recognition he believed it to deserve. He entered the competition with his own symbolic method but apparently did not try to get in touch with other opponents, especially outside Britain. As such, he was peripheral to, if not outside, the formidable network that was growing in Europe and North America, with many logicians exchanging rich correspondence and discussing each other's work privately and in print (Peckhaus, 1998). This agitation culminated at the Philosophy Congress in Paris in 1900 that gathered the main symbolic logicians for the first time. Carroll remained loyal to his immediate network made of Oxonian friends and family members to whom he sent his logic problems. The controversy that turned on the barbershop problem probably was his moment of fame that introduced him to most of his contemporary logicians in Britain but he went fast forgotten shortly after his death. He probably would have remained ignored as a logician if he did not happen to be the author of the wonderful *Alice* tales and did not publish in 1895 a short note: "What the Tortoise said to Achilles" that intrigued logicians ever since (Carroll, 1895; Moktefi & Abeles, 2016).

It might be tempting at first to compare the logic holdings of Carroll's library with other collections of logic books from the same period. For instance, Venn donated an impressive collection of more than a thousand logic volumes to Cambridge University Library in 1888 (Francis, 1889; Boswell, 1995). It would be misleading to compare these two collections without keeping in mind that Carroll and Venn evidently had different collecting practices. The former gathered few books that were accessible and relevant to him in relation to his immediate study of logic while the latter aimed at the formation of a special collection that would gather any work of logic that was ever known to exist. It follows that Carroll's library is more informative on the logic literature that circulated in late Victorian Britain. Interestingly, Venn did not include in his donation many of the symbolic logic books that he owned and which he probably continued to use for the purpose of his study. In a way, a catalogue of the books that Venn did not donate would certainly give a better picture of his interests than the collection of books he included in his donation. Not all symbolic logicians could afford to collect logic books. Hugh MacColl certainly had a different logic library, as he explained in a letter to Bradley, dated on 14 December 1904:

> If I were a professor of logic, I would certainly get your books and study them; but as I am only an amateur, driven by I know not what mental perversity towards abstract studies from which I can never hope to reap any material gain or benefit, I am afraid I must content myself with the few books on logic that I already possess […] I cannot afford the luxury of a large library. (Keene, 1999, p. 308)

When we study private libraries, it is important to keep in mind the variety of motivations, resources and practices that move their owners (Potten, 2015).

Hence, claims related to the presence or absence of a given book in an author's library should take into account these individual conducts as well as the social and cultural practices of the community that is considered. These methodological imperatives and the confrontation with other sources are necessary to secure library arguments. Although exceptions exist (Harvey, 1980; Anellis, 1994; Brobjer, 1997; Zurlini, 2004; Leu, Keller & Weidmann, 2008), one seldom meets with library studies in intellectual history literature. It is hoped that the present study will contribute to overcome this prejudice as libraries certainly offer valuable information on their owners.

Acknowledgments

This work uses material that was accessed thanks to research grants from the *Maison Française d'Oxford* (2006) and the *Friends of the University of Princeton Library* (2007). Also, this paper draws upon research support from the ERC project 'Abduction in the age of uncertainty' (PUT 1305, Principal Investigator: Prof. Ahti-Veikko Pietarinen).

Appendix

This is an alphabetical list of the 27 (formal) logic books known or assumed to have been owned by Lewis Carroll in his private library. As explained in the article, it is mainly based on the sale catalogues *A*, *B*, *D*, *E*, and indexes *S* and *L*. We added one title that is not found in any of these sources. For each title, we provided information gathered from the catalogues but, when possible, we added bibliographical information to make each reference more complete. Each title is followed {between braces} by the catalogue(s) where it is listed and its number in each catalogue. Catalogue *D* being originally unnumbered, we followed Lovett's numbering. It is hoped that further titles will be revealed in future auctions and studies.

[1] Boole, G., *An Investigation of the Laws of Thought, on which are Founded the Mathematical Theories of Logic and Probabilities*, London: Macmillan and Co., 1854. {Uncertain; possibly *A*-505, *S*-532}

[2] Bosanquet, B., *Logic, or the Morphology of Knowledge*, 2 vols., Oxford: Clarendon Press, 1888. {*A*-508, *D*-105, *S*-536, *L*-199}

[3] Bradley, F. H., *The Principles of Logic*, London: Kegan Paul, Trench, & Co., 1883 {*A*-515, *S*-557, *L*-228}

[4] De Morgan, A., *Formal Logic: or, the Calculus of Inference, Necessary and Probable*, London: Taylor & Walton, 1847. {*A*-508, *D*-52, *S*-814, *L*-557}

[5] De Morgan, A., *Syllabus of a Proposed System of Logic*, London: Walton & Maberly, 1860. [*D*-106, *S*-817, *L*-558]

[6] Fowler, T., *Elements of Deductive Logic: Designed Mainly for the Use of Junior Students in the Universities*, 2nd ed., Oxford: Clarendon press, 1867. {Uncertain; *L*-726}

[7] Gilbart, J. W., *Logic for the Million; A Familiar Exposition of the Art of Reasoning; With an Appendix on the Philosophy of Language*, London: Bell & Daldy, 1865. {*D*-107, *S*-1064, *L*-772}

[8] Hamilton, Sir W., *Lectures on Metaphysics and Logic*, edited by H. L. Mansel & J. Veitch, 4 vols., 2nd ed., Edinburgh & London: William Blackwood and Sons, 1861 {*A*-509, *B*-1065, *S*-1132, *L*-858}

[9] Holman, H., *Questions on Logic: Part I.*, London: W. B. Clive & Co., 1891. {*E*-247, *S*-1214, *L*-953}

[10] Hughlings, I. P., *The Logic of Names: An Introduction to Boole's Laws of Thought*, London: James Walton, 1869. {*E*-235, *S*-1269, *L*-1020}

[11] Huyshe, J., *A Treatise on Logic, on the Basis of Aldrich, with illustrative notes*, 3rd ed., Oxford: J. Vincent, 1842. {Uncertain; *L*-1029}

[12] Jevons, W. S., *The Principles of Science: a Treatise on Logic and Scientific Method*, 2 vols., London: Macmillan and Co., [Probably 1st ed., 1874]. {*A*-505, *S*-1307, *L*-1074}

[13] Jevons, W. S., *Pure logic, or, the Logic of Quality apart from Quantity: with Remarks on Boole's System, and on the Relation of Logic and Mathematics*, London: Edward Stanford, 1864. {*E*-401, *S*-1308, *L*-1075}

[14] Keynes, J. N., *Studies and Exercises in Formal Logic: Including a Generalization of Logical Processes in their Application to Complex Inferences*, London: Macmillan

and Co, 2 copies: 3rd ed., 1894 [and probably 2nd ed., 1887]. {*A*-505 & *A*-508, *D*-108, *S*-1351, *L*-1127}

[15] Lotze, R. H., *Logic: in Three Books, of Thought, of Investigation, and of Knowledge*, English translation by B. Bosanquet, Oxford: Clarendon press, 1884. {*D*-109, *S*-1444, *L*-1254}

[16] Mansel, H. L., *Prolegomena Logica: An Inquiry into the Psychological Character of Logical Processes*, 2nd ed., Oxford: Henry Hammans & London: Whittaker, 1860. {*A*-510, *B*-1133, *S*-1482, *L*-1296}

[17] Mill, J. S., *An Examination of Sir William Hamilton's Philosophy, and of the Principal Philosophical Questions Discussed in his Writings*, 4th ed., London: Longmans, Green, Reader and Dyer, 1872. {*A*-510, *B*-1139, *S*-1518, *L*-1349}

[18] Mill, J. S., *A System of Logic, Ratiocinative and Inductive, Being a Connected View of the Principles of Evidence, and the Methods of Scientific Investigation*, 2 vols., 3rd ed., London: John W. Parker, 1851. {*A*-510, *B*-1140, *S*-1519, *L*-1350}

[19] Minto, W., *Logic: Inductive and Deductive*, London: John Murray, [1893 or 1894]. {*A*-506, *S*-1529, *L*-1364}

[20] Members of the Johns Hopkins University, *Studies in Logic*, Boston: Little Brown and Co., 1883. {*B*-1245, *S*-154, *L*-1518}

[21] Renton, W., *Analytic Theory of Logic*, Edinburgh: James Thin & London: Simpkin, Marshall & Co, 1887 {not previously listed}

[22] Sigdwick, A., *Fallacies: A view of Logic from the Practical Side*, London: Kegan Paul, Trench, & Co. [edition unknown, 1st ed. in 1883]. {*A*-516, *S*-1885, *L*-1845}

[23] Swinburne, A. J., *Picture Logic; or, the Grave Made Gay: An Attempt to Popularise the Science of Reasoning by the Combination of Humorous Pictures with Examples of Reasoning Taken from Daily Life*, London: Longmans, Green, and Co., [edition unknown, 1st ed. in 1875]. {*A*-516, *S*-71, *L*-1985}

[24] Thomson, W., *An Outline of the Necessary Laws of Thought: A Treatise on Pure and Applied Logic*, 2nd ed., London: William Pickering & Oxford: W. Graham, 1849. {Possibly *A*-505, *B*-1257, *S*-2069, *L*-2076}

[25] Venn, J., *Symbolic logic*, London: Macmillan & Co, 2nd ed., 1894. {*A*-517, *B*-1273, *S*-2121a, *L*-2154}

[26] Welton, J., *A Manual of Logic*, 2 vols., London: W. B. Clive, vol. 1: 1891, vol. 2: 1896. {*A*-517, *B*-1286 & *B*-1287, *S*-2175, *L*-2227}

[27] Whately, R., *Logic [From the Encyclopaedia Metropolitana]*, 2nd ed., London: J. J. Griffin & Glasgow: R. Griffin, 1849. {*B*-1289, *S*-2178, *L*-2231}

References

Abeles, F. F. (1994), *The Mathematical Pamphlets of Charles Lutwidge Dodgson and Related Pieces*, New York: the Lewis Carroll Society of North America.

—— (2010), *The Logic Pamphlets of Charles Lutwidge Dodgson and Related Pieces*, New York: The Lewis Carroll Society of North America.

Abeles, F. F. & Moktefi, A. (2011), 'Hugh MacColl and Lewis Carroll: crosscurrents in geometry and logic,' *Philosophia Scientiae,* vol. 15, no. 1, pp. 55–76. https://doi.org/10.4000/philosophiascientiae.362

Anellis, I. H. (1994), 'Logic and mathematics in the library of Casimir Lewy,' *Modern Logic*, vol. 4, no. 3, pp. 286–298.

Bartley III, W. W. (1986), *Lewis Carroll's Symbolic Logic*, 2nd ed., New York: C. N. Potter.

Boswell, T. (1995), 'A note on John Venn as a collector and bibliographer of works on logic,' *History and Philosophy of Logic*, vol. 16, no. 1, pp. 121–125. https://doi.org/10.1080/01445349508837244

Brobjer, T. H. (1997), "Nietzsche's reading and private library, 1885–1889," *Journal of the History of Ideas*, vol. 58, no. 4, pp. 663–693. https://doi.org/10.1353/jhi.1997.0034

Burrows, M. (1861), *Pass and Class: An Oxford Guide-Book*, Oxford & London: J. H. and J. Parker.

Carroll, L. (1894), 'A logical paradox,' *Mind*, vol. 3, no. 11, pp. 436–438. https://doi.org/10.1093/mind/IV.14.278

—— (1895), 'What the Tortoise said to Achilles,' *Mind*, vol. 4, no. 14, pp. 278–280.

—— (1897), *Symbolic Logic. Part 1: Elementary*, 4th ed., London: Macmillan.

Cohen, M. N. & Gandolfo, A. (1987), *Lewis Carroll and the House of Macmillan,* Cambridge: Cambridge University Press.

Collingwood, S. D. (1898), *The Life and Letters of Lewis Carroll (rev. C. L. Dodgson)*, London: T. Fisher Unwin.

Cook Wilson, J. (1926), *Statement and Inference: with Other Philosophical Papers*, 2 vols., edited by A. S. L. Farquharson, Oxford: Clarendon Press.

Despeaux, S. E. (2007), 'Launching mathematical research without a formal mandate: The role of university-affiliated journals in Britain, 1837–1870,' *Historia Mathematica*, vol. 34, pp. 89–106. https://doi.org/10.1016/j.hm.2006.02.005

Dodgson, C. L. (1867), *Elementary Treatise on Determinants*, London: Macmillan.

—— (1879), *Euclid and his Modern Rivals*, London: Macmillan.

—— (1894), 'Letter to Henry Sidgwick, 13 March 1894,' *The Henry Sidgwick Papers*, Trinity College Library, Cambridge, UK, add. Ms. c. 93. 106.

Durand-Richard, M.-J. & Moktefi, A. (2014), 'Algèbre et logique symboliques: arbitraire du signe et langage formel,' in J.-Y. Béziau (ed.) *La Pointure du Symbole*, Paris: Pétra, pp. 295–328.

Francis, H. T. (1889), *Catalogue of a Collection of Books on Logic Presented to the Library by John Venn*, Cambridge: University Press.

Grattan-Guinness, I. (2011), 'Victorian logic: From Whately to Russell,' in R. Flood, A. Rice & R. Wilson (eds.) *Mathematics in Victorian Britain*, Oxford: Oxford University Press, pp. 359–374.

Harvey, R. A. (1980), 'The private library of Henry Cavendish (1731–1810),' *The Library*, no. 2, pp. 281–292. https://doi.org/10.1093/library/s6-II.3.281

Hudson, D. (1976), *Lewis Carroll: An Illustrated Biography*, 2nd ed., London: Constable.

Keene, C. A. (1999), *F. H. Bradley. Selected Correspondence: June 1872 – December 1904*, Bristol: Thoemmes.

Lennon F. B. (1972), *The Life of Lewis Carroll*, New York: Dover.

Leu, U. B.; Keller, R. & Weidmann, S. (2008), *Conrad Gessner's Private Library*, Leiden & Boston: Brill. https://doi.org/10.1163/ej.9789004167230.i-311

Lovett, C. (2005), *Lewis Carroll among his Books: A Descriptive Catalogue of the Private Library of Charles L. Dodgson*, Jefferson, North Carolina & London: McFarland.

MacColl, H. (1896), "Review of Lewis Carroll's *Symbolic Logic: Part I*," *The Athenaeum*, no. 3599, 17 October, pp. 520–521.

Marion, M. & Moktefi, A. (2014), 'La logique symbolique en débat à Oxford à la fin du XIXe siècle: les disputes logiques de Lewis Carroll et John Cook Wilson,' *Revue d'Histoire des Sciences*, vol. 67, no. 2, pp. 185–205. https://doi.org/10.3917/rhs.672.0185

Moktefi, A. (2007a), 'Lewis Carroll and the British nineteenth-century logicians on the barber shop problem,' *Proceedings of The Canadian Society for the History and Philosophy of Mathematics*, vol. 20, pp. 189–199.

—— (2007b), *Déduire et Séduire: La Logique Symbolique de Lewis Carroll*, PhD dissertation, Strasbourg: Université Louis Pasteur.

—— (2008), "Lewis Carroll's Logic," in D. M. Gabbay & J. Woods (eds.) *British Logic in the Nineteenth Century*, Handbook of the History of logic series, vol. 4, Amsterdam: North-Holland, pp. 457–505. https://doi.org/10.1016/S1874-5857(08)80013-1

—— (2011), 'Geometry: the Euclid debate,' in R. Flood, A. Rice & R. Wilson (eds.) *Mathematics in Victorian Britain*, Oxford: Oxford University Press, pp. 320–336.

—— (2015), "On the social utility of symbolic logic: Lewis Carroll against 'The Logicians'," *Studia Metodologiczne*, vol. 35, pp. 133–150.

Moktefi A. & Abeles F. F. (2016), "The making of 'What the Tortoise said to Achilles': Lewis Carroll's logical investigations toward a workable theory of hypotheticals," *The Carrollian: The Lewis Carroll Journal*, vol. 28, pp. 14–47.

Moktefi, A. & Pietarinen, A.-V. (2015), 'On the diagrammatic representation of existential statements with Venn diagrams,' *Journal of Logic, Language and Information*, vol. 24, no. 4 (December), pp. 361–374. https://doi.org/10.1007/s10849-015-9228-1

Pearson, D. (2006), 'Private libraries and the collecting instinct,' in A. Black & P. Hoare (eds.) *The Cambridge History of Libraries in Britain and Ireland*, vol. 3, Cambridge: Cambridge University Press, pp. 180–202. https://doi.org/10.1017/CHOL9780521780971.016

Peckhaus, V. (1998), 'Hugh MacColl and the German algebra of logic,' *Nordic Journal of Philosophical Logic*, vol. 3, pp. 17–34.

Peirce, C. S. (1883), *Studies in Logic*, Boston: Little, Brown, and Company.

Potten, E. (2015), 'Beyond bibliophilia: contextualizing private libraries in the nineteenth century,' *Library & Information History*, vol. 31, no. 2, pp. 73–94. https://doi.org/10.1179/1758348914Z.00000000076

Rice, A. & Torrence, E. (2007), "'Shutting up like a telescope': Lewis Carroll's 'curious' condensation of method for evaluating determinants," *The College Mathematics Journal*, vol. 38, no. 2, pp. 85–95.

Seneta, E. (1993), "Lewis Carroll's 'Pillow Problems': on the 1993 centenary," *Statistical Science*, vol. 8, no. 2, pp. 180–186. https://doi.org/10.1214/ss/1177011011

Smith, W. J. (1984–1985), "Dodgson's scientific interests with reference to the books in his library," *Jabberwocky*, no. 61, pp. 3–9.

Stern, J. (1981), *Lewis Carroll's Library*, New York: The Lewis Carroll Society of North America.

—— (1997), *Lewis Carroll Bibliophile*, Luton, Bedfordshire: White Stone publishing.

Venn, J. (1887), 'The game of logic,' *Nature*, vol. 36, no. 916 (19 May), pp. 53–54. https://doi.org/10.1038/036053g0

—— (1894), *Symbolic Logic*, 2nd ed., London: Macmillan.

Wakeling, E. (1993–2007), *Lewis Carroll's Diaries: The Private Journals of Charles Lutwidge Dodgson (Lewis Carroll)*, 10 vols., Luton, Beds & Clifford, Herefordshire: The Lewis Carroll Society (vol. 1, 1993; vol. 3, 1995; vol. 6, 2001; vol. 8, 2004; vol. 9, 2005).

—— (2015), *Lewis Carroll: The Man and his Circle*, London & New York: I B Tauris.

Weaver, W. (1980), *The Mathematical Manuscripts of Charles Lutwidge Dodgson (Lewis Carroll) in the Morris L. Parrish collection*, microfilm, Princeton: Princeton University Library.

Wilson, R. (2008), *Lewis Carroll in Numberland: His Fantastical Mathematical Logical Life*, London: Allen Lane.

Zurlini, F. (2004), 'The library of the physician Romolo Spezioli (Fermo 1642 – Rome 1723): An example of the history of medical libraries,' *Intellectual News*, vol. 14, no. 1, pp. 34–43. https://doi.org/10.1080/17496977.2004.11417767

Amirouche Moktefi is lecturer in Philosophy at Tallinn University of Technology, Estonia. He is member of the Ragnar Nurkse Department of Innovation and Governance. He holds a PhD in the History and Philosophy of Science at the University of Strasbourg (2007). His research interests include the history of symbolic logic, visual reasoning and the philosophy of mathematical practice.

Acta Baltica Historiae et Philosophiae Scientiarum
Vol. 5, No. 1 (Spring 2017)
DOI : 10.11590/abhps.2017.1.03

Periods in the Use of Euler-Type Diagrams

Jens Lemanski

FernUniversität in Hagen
Universitätsstr. 33, KSW,
Hagen 58084, Germany
E-mail: jens.lemanski@fernuni-hagen.de

Abstract: Logicians commonly speak in a relatively undifferentiated way about pre-Euler diagrams. The thesis of this paper, however, is that there were three periods in the early modern era in which Euler-type diagrams (line diagrams as well as circle diagrams) were expansively used. Expansive periods are characterized by continuity, and regressive periods by discontinuity: While on the one hand an ongoing awareness of the use of Euler-type diagrams occurred within an expansive period, after a subsequent phase of regression the entire knowledge about the systematic application and the history of Euler-type diagrams was lost. I will argue that the first expansive period lasted from Vives (1531) to Alsted (1614). The second period began around 1660 with Weigel and ended in 1712 with Lange. The third period of expansion started around 1760 with the works of Ploucquet, Euler and Lambert. Finally, it is shown that Euler-type diagrams became popular in the debate about intuition which took place in the 1790s between Leibnizians and Kantians. The article is thus limited to the historical periodization between 1530 and 1800.

Keywords: *diagrammatic reasoning, Euler diagrams, history of logic, logic diagrams*

Introduction

Euler diagrams and Euler-type diagrams have been an increasingly used and investigated tool for the presentation of logical relations since the late 20th century (Moktefi & Shin, 2012; Legg, 2013). Euler diagrams are logic diagrams in the form of circles which illustrate the actual relation between concepts or classes.

Here, the auxiliary term 'Euler-type diagram' refers to diagrams which have a similarity to those of Euler, but without necessarily referring to his own sketches. Today, it is well known that such logic diagrams were not first used by Leonhard Euler. The question of whether diagrams were used first in ancient, medieval, or early modern times is controversial (Stekeler-Weithofer, 1986, pp. 27–88; Edwards, 2006; Macbeth, 2014, pp. 58–107) and will not be discussed in what follows. More relevant is the fact that one can speak of an increasing use of Euler-type diagrams in early modern times over several centuries (Baron, 1969, p. 115).

Logicians commonly speak in a relatively undifferentiated way of pre-Euler diagrams: Peter Bernhard (2001, pp. 69–80) has summarized them under the title 'The use of diagrams before Euler'. Mark Greaves (2002, pp. 115–21) has compiled both Euler-type and other logic diagrams under the heading 'Early diagrams for Syllogistic Logic'. Amirouche Moktefi and Sun-Joo Shin (2012, p. 616) have explained that although there were diagrams before the 18th century, it was only with Euler, who had popularized them through his systematics, that one could speak of a "golden age of logic diagrams" starting with him. These illustrative texts show that the authors emphasize the epoch-making achievement of Euler, but they are not concerned with a periodization of the early-modern diagrams. However, a chronological summary shows that there have always been very long periods of presence as well as absence of Euler-type diagrams in early modern times. Similar to an economic cycle, one can speak of 'periods of expansion and recession' in the history of Euler-type diagrams.

The thesis of the present paper, however, is that there were three periods in the early modern era in which Euler-type diagrams were expansively used. My criterion for a period consists of continuity as well as discontinuities: While on the one hand an ongoing awareness of Euler-type diagrams occurs during the expansive periods, these periods are followed by phases of regression in which the entire body of knowledge about the systematic application and the history of Euler-type diagrams is lost. Expansive periods are characterized by continuity, and regressive periods by discontinuity.

With the help of this criterion, I will argue that the first expansive period lasted from 1531 to 1614. The second period began around 1660 and ended in 1712. The third period of expansion started around 1760. The article is thus limited to the historical periodization between 1530 and 1800. Since I am mainly interested in exposing the continuities and breaks in history, I will only describe and explain some diagrams as examples. The focus of this article is rather on the reception history associated with the periodization.

Period I (1531–1614)

The first Euler-type diagram, found in a mechanically reproduced work, dates from 1531 by Juan Luis Vives. In the syllogism chapter of the second book of *De censura veri et falsi*, Vives first describes the classical syllogism. Then he explains the Aristotelian *dictum de omni* (*et nullo*) and the *modus barbara*, which he illustrates with a Euler-type diagram (Fig. 1; Vives, 1531, fol. 57[v]). Vives gives no indication of how this diagram is to be understood or whether he has taken this method of illustration from somewhere. The text and diagram correspond only to one sentence: Vives speaks of the fact that one can represent the transitive inference with three triangles ("*vt si tres trianguli pingantur,...*"; Vives, 1531, fol. 57[v]). In many cases, logic historians have asked why Vives speaks in the text of triangles, yet the figure shows angles or V's (Lange, 1894, p. 10). Vives' diagram was first placed in a context with other logic diagrams in the early 19th century (Denzinger, 1824, p. 66).

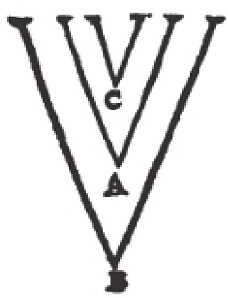

Figure 1. Vives' diagram

In 1589, two further intensively discussed diagrams are found in the logic of the astronomer Nicolaus Reimers (Ursus Dithmarsius), who was active in Strasbourg during this time. Already in the title of his book *Metamorphosis Logicae*, he announces his diagrams. His textbook on logic contains "a solid, highly evident and conspicuous exposition of the compelling reasoning" (Reimers, 1589, title page). The two circle diagrams found in the book refer to the *dictum de omni* (Fig. 2) and to the *dictum de nullo* (Fig. 3) (Reimers, 1589, pp. 32, 35). Reimers suggests several times that the diagrams are directly inspired by the metaphors of Aristotle. Apart from the Aristotelian and Ramistic logic, he criticizes all other

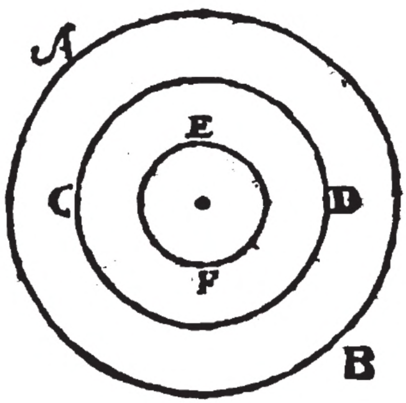

Figure 2. Ursus' diagram (*dictum de omni*)

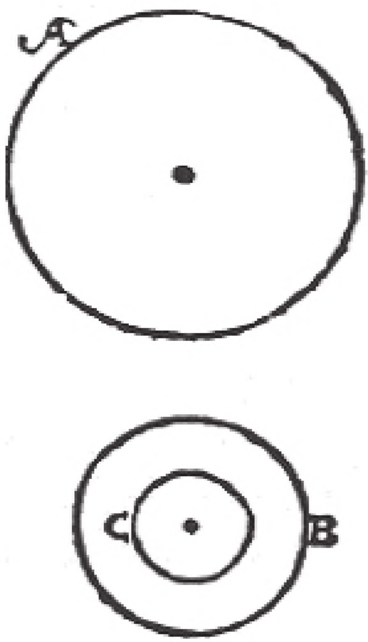

Figure 3. Ursus' diagram (*dictum de nullo*)

logical textbooks. Thus, there is no direct historical reference to whether Reimers took over Euler-type diagrams from a predecessor. It was not until the late 20th century that a relationship between Reimers' diagrams and Euler-type diagrams was mentioned (Risse, 1970, pp. 191–192).

The last two Euler-type diagrams in this period are found in Bartholomäus Keckermann in 1601 and 1603, as well as in Johann Heinrich Alsted in 1614. Keckermann uses line diagrams (Fig. 4) to explain why the first of the three Aristotelian figures and the *dictum de omni* are evident ("*Dispositio huius figurae [sc. prima figura] evidens est*"; Keckermann, 1601, p. 91). But there are two different versions of the same diagram: In 1601 it consists of equal lines (Fig. 4; Keckermann, 1601, p. 91), yet in 1603 the lines are of different length (Fig. 5; Keckermann, 1603, p. 429). In 1614, Alsted adopts the diagram ("*diagramma*") and the associated logical example of Keckermann from 1601 (Alsted, 1614,

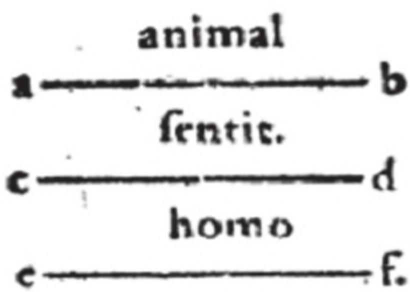

Figure 4. Keckermann's diagram (1601)

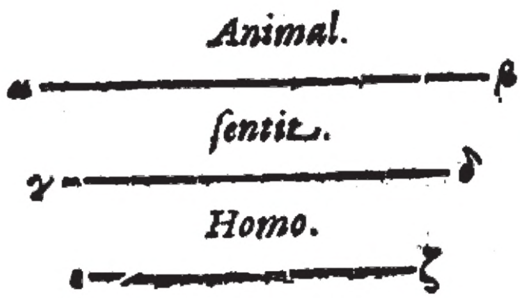

Figure 5. Keckermann's diagram (1603)

p. 395).[1] Although an explicit reference to the diagrammatic method cannot be found in either of the authors, it is very likely that both knew of Vives' Euler-type diagram. Alsted was a student of Keckermann and Keckermann often refers to Vives and praises him to the skies. While the diagrams of Alsted were already discussed in the 19th century (Hamilton, 1860, p. 256), Keckermann's diagrams have not yet been mentioned in logic history.

The fact that Vives, Reimers, Keckermannn, and Alsted refer to their diagrams as an explanation of perfect syllogisms in relation to the *dictum de omni* (*et nullo*) reveals a similarity between all the authors and a continuity within the first period. Since Vives, Keckermann, and Alsted can be attributed to the same encyclopaedic movement, there is a historical continuity (Leinsle, 1988). In the widest sense, Reimers is attached to this tradition. But he falls out of the frame in so far as he mentions no other author of this period by name and in so far as his diagrams remained unknown for a long time.

Period II (1660–1712)

The second period consists of two schools that developed and used Euler-type diagrams independently of one another. The first school developed around Erhard Weigel in Jena and consists of Johann Christoph Sturm and Gottfried Wilhelm Leibniz; the second school was formed around Christian Weise in Zittau, and his students were Samuel Grosser and Johann Christian Lange.[2]

It is highly probable that within this period Weigel was the first to find the Euler-type diagrams around 1660. In later years, he explained that he had encountered Euler-type diagrams by interpreting Aristotelian metaphors (Weigel, 1669, p. 46). For this reason, he himself and some of his contemporaries spoke of "*Weigelii inventa*" in relation to his diagrams (Petri, 1704, p. 4; Weigel 1672, B 2). After several controversies within his university, Weigel was not permitted to publish his original logical theories. Perhaps for this reason, he sent his student Sturm to the liberal state of the Netherlands in order to make his invention public

[1] I will not take into account the dispute between Venn and Hamilton (1860, p. 256) as to what extent the linear diagrams of Alsted actually anticipate Lambert's visualization method. However, Hamilton argues that Alsted had lines of different length (as in Fig. 5) in mind and the diagram is only misrepresented (as in Fig. 4). Venn (1894, pp. 422–423) sees this differently.

[2] For a more detailed description of the second period see Lemanski, forthcoming.

(Weigel, 1669, p. 47; Bullynck, 2013). Weigel's own diagrams were published much later, in 1693, in *Philosophia Mathematica*. Weigel used a peculiar method: instead of circles, triangles or lines, he used uppercase letters to represent all valid syllogistic forms, for example in Figure 6 (Weigel, 1693, I p. 122, II p. 105). But earlier, in 1661, Sturm published a book entitled *Novi Syllogizandi Modi* in Den Haag in which he used circle diagrams in order to prove unusual forms of syllogisms (Sturm, 1661).

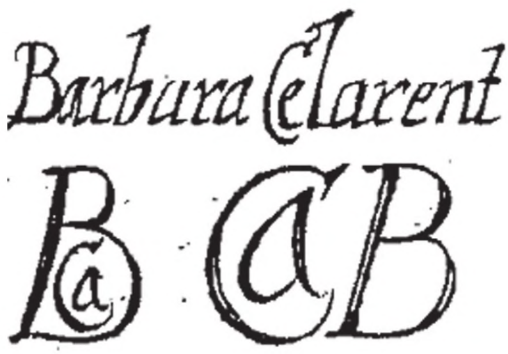

Figure 6. Weigel's diagram

In 1666 Leibniz published his dissertation in which he dealt with Euler-type diagrams. Leibniz criticized Sturm's method, arguing that it was not valid (Leibniz, 1666, p. 23). Yet, beginning in the late 1670s, Leibniz used circular and linear diagrams in several writings (Lenzen, 1990, pp. 15–21). These logical writings, however, remained mostly unpublished until the beginning of the 20th century (Leibniz, 1903).[3] In later years Leibniz confirmed that Weigel played a decisive role in the development of Euler-type diagrams in this period (Leibniz, 1710, pp. 390–391). Furthermore, Leibniz not only knew the diagrams of Weigel and Sturm, but he also had established contact with the Weise circle (especially with Lange) during his final years of life (Leibniz, 1768, V, pp. 404–405).

In parallel with the development of the Euler-type diagrams of Leibniz and Weigel, a second school developed not far from Jena. In the 1790s, Weise was president of the Gymnasium in Zittau and taught four hours of logic weekly. Many logicians and rhetoricians came out of his school. Although only a few tree diagrams can be found in Weise's books, it is astonishing that two of his students

[3] The diagrams of Weigel and Sturm also became popular again in the 20th century (Risse, 1970, p. 145; Scholz, 1961, pp. 118–119).

have made intensive use of diagrams. Both students, Grosser and Lange, point verbally to a diagrammatic doctrine taught by Weise. In two books, published around 1797, Grosser uses a combination of a triangular and semicircular diagram in order to discuss the relationship between subject and predicate in judgments (Fig. 7; Grosser, 1697, pp. 117–118).[4]

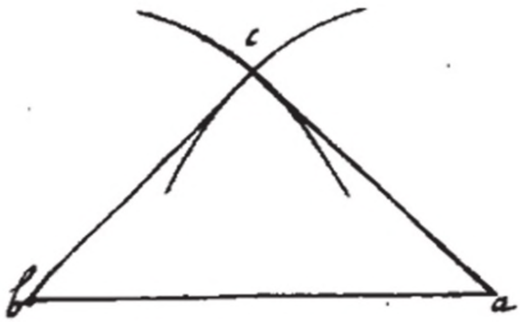

Figure 7. Grosser's diagram

After the death of Weise, Lange commented extensively on his teacher's principal work on logic. He published Weise's handbook of logic together with his 700-page commentary in 1712 under the title *Nucleus Logicae Weisianae*. These comments contain numerous diagrams, in which Lange not only uses circles to illustrate syllogisms but also to represent exceptional cases of logic (such as sorites, etc., see Fig. 8). In addition, the book contains numerous notes on the history of logic diagrams (Weise & Lange, 1712, pp. 248, 295, 707, 827). Lange explained that he was not only influenced by Weise, but also by Sturm und Grosser. Although Sturm's diagrams seemed to be related to his own circle diagrams, Lange presents arguments against Strum which are similar to those of Leibniz. Only later did he realize that Weigel had also used Euler-type diagrams. Regarding general logic diagrams, he traced the history back to the early sixteenth century. But concerning Euler-type diagrams, he explained that Weigel played an important role for Sturm, Weise, Grosser, and himself. Leibniz, Vives, Keckermann and Alsted were mentioned once, but not in connection with the history of the logic diagrams. A reference to Reimers is missing.

In sum, Lange's commentary is the most valuable guide to the development of logic diagrams in the time before Euler. In addition to Euler-type diagrams, he discusses numerous other diagram forms and related authors. Furthermore,

[4] Because of the clearer representation, Figure 7 has been taken from the 1721 edition.

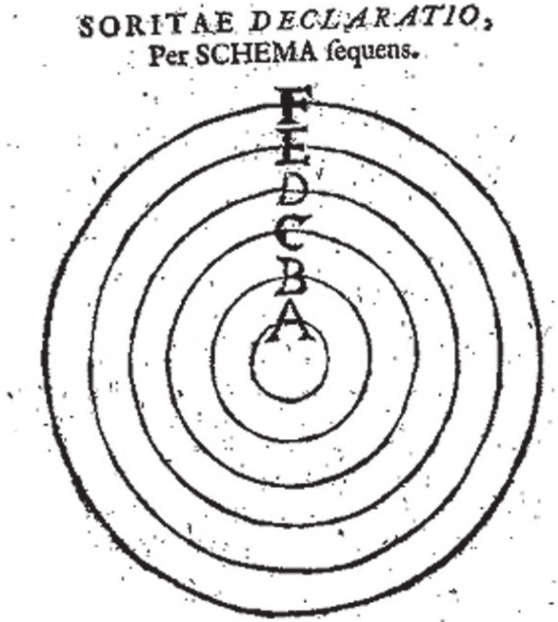

Figure 8. Lange's diagram

the work shows the subsequent link with all authors who used diagrams in the second period (except for Leibniz). He knew of diagrams from the first period, that is, before Weigel and Sturm, but he does not name Euler-type diagrams from the 16th century. This indicates a clear gap between the two periods: Lange, like Weigel, Sturm, Leibniz, Weise and Grosser, knows many (or even all) Euler-type diagrams from the second period, but none from the first.

Period III (1760–1880)

In the period of the recession from 1712 to about 1760, at least one person dealt with Euler-type diagrams. As recent studies prove, Euler already used circle diagrams in his notebook in the late 1730s (Kobzar, 2010). It is probable that he also used them for teaching purposes in Saint Petersburg. But in his diary as well as in *Letters to a German Princess, On Different Subjects in Physics and Philosophy*, written in 1762 and published in 1768, Euler gave no historical reference: Either Euler himself had the idea of using circle diagrams in logic, or for some reason he just did not specify from whom he acquired this method.

Besides Euler, in the late 1750s and 1760s, Johann Heinrich Lambert and Gottfried Ploucquet still used line and square diagrams in a similar manner in logic. However, the fact that Lambert and Ploucquet argued intensively about who first had the idea to use Euler-type diagrams reveals the discontinuity between the third period and the other previous two.

Although Euler was the first to have the idea in this period, Ploucquet was the first logician to publish Euler-type diagrams in the third period (Bellucci, Moktefi & Pietarinen, 2014). He published his squares (Fig. 9) in *Fundamenta Philosophiae Speculativae* as early as 1759, without any historical comment (Ploucquet, 1759, p. 25). It was not until 1763 that Lambert published his diagrams in his *Neues Organon*. At first he only learned from Georg Jonathan von Holland (1764) that Ploucquet had also used Euler-type diagrams. He probably assumed that he and Ploucquet had published their diagrams at about the same time (Wolters, 1980, pp. 120–122). For this reason, Lambert reported that already in 1762 he had found an "old scholastic logic, or a commentary on the logic of Aristotle" with logical "figures in woodcut" in the citizens' library of the Zurich Water Church, which illustrated "many concepts and relations" (Lambert, 1782, vol. 1, pp. 403–408). Because of this book, Lambert came to the idea to develop Euler-type diagrams. Ploucquet informed Lambert that his diagrams had already been published in 1759 and that he had had the idea a year earlier (Ploucquet, 1765, p. 8).

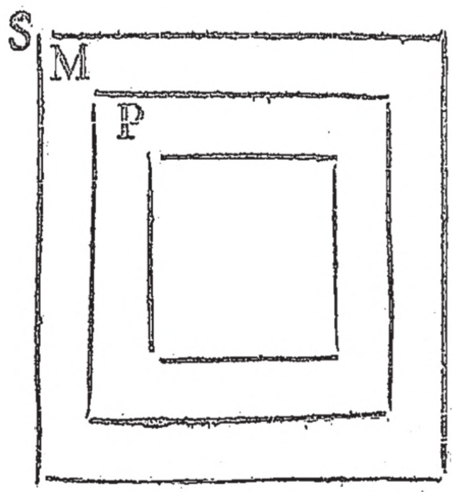

Figure 9. Ploucquet's diagram

In the 1760s, Ploucquet sought out precursors of his calculus. By referring to historical notes in Johann Jakob Brucker and Heinrich Wilhelm Clemm, he denied that Richard Suiseth and Ramon Llull were forerunners of his method (Ploucquet, 1765, pp. 10–14). He also points to a work by Lange (*Inventum Novum Quadrati Logici Universalis*), in which there are diagrams: While Lange himself interpreted them as Euler-type diagrams, Ploucquet only talks about their subordination method (Ploucquet, 1763, p. 22). In 1771, Lambert also wrote some historical notes on Euler-type diagrams (Lambert, 1771, vol. 1, pp. XIII, XXI, 128). He had recently found the commentary of Lange's *Nucleus Logicae Weisianae* from the second period. As described above, Lange's commentary to the *Nucleus Logicae Weisianae* contained more obvious Euler-type diagrams than the book that Ploucquet had discovered. In principle, Lambert explained, Lange's diagrams were the same as those of Euler. But for Lambert, his own method was more closely related to that of Ploucquet. Moreover, he does not know about the history of Euler-type diagrams. Lambert's discovery of Lange's diagrams, however, was not taken into account for more than sixty years. Only Moritz Wilhelm Drobisch (1827, p. 5) and later Friedrich Ueberweg (1857, p. 225) referred back to Lambert's discovery of Lange's diagrams.

Although Lambert's and Ploucquet's methods had been widely discussed in the mid-1760s, the public interest declined sharply. Euler's logic diagrams and his metaphysics, published in 1768, were not discussed by professors of philosophy, especially in German-speaking countries. Euler's letters were reproduced several times until the end of the 1780s and translated into German in 1769; however, a philosophical reception of his logic was initially lacking. The philosophical reception of the logic of Ploucquet, Euler and Lambert began only twenty years after the publications. Only in the 1790s did Kantian and later Kant-opponents mention and use the first Euler-type diagrams. Thus, it does not suffice to speak only of three periods in early modern times in which Euler-type diagrams were used. One must also divide the third period into several sections. The first section begins with Ploucquet, Lambert and Euler, and the second section with Kantians and Kant-critics.

Immanuel Kant himself used numerous diagrams in his logic lectures in Königsberg (AA XVI, p. 726; Fig. 10), and some of them were Euler diagrams (Lu-Adler, 2012): At one point, in 1772, Kant explicitly spoke in his lectures of "Euler's […] figures" (AA XXIV/I, p. 454). However, since his lectures contain many more traditional diagrams that Euler did not use, the *Letters to a German Princess* cannot have been his only source (and also not Lambert's *Neues Organon*

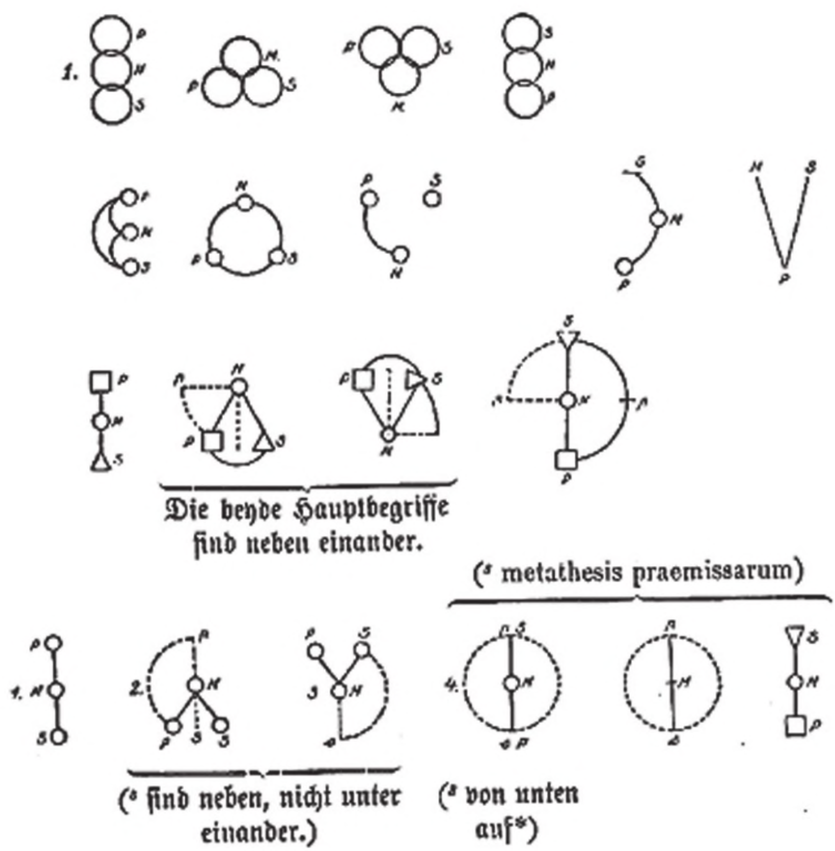

Figure 10. Kant's diagrams

or Ploucquet's *Fundamenta Philosophiae Speculativae*). Kant knew Lambert's writing with Euler-type diagrams, but whether he also knew Ploucquets' diagrams or whether he was interested in his criticism at all is uncertain.[5] But it was not until 1800 that Gottlob Benjamin Jäsche published a compilation of these logic lectures (including diagrams), which became pioneering for the 19th century (Kant, 1800).

Previously, however, there was a dispute about the validity and development of geometrical figures and logic diagrams between Leibnizians and Kantians. Since the middle of the 1780s, Leibnizians had criticized the function of intuition in geometry, which Kantians had just pointed out (Allison, 1973, pp. 1–104;

5 For a detailed description of the reception of Lambert by Kant cf. Peckhaus, 1997, pp. 110–120.

Koriako, 1999, §24). In addition to this long-standing discussion on intuition in geometry, a second debate about the history and relevance of logic diagrams developed. Rather neutral are the logics of Johann August Heinrich Ulrich (1785, p. 148) and Gotthelf Samuel Steinbart (1787, pp. 14–17), but the two use only linear diagrams.

Later, in the logic debate, Leibnizians appealed to the Kant-critic Ploucquet and tried to harmonize him with Lambert: The anti-Kantian Johann Gebhardt Ehrenreich Maaß (1793; Bernhard, 2007) used triangles in his logic based on Lambert's line diagrams. In his opinion, Euler's diagrams are "useless" (Maaß, 1793, p. IX). The Leibnizian Wilhelm Ludwig Gottlob von Eberstein (1794, pp. 93, 302, 454) wrote that Ploucquet was the first one to use squares, followed by Lambert's use of lines, and finally Maaß's triangles in syllogistics. Eberstein (1794, p. 244) mentions Euler only once in connection with the critics of the monad doctrine (Knobloch, 2010). These critics are strongly abused by Eberstein. At the beginning of the 1790s, there was even a German edition of *Letters to a German Princess*, in which the sections on logic and metaphysics (directed against Leibniz and Wolff) were excluded. The publisher explained that there was no "general interest" in Euler's logic and metaphysics; furthermore, both sections were strongly in need of modernization (Euler, 1792/1793, vol. 1, p. V). German supporters of Leibniz and Wolff welcomed the reduction of this work to its scientific content (Br., 1793).

In contrast to the Leibnizians, the Kantians expressed the opinion in the 1790s that Lambert was more in harmony with Euler and that both were forerunners of Kant. Johann Gottfried Kiesewetter, who had studied in Königsberg in 1788, used circle diagrams in order to illustrate rules of conversion (Kiesewetter, 1793, pp. 125–127). Particularly relevant is Georg Samuel Albert Mellin (1799, pp. 581–611), who linked Kant's *The False Subtlety of the Four Syllogistic Figures* with Euler's and Lambert's logic. In a table at the end of the book, he contrasts eight line diagrams of Lambert with eight circle diagrams of Euler (Fig. 11).

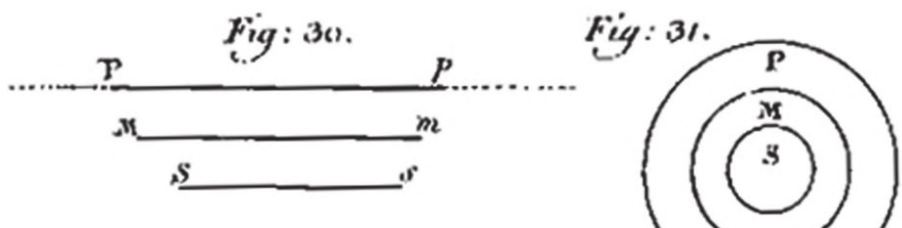

Figure 11. Mellin's diagram

On the basis of these different perspectives, we can assume that the term 'Euler diagrams' is used today only for the reason that Kantians have prevailed to a certain extent against Leibnizians. However, with the appearance of the Jäsche-logic, the reception of logic diagrams began to strengthen from 1800 onwards. It was only with the discovery of the 'Weierstrass monsters' and the so-called 'new logic' of Frege that the reception suddenly stopped in the German-speaking world in about 1880. From then on, formalism prevailed in Central Europe and the use of Euler-type diagrams remained a second-class approach in logic until the end of the 20th century (Bernhard, 2001, pp. 11–17).

Conclusion

I have argued that there have been three periods of Euler-type diagrams in early modern history. The first period began with Vives, whose diagram was taken by Keckermann and Alsted. Reimers remained an outsider in this period. The second period consisted of two schools: the Weigel circle with Weigel as the teacher of Sturm and Leibniz, as well as the Weise circle with Weise as the teacher of Grosser and Lange. In this period, Leibniz was aware of the published diagrams of Weigel and Sturm; furthermore, Lange knew of all the published Euler-type diagrams of this period. There was, however, no indication that the authors of the second period knew about the Euler-type diagrams of the first period.

This was similar in the third period. Ploucquet and Lambert argued in the 1760s about who had invented Euler-type diagrams. Euler did not comment on the history of the diagrams. Lambert found in later years Lange's Euler-type diagrams from the second period. This historical note, however, was only taken up again many decades later. To this extent, the third period also has a discontinuity with the other two periods. However, I have also suggested that further sections should be mentioned within the third period. While the diagrams of Lambert and Ploucquet were discussed intensively in the 1760s, the discussion thereafter sharply diminished. It was not until the 1790s that Euler-type diagrams were recalled by logicians in connection with the debate between Leibnizians and Kantians on intuition in geometry and logic. The connections and interruptions between the authors of the three periods can be viewed on the accompanying diagram (Fig. 12).

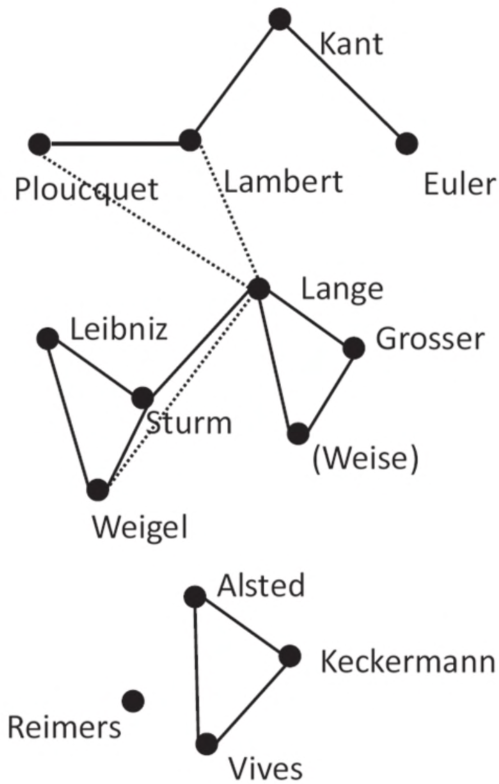

Figure 12. This Hasse-type diagram shows the proven, or highly probable, influence from one author to another (indicated by solid lines). Dotted lines illustrate the fact that an author later became aware of the other author.

The individual sections of the third epoch have not yet been explored. Neither is it known how many schools or sections this period has, nor whether it makes sense to look for further sections in this period. In connection with the research of this period, the question arises as to when Euler emerges for the first time as a prominent name for logic diagrams and when exactly the term 'Euler diagrams' finds itself in literature. It also remains questionable whether the expansion of logic diagrams since the 1990s can still be assigned to a section of the third period.

Acknowledgments

The paper introduces research that was presented at some scientific events during May 2017 in Estonia, including a philosophical seminar at Tallinn University of Technology (May 15, 2017) and the 28th Baltic Conference on the History of Science in Tartu (May 18–20, 2017), and benefited from discussions in those events. I especially thank Ahti-Veikko Pietarinen, Amirouche Moktefi, Daniele Chiffi, Peeter Müürsepp, Eberhard Knobloch, Jon Regan and the two anonymous reviewers for helpful comments.

References

AA (1900–), *Immanuel Kant: Gesammelte Schriften* (Akademie-Ausgabe), ed. by Preußische/Deutsche/Göttinger/Berlin-Brandenburgische Akademie der Wissenschaften. Berlin: Preußische/Deutsche/Göttinger/Berlin-Brandenburgische Akademie der Wissenschaften.

Allison, H. E. (1973), *The Kant-Eberhard-Controversy*, Baltimore & London: The Johns Hopkins University Press.

Alsted, J.-H. (1614), *Logicæ Systema Harmonicum…*, Herbornæ Nassoviorum: s.e.

Bellucci, F.; Moktefi, A. & Pietarinen, A.-V. (2014), 'Diagrammatic Autarchy. Linear Diagrams in the 17th and 18th Centuries,' in J. Burton & L. Choudhury (eds.) *Diagrams, Logic and Cognition, CEUR Workshop Proceedings*, vol. 1132, pp. 23–30.

Bernhard, P. (2001), *Euler-Diagramme: Zur Morphologie einer Repräsentationsform in der Logik*, Paderborn: Mentis.

—— (2007) 'The Remarkable Diagrams of Johann Maass,' in G. Löffladt (ed.) *Mathematik–Logik–Philosophie: Ideen und ihre historischen Wechselwirkungen*, Frankfurt am Main: Harri Deutsch, pp. 83–93.

Br. [= **Mayer, J. T.**] (1793), 'Leonhard Eulers Briefe über verschiedene Gegenstände aus der Naturlehre…,' *Intelligenzblatt der neuen allgemeinen deutschen Bibliothek*, vol. 21, pp. 558–559.

Bullynck, M. (2013), "Erhard Weigel's Contributions to the Formation of Symbolic Logic," *History and Philosophy of Logic*, vol. 34, no. 1, pp. 25–34. https://doi.org/10.1080/01445340.2012.726855

Denzinger, I. (1824), *Institutiones logicæ*, vol. II, Leodii: Collardin.

Drobisch, M. W. (1827), *De calculo logico*, Lipsiae: Melzer.

von Eberstein, W. L. G. (1794), *Versuch einer Geschichte der Logik und Metaphysik bei den Deutschen von Leibniz bis auf die gegenwärtige Zeit*, Halle: Joh. Gottfr. Ruff.

Edwards, A. W. F. (2006), 'An Eleventh-Century Venn Diagram,' *BSHM Bulletin: Journal of the British Society for the History of Mathematics*, vol. 21, pp. 119–121. https://doi.org/10.1080/17498430600804407

Euler, L. (1792/93), *Briefe über verschiedene Gegenstände aus der Naturlehre*, ed. by F. Kries, 2 vol., Leipzig: Dyck.

—— (1768), *Lettres à une princesse d'Allemagne sur divers sujets de physique & de philosophie*, 2 vols., Saint Petersbourg: Academie Impérial des Sciences.

Gardner, M. (1958), *Logic Machines and Diagrams*, New York, Toronto & London: Mcgraw-Hill Book Company.

Greaves, M. (2002), *The Philosophical Status of Diagrams*, Stanford: CSLI.

Grosser, S. (1697), *Gründliche Anweisung zur Logica…*, Budißin & Görlitz: Johann Wilisch.

Hamilton, W. (1860), *Lectures on Metaphysics and Logic*, ed. by H. L. Mansel & J. Veitch, vol. 3, Edinburgh & London: William Blackwood and Sons.

Holland, G. J. (1764), *Abhandlung über die Mathematik, die allgemeine Zeichenkunst und die Verschiedenheit der Rechnungsarten: Nebst einem Anhang, worinnen die von Hrn. Prof. Ploucquet erfundene logikalische Rechnung gegen die Leipziger neue Zeitungen erläutert und mit Hrn. Prof. Lamberts Methode verglichen wird*, Tübingen: Cotta.

Kant, I. (1800), *Logik: Ein Handbuch zu Vorlesungen*, ed. by G. B. Jäsche, Königsberg: Nicolovius.

Keckermann, B. (1601), *Systema Logicæ: Sompendiosa methodo…*, Hanoviae: Guilielmus Antonius.

—— (1603), *Systema Logicæ: Tribus Libris Adornatvm…*, Hanoviae: Guilielmus Antonius.

Kiesewetter, J. G. (1793), *Grundriß einer reinen allgemeinen Logik nach kantischen Grundsätzen…*, Frankfurt & Leipzig: s.e.

Knobloch, E. (2010), 'Leonhard Euler als Theoretiker,' in W. Velminski & H. Bredekamp (eds.) *Mathesis & Graphe: Leonhard Euler und die Entfaltung der Wissensysteme*, Berlin: Akademie, pp. 19–36. https://doi.org/10.1524/9783050088235.19

Kobzar, V. I. (2010), "Gnoseologiia i logika L. Eilera v 'Pismakh k nemetskoi printsesse o raznykh fizicheskikh i filosofskikh materiiakh'," *Logiko-filosofskie studii*, vol. 8, pp. 98–120.

Koriako, D. (1999), *Kants Philosophie der Mathematik: Grundlagen–Voraussetzungen–Probleme*, Hamburg: Meiner.

Lambert, J. H. (1771), *Anlage zur Architectonic, oder Theorie des Einfachen und des Ersten in der philosophischen und mathematischen Erkenntniß*, 2 vols., Riga: Johann Friedrich Hartknoch.

—— (1764), *Neues Organon oder Gedanken über die Erforschung und Bezeichnung des Wahren und dessen Unterscheidung vom Irrthum und Schein*, 2 vols., Leipzig: Johann Wendler.

—— (1782), *Deutscher gelehrter Briefwechsel*, ed. by J. Bernoulli, 2 vols., Berlin: Johann Bernoulli.

Lange, F. A. (1894), *Logische Studien: Ein Beitrag zur Neubegründung der formalen Logik und der Erkenntnistheorie*, Iserlohn: Julius Baedeker.

Legg, C. (2013), 'What is a Logical Diagram?' in S.-J. Shin & A. Moktefi (eds.) *Visual Reasoning with Diagrams*, Basel: Birkhäuser, pp. 1–18. https://doi.org/10.1007/978-3-0348-0600-8_1

Leibniz, G. W. (1903), *Opuscules et fragments inédits de Leibniz: Extraits des manuscrits de la Bibliothéque royale de Hanovre*, ed. by L. Couturat, Paris: Félix Alcan.

—— (1710), *Essais de théodicée, sur la bonté de Dieu, la liberté de l'homme, et l'origine du mal*, Amsterdam: Isaac Troyel.

—— (1768), *Opera omnia nunc primum collecta, in classes distributa, præfationibus et indicibus exhornata, studio Ludovici Dutens*, Genevæ: Fratres de Tournes.

—— (1666), *Dissertatio de arte combinatoria…*, Lipsiae: Joh. Simon Fickium et Joh. Polycarp. Seuboldum.

Leinsle, U. G. (1988), *Reformversuche protestantischer Metaphysik im Zeitalter des Rationalismus*, Augsburg: Maro Verlag.

Lemanski, J. (*forthcoming*), 'Logic Diagrams in the Weigel and Weise Circles,' in *History and Philosophy of Logic.*

Lenzen, W. (1990), *Das System der Leibnizschen Logik*, Berlin & New York: de Gruyter.

Lu-Adler, H. (2012), *Kant's Conception of Logical Extension and Its Implications*, PhD thesis, University of California. Retrieved from https://philpapers.org/rec/LUAKCO [accessed May 2017]

Maaß, J. G. E. (1793), *Grundriß der Logik, zum Gebrauche bei Vorlesungen*, Halle: Michaelis und Compagnie.

Macbeth, D. (2014), *Realizing Reason: A Narrative of Truth and Knowing*, Oxford: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780198704751.001.0001

Mellin, G. S. A. (1799), *Encyclopädisches Wörterbuch der kritischen Philosophie*, vol. 2, sect. 2, Jena & Leipzig: Friedrich Frommann.

Moktefi, A. & Shin, S.-J. (2012), 'A History of logic diagrams,' in D. M. Gabbay, F. J. Pelletier & J. Woods (eds.) *Logic: A History of its Central Concepts*, Burlington: Elsevier Science, pp. 611–683. https://doi.org/10.1016/B978-0-444-52937-4.50011-3

Peckhaus, V. (1997), *Logik, Mathesis universalis und allgemeine Wissenschaft: Leibniz und die Wiederentdeckung der formalen Logik im 19. Jahrhundert*, Berlin: Akademie.

Petri, J. G. (1677), *Deus in naturae admirandis repraesentatus, & Serenissimo Principi Lotharingiae & Voudemont*, Francofurti: Waltheri.

Ploucquet, G. (1759), *Fvndamenta Philosophiæ Speculativæ*, Tubingae: Joh. Georg. Cotta.

—— (1763), *Methodvs Calcvlandi in Logicis*, Francofurtum, Lipsiae: s. e.

—— (1765), 'Untersuchung und Abänderung der logikalischen Constructionen des Hrn. Prof. Lambert,' in Bök (ed.) *Sammlung der Schriften*, Tübingen: Johann Georg Cotta, pp. 157–202.

Reimers (Raymarus Ursus Dithmarsius), N. (1589), *Metamorphosis Logicae…*, Argentoratum: s. e.

Risse, W. (1964), *Die Logik der Neuzeit: Vol. 1: 1500–1640*, Stuttgart-Bad Cannstatt: Frommann-Holzboog.

—— (1970), *Die Logik der Neuzeit: Vol. 2: 1640–1780*, Stuttgart-Bad Cannstatt: Frommann-Holzboog.

Scholz, H. (1961), *Concise History of Logic*, transl. by K. F. Leidecker, New York: Philosophical Library.

Steinbart, G. S. (1787), *Gemeinnützige Anleitung des Verstandes zum regelmäßigen Selbstdenken*, 2nd ed., Züllichau: Frommanns Erben.

Stekeler-Weithofer, P. (1986), *Grundprobleme der Logik: Elemente einer Kritik der formalen Vernunft*, Berlin & New York: de Gruyter.

Sturm, J. Chr. (1661), *Universalia Euclidea…*: *Accedunt ejusdem XII. Novi Syllogizandi Modi in propositionibus absolutis, cum XX. aliis in exclusivis, eâdem methodo Geometricâ demonstrates*, Hagæ-Comitis: Adrianus Vlaccq.

Ueberweg, F. (1857), *System der Logik und Geschichte der logischen Lehren*, Bonn: Marcus.

Ulrich, I. A. H. (1792), *Institvtiones logicae et metaphysicae: Scholae svae scripsit perpetva Kantianae disciplinae ratione habita*, Ienae: Croekeria.

Venn, J. (1894), *Symbolic Logic*, London: Macmillan.

Vives, I. L. (1531), 'De censura veri et falsi,' in *De disciplinis Libri XX, Tertio tomo de artibus libri octo*, Antverpia: Michael Hillenivs.

Weigel, E. (1669), *Idea Matheseos universæ cum speciminibus Inventionum Mathematicarum,* Jenae: Bauhoferus.

—— (1672), *Neu-erfundener Hauß-Rath / so wohl zur Nothdurfft / als zur Lust und Bequemligkeit/ zu gebrauchen*, Jena: Bauhofer.

—— (1693), *Philosophia Mathematica: Archimetria*, Jenæ & Helmstad: Matth. Bircknerus.

Weise, C. & Lange, I. C. (1712), *Nvclevs Logicae Weisianae:* […] *illustrates* […] *per varias schematicas* […] *ad ocularem evidentiam deducta…*, Gissa-Hassorum: Henningius Müllerus.

Wolters, G. (1980), *Basis und Deduktion: Studien zur Entstehung und Bedeutung der Theorie der axiomatischen Methode bei J.H. Lambert (1728–1777)*, Berlin & New York: de Gruyter.

Jens Lemanski studied Philosophy and Biology at the universities of Bochum, Mainz and Lecce. He holds a PhD in Philosophy from the Johannes Gutenberg-Universität Mainz and the Università del Salento. As a research fellow for Theoretical Philosophy at the FernUniversität in Hagen he specializes in logic and philosophy of science. With regard to the interpretation and evaluation of logic diagrams, he adopts the standpoint of 'rational representationalism'.

Acta Baltica Historiae et Philosophiae Scientiarum
Vol. 5, No. 1 (Spring 2017)
DOI : 10.11590/abhps.2017.1.04

Scientific Research in Stanisław Leszczyński Academy in Nancy in the Field of Agriculture and Its Practical Applications (1750–766)

Małgorzata Durbas

Institute of History,
Academy of Jan Dlugosz in Częstochowa
al. Armii Krajowej 36a,
Częstochowa 42-200, Poland
E-mail: skwarczynskam@wp.pl

Abstract: Scientific societies and academies, which represented the path to knowledge and the way of constructing theoretical sciences, constituted a distinctive feature of the intellectual life in mid-eighteenth-century Europe. These societies worked towards knowledge—in its broad sense—within the country and towards the cooperation of scholars to exchange scientific achievements and introduce technical innovations into practice. The Royal Society in Nancy (*Société Royale des Sciences et Belles Lettres*), now called the Stanisław Academy, established in 1750, started research in various topics in the field of agriculture. They focused on methods of improving soil efficiency and the use of modernised farming machines in Lorraine and Bar. King Stanisław Leszczyński, founder of the institution, took great care in academic research activities, encouraging researchers to hold public speeches, advising and searching for novelties in a field, such as, for example, a new species of grass from England. He considered agriculture the driving force in the development of societies and believed that an increase in farming production would benefit common wealth. He used many innovations in his properties to underline the importance of work in agriculture and popularise various kinds of novelties.

Keywords: *academies, agriculture, Lorraine, scientific research, scientific societies, Stanisław Leszczyński*

The last Duke of Lorraine and Bar (Durbas, 2016, pp. 449–463), King Stanisław Leszczyński, as a true representative of the Enlightenment, managed to match his charity actions in Lorraine (*Précis des fondations*…, 1758, pp. 188–194) with the scientific movement of Western Europe. He established the Royal Society in Nancy (*Statuts de la Société Royale des Sciences*, 1751) with a founding edict in 1750, which later changed its name into Academy Stanisław (Durbas, 2013). The Academy was founded rather late in comparison with other institutions in France in the 18th century—later, for example, than the ones in Dijon (1725), Marseilles (1726), Arras (1737), Rouen (1744), and Toulouse (1730) (Michaux, 2008, p. 82). The mission of the Academy was to support the sciences, develop intellectual life in different fields and encourage internal competition. One of the main aims of such institutions, especially the Scientific Society in Nancy, was utilitarianism in research and technical solutions.

The aim of this article is to discuss the scientific studies presented for the Academy of Science in Nancy and practical projects implemented in the field of modern agricultural cultivation of crops in the years 1750–1766.

It is necessary to mention that the importance of land and introducing new ways of land cultivation were the priorities of academic research in Paris, where *Académie royale des Sciences* started to publish its agricultural research materials in the 1750s (Duhamel du Monceau, 1750–1757). All changes in theoretical and practical sciences shared one feature which distinguished them from teaching. Scientific research was a private matter of individuals and, like art, science was regarded a vocation rather than a job. According to Stefan Amsterdamski (1983, p. 97), scientific research was treated as a hobby and amateur scholars came not only from the upper class but also from the middle class of townspeople. The large number of encyclopaedists proved the immensity of non-institutionalised intellectual life in France in the mid-eighteenth century. Diderot and d'Alembert's *Encyclopedie* was the work not only of professionals but also of dilettantes and amateurs (Rostworowski, 1998, p. 415).

In Stanisław Leszczyński Academy, research was connected to new ways of preparing the soil and using improved farming machines in Lorraine. Some of the presented devices, which were modern for the time, could be found in Poland even as late as in the 20th century. Leszczyński believed that land was the basic good and agriculture was the driving force in the development of the society—his ideas were similar to physiocratic ideas that were introduced several years later.

The topics taken up by the *Société Royale des Sciences et Belles Lettres* in Nancy illustrated contemporary ideas in natural sciences and literature. The topics were discussed by teams of several people, possibly consisting of scholars appointed by the king, the founder. Famous physiocrats were invited to the Royal Society in Nancy as well. Henry Pattullo (Voisine, 1974), the famous foreign physiocrat, agronomist and the author of *Essai sur l'amélioration des terres* (Pattullo, 1758), became an associated member of the Society. In 1760, Louis-François de Menon, Marquis de Turbilly, also became an associated member. He published a piece, entitled *Mémoire sur les défrichements*, about the preparation of soil for adaptation in wastelands (Turbilly, 1762).

This work attracted considerable interest in scientific circles and the French court and caught the attention of the aged and almost blind King Stanisław, who invited Marquis de Turbilly to the Society in Nancy. The Marquis was honoured and accepted the invitation. He also promised to come to Lorraine from the side of Germany and survey the land to ascertain the need of clearing and the new way of cultivation (Sauvy & Hecht, 1965). Marquis de Turbilly gave a speech upon his arrival at the Stanisław Leszczyński Academy in Nancy on the popular physiocratic trend which emphasised the importance of work and agriculture as the only source of wealth. De Turbilly reminded that agriculture is the basis of happiness and the power of countries, the mother of trade and crafts (*P.V. ms.*, 1759–1765, pp. 220–227). The Marquis gave a very interesting historical retrospect of the agrarian culture of ancient countries and pointed at the fall of this culture in the modern age. Using the example of the Assyrian people, the Hanging Gardens and Egyptians with their efficient agriculture, he underlined the advanced ancient knowledge and ideology, which put the agriculture at the top of the hierarchy of values. De Turbilly, who after a career in the army became engaged in agricultural experiments, became famous for the reviews of clearing, firing and fertilising the soil (Bonnefont, 2006, p. 53).

Agriculture was considered the most important discipline by King Stanisław (*Nouvelles découvertes.., n.d.*) He encouraged scholars to start research in that field, which was conducted in two ways:

- theoretical—novelties were submitted and discussed, and
- practical (experimental)—new and old methods of cultivation were used simultaneously and the results were compared to each other.

The article first presents the theoretical part to explain these scientific processes.

François-Alexis Credo, a member of Stanisław Leszczyński Academy who was interested in chemistry and botany, started experiments related to new methods of cultivation and gaining more efficient crops on the lands of Lorraine. As he mentioned, it had been an order from King Leszczyński (Credo, 1758, p. 4).

Credo experimented with cultivation and led experiments with the use of modern farming machines (*P.V. ms.*, 1754–1759, p. 593). In 1756, he became the attorney for King Stanisław for introducing innovative farming machines in Chanteheux, one of the king's estates—a seed drill for continuous sowing of the seed and a plough (*P.V. ms.*, 1754–1759, pp. 240–241). Credo discussed the new process of farm production used on the land bought on the King's orders. The lot, sized three *morgen*, adjoined the property of the Jesuit organisation *Mission Royale*. It was divided into three arable fields. Credo began his work by giving reasons for the need of precise preparation of soil, which required ploughing at different depths, depending on the type of land. He introduced an effective method of weeding as part of modern cultivation which had not been sufficiently used. For a few years, he sowed different crops—domestic, foreign and a new variety of rye—on the experimental fields. Credo introduced his innovative and versatile methods to prepare soil with the new farming machines used in France. The next part of his work consisted of a report with detailed calculations on the amount of crops, their quality and the possibility of using new farming tools. Credo announced the results in his dissertation *Mémoire sur la nouvelle culture* (*P.V. ms.*, 1754–1759, p. 596; Credo, 1758) based on his statistics and record lists. He was even considered for an informal award by his principal, but the prize was not awarded for science.

However, the published results of the experiments in Lorraine were acknowledged as a great piece of research at *Académie royale des Sciences* in Paris. The treatise *Mémoire sur la nouvelle culture* was qualified for publication in the collaborative work *Traité de la Culture des Terres* (Duhamel du Monceau, 1758, pp. 20–39). Credo's next treatise presented to the Society in Nancy focused on the new method of preservation of seeds (*P.V. ms.*, 1754–1759, p. 559).

Mémoire sur Ray Grass ou Faux Seigle is another, very interesting work presented to the Royal Society in Nancy; it discusses modern cultivation, and was published anonymously in the fourth volume of *Mémoires de la Société Royale à Nancy* (*M.S.R.N.*, 1759, pp. 124–129). The study was presented to the Society in 1759 (*P.V. ms.*, 1759, pp. 89–97) and as part of a broader edition to King Stanisław Leszczyński (Miroudot, 1760), who ordered that the work be printed and disseminated in Lorraine. The author, monk Jean-Baptiste Miroudot du Bourg, was appointed *d'aumonier à brevet* by King Stanisław. Father Miroudot du Bourg (1722–1798) was first appointed to the Cistercian monastery in Barrois. He was interested in agriculture, which connected him to King Leszczyński for several years. In 1776, he was delegated from France to Baghdad as a bishop and consul. Mirodout became infamous in Rome as he took an oath on the Civil Constitution of the Clergy (Michaud, 1821, pp. 142–143; Delarc, 1884–1897, p. 413).

The content of the work is so interesting that it deserves a short note in this article. The work describes experiments on gaining more efficient crops which were started by the king and were continued after the work was published. The author informs that the experiments of cultivating darnel were carried out in Lorraine in about 1756. He writes that agriculture is undergoing great changes and mentions the dominance of English agriculture over that of Lorraine. Englishmen created artificial pastures and achieved very efficient modern fodder, beneficial to the soil.

Mirodout (1760, p. 37) underlines that he created artificial pastures on the territory of Malgrange on the orders of King Stanisław, which enabled him to improve the quality of even the most barren soil. *Fabaceae* (legumes) and a new type of grass, *ray grass*, not known in France before, was sown in the part of the fields used for corn. The plant did not have a French name, which is why some botanists considered it couch grass, and sometimes the name was translated as rye (*M.S.R.N.*, 1759, p. 125). The plant belongs to the group of perennials which grow on all types of soil, even the "hungry" ones. It does not need fertilising and is inexpensive to cultivate. The only thing that had to be done before sowing was to plough the land. Spring was the best sowing time. Between 48 and 50 pounds of *ray grass* with 2 pounds of medick or clover or 1.5 bushels of oats were used to sow the area of one of the Lorraine lots (Matkowski & Ciesielska-Borkowska, 1928, p. 466). The other plants were necessary to strengthen the root system and support the ear. The first year of cultivation gave a very good but single harvest; in the following years there were up to three harvests. *Ray grass* grown as fodder to be used in cattle, horse and sheep breeding was one of the most efficient plants. Mirodout informs that a number of experiments were conducted to cultivate this plant, the results of which were not as excellent as the English experiments, but still very productive. An additional leaflet revealed important information: the Lorraine nobility, officers of Parliament Regional, people in high positions and even enlightened minds were growing experimental crops similar to Miroudot's in

Malgrange under the guidance of King Stanisław and the city (Skwarczyńska [Durbas], 2005, pp. 113–120).

At that time, as the authors claim, the planting of 20 or 30 *morgen* of a new crop was rather common in Lorraine. The owner of Château de Fléville (Lambel, 2003, pp. 119–130), Marquise Anne Desarmoises (Des Armoises), had good relations with King Stanisław. According to the contemporary owner of the chateau in the suburbs of Nancy, Count Thierry de Lambel, King Leszczyński assigned monk Miroudot du Bourg, a specialist of *des prairies artificielles* (artificial grasslands), in Chateau de Fléville to create beautiful lawns in the French formal garden. Marquise Anne Desarmoises, who lived there in the 18th century, increased the harvest every year. The grass was slowly changed into a lawn grass with the help of Father Miroudot. (Lambel, 2003, pp. 119–130)

The experimental fertilising of the soil was used in order to increase the harvest. Miroudot, applying his own method, mentioned that this is a very important factor in increasing the quality and quantity of the crops. This method consisted in mixing the hungry soil with loam or alluvial soil. He described the two ways as follows: 100 carriages of good soil was mixed with hungry soil or, the opposite, 200 carriages of sand or grit was added to the terrain with loamy soil. This type of mixture, as he informed, was used to enrich land around Malgrange (Miroudot, 1760, p. 45). He followed the example of Henry Pattullo, agronomist, physiocrat and a member of the Society (*P.V. ms.*, 1759–1765, p. 383), and his *Essai sur l'amélioration des terres* (Pattullo, 1759). Father Miroudot contacted the Chairman of the Parliament in Besançon and the Society of Agriculture, Trade and Art in Brittany, where similar experiments were carried out to popularise cultivation (*M.S.R.N.*, 1759, p. 129).

King Stanisław Leszczyński was the main initiator of agricultural researches in the Stanisław Leszczyński Academy in Nancy. He was also the initiator working with the new method of preparing the soil and using better farmimg machines in Lorraine.

This field was considered by the Polish King, Duke of Lorraine and Bar, as one of the most important branches of knowledge (*Nouvelles découvertes pour l'avantage...*, p. 6). He said that: "everyone who learns about the superiority of agriculture over the other branches of knowledge, will not hesitate to spend his time and engagement in research in improving the mechanics which is connected to this social need".

In 1756, the Academy received an anonymous text, *Memoire*, about the new useful machines and other inventions. Simultaneously, the printed version of the anonymous *Nouvelles découvertes pour l'avantage et l'utilité du public* ('New discoveries for public benefit and utility') was dedicated to *A Messieurs de la Societé Royale des Sciences, Arts et Belles-Lettres de Nancy*. The author, King Stanisław Leszczyński, expressed his admiration for the advancement of sciences and arts in Lorraine since the time the Academy was created using the words "I am grateful for the care in perfecting the talents and stimulation for competition and making it possible for the intelligent researchers to submit their projects to the Academy." (*Nouvelles decouvertes…*, *n.d.*, p. vj). King Stanisław underlined that his work is the result of various experiments he had seen with his own eyes and collected for his own use. In the preface, he announced a genius invention for a modern way of cultivation, the only fault of which was that it was invented too late. While waiting for that time, Stanisław believed that this invention would be used only when its public approval triumphed over the custom treated as law. He presented the easiest way of ploughing, more plentiful production of crops and the method of threshing that did not require any effort. The king added some more interesting inventions to this list. He was sure that clever minds eager for knowledge could improve those inventions. "In order to, let me say, heat up the old ideas and nurse those seeds better than I did this, I ask [the researchers] to continue and not to bereave the society of the results that can come from those seeds" (*Nouvelles decouvertes…*, *n.d.*, p. vj).

The inventions that were introduced in the press, complied with the conditions of *utilitatis* (utility) and were presented to the Royal Society in Nancy, are worth a closer look. After the academicians acquainted with the text, the plough, new for that time, was the most controversial one. There is a note in the protocols of the Society's meetings in which the inventor (King Stanisław) was compared to Cincinnatus bound to his plough: "The plough no longer boasts of having seen Cincinnatus attached to its share..." (*P.V. ms.*, 1754–1759, p. 241).

In reality, two types of ploughs were presented to the academicians. One of them was an improved, complicated tillage plough, operated by only two horses. The experiments were carried out on different types of soil and even on the hard surface of a county road that had been used for many years. The experimental fields were in Jolivet (the estate of 162 hectares close to Lunéville) and its appurtenances (Skwarczynska [Durbas], 2005, p. 105). At first sight, the new plough did not differ from the ones commonly used. The main parts were the same but the way of construction made it better in many respects. The ploughshare control, which allowed changing the depth and width of the ploughed area, was the innovative element (*Nouvelles découvertes…*, *n.d.*, p. 4).

The second plough was designed for swampy soils on which the common wheeled plough could not be used. There were also two horses used for operating but the way of harnessing them was different: the horses were attached to a thill rather than a drawbar, thus to a carriage with two drawbars. The lack of wheels enabled tillage on hard, firm soils which were difficult to access. This plough was also used on the Jolivet field to the satisfaction and approval of farmers. The researches and experiments using modern and improved machines were introduced in Paris for the Academy of Sciences under the supervision of M. de Duhamel. King Stanisław recommended making changes, changing different parts, and improving some of the mechanisms which led to the greater efficiency of the farming machines (Durbas, 2013, pp. 171–201).

Producing more plentiful crops (*production plus abondante de la semence*) was achieved with a detailed recipe for a chemical solution mixed with nutritive substances, that is, manure. This would be nothing uncommon, except for the fact that the king added a new step to its process of use: soaking the grains in diluted solution before sowing in the field increased yields. The grains were soaked for 24 hours, after which they were dried and seeded. The solution was also used for watering flowers, vegetables and other plants. Even a single injection of this substance accelerated plant growth. (*Nouvelles découvertes…*, *n.d.*, pp. 10–11) The experiments with manure took also place in the area of Jolivet called *Ménagerie du Roi dans Recueil de plans...* ("The King's menagerie of collection of plants", Héré, 1750) and they benefited the farmers and the royal vegetable garden. Also, the solution was used for fertilising flowers in King Stanisław's beautiful gardens (Skwarczyńska [Durbas], 2005, pp. 107–108).

The next invention was a new model of threshing device, which later became to be called a thresher—*machine à battre le bled* (*Nouvelles découvertes...*, *n.d.*, pp. 12–22). Owing to its innovative construction, the machine was able to thresh the corn almost without effort and cost, as was written in the description. Only one man and one horse was used to activate and operate it. The convenience of using the device involved economical factors (saving human labour and greater efficiency). The advantages of using *machine à battre le bled* were set against the old time-consuming methods of gaining seeds with a flail. The machine's description claimed that one or two of these devices would be sufficient for one village. The description also mentioned that to decrease the costs, the power of water current could be used instead of the horse. There are two illustrations presenting the machine from the technical point of view that complete the image and demonstrate the main operation principle of the thresher—multiplied transmission of forces (*Nouvelles découvertes ...*, *n.d.*, p. 22).

A simple thresher (*la batteuse simple*), which could be used by simple farmers, was presented as well. “Peasants, preoccupied with the present, very seldom see in an economic way beyond the day which dawns (*Nouvelles découvertes…*, *n.d.*, p. 21). King Stanisław presented the second model of thresher as considerably cheaper and simpler in construction. This machine had been, and was, as the king underlined, used in Einville-au-Jard, an estate in Lorraine close to Lunéville. The old Einville castle, destroyed by the French during the Thirty Years’ War, was rebuilt in 1701 by Leopold, the Duke of Lorraine. During the reign of King Stanisław, the garden with the giant park and its appurtenances was spread over 126 hectares, covering fields and forests. The fields were the place of experiments with new machines and methods of cultivation (Skwarczyńska [Durbas], 2005, pp. 110–113).

The king wished that academicians would take interest also in another device—the winnowing machine (*machine à vanner le bled*), a farming machine used for cleaning threshed seeds by separating them from chaffs and other impurities (*Nouvelles découvertes…*, *n.d.*, p. 23). The advantage of the machine was its incredible efficiency. It was used in the estate named Chantheux (Chanteheux) four kilometres from Lunéville palace, in a straight line from the main garden alley (Skwarczyńska [Durbas], 2005, pp. 104–108).

The device was able to clean as many seeds with one person operating it in one day as four old machines would during one week. Gaining the cleanest and richest seeds was possible because the blow of wind removed not only the chaffs but also dust and other impurities (*Nouvelles découvertes …*, *n.d.*, p. 24).

Studies in the field of agriculture at the Stanisław Academy of Sciences (1750–1766) were connected with new ways of preparing the soil and using improved farming machines in Lorraine. Some of the presented devices could be still found in Poland in the twentieth century. Leszczyński believed that the land was the basic good and agriculture was the driving force in the development of the society, an idea which was similar to those of physiocrats several years later. King Stanisław Leszczyński was the initiator of agricultural innovations, he was inspired by scientific achievements and adapted them in his own scientific experiments. All new solutions were presented during scientific meetings in order to make them widely available.

King Stanisław's interest in the development of local agriculture contributed to experimental arable farming, increase in the agricultural production, and mechanisation in agriculture.

References

Amsterdamski, S. (1983), *Między historią a metodą. Spory o racjonalność nauki*, Warszawa: Państwowy Instytut Wydawniczy (PWN).

Bonnefont, J. C. (2006), 'Les agronomes de la Société royale des Sciences et Belles-Lettres de Nancy (1750–1793): Les précurseurs de Mathieu de Dombasle en Lorraine,' *Annales de l'Est*, no 1.

Credo, A. (1758), *Mémoire sur la nouvelle culture*, Nancy: Pierre Alliot.

Delarc, O. J. M. (1884–1897), *L'église de Paris pendant la Révolution Française*, 1789–1801, vol. I, Paris: Desclee, de Brouwer et cie.

Duhamel du Monceau, M. (1750–1757), *Traité de la Culture des Terres*, vols. 1–5, Paris: H. L. Guerin, L. F. Delatour.

Durbas, M. (2016), 'Ważność drugiej elekcji króla Stanisława Leszczyńskiego w świetle trzeciego traktatu wiedeńskiego,' in M. Markiewicz, D. Rolnik & F. Wolański (eds.) *Wokół wolnych elekcji w państwie polsko-litewskim XVI-XVIII wieku. O znaczeniu idei wyboru - między prawami a obowiązkami*, Katowice: Wydawnictwo Uniwersytetu Śląskiego, pp. 449–464.

—— (2013), *Akademia Stanisława w Nancy (1750–1766)*, Krakow: Libron.

Héré, E. (1750), *Recueil des plans, élévations et coupes tant géométrales qu'en perspective, des châteaux, jardins et dépendances, que le Roi de Pologne occupe en Lorraine, y compris les bâtiments qu'il a fait élever ainsi que les changements considérables, les décorations et autres enrichissements qu'il a fait faire à ceux qui étaient dêjà construits. Le tout dédie à Sa Majesté par M. Héré son premier architecte, Ière partie*, Paris: François.

Lambel, T. Comte de (2003), *Histoire du Château de Fléville*, Nancy. Retrieved from https://www.google.ee/search?q=Histoire+du+Ch%C3%A2teau+de+Fl%C3%A9ville&ie=&oe=# [accessed July 2017]

Michaud, L. G., ed. (1821), *Biographie universelle, ancienne et moderne: ou Histoire, par ordre alphabétique, de la vie publique et privée de tous les hommes*, vol. 29.

Michaux, M. G. (2008), *Naissance et développement des académies en France aux XVIIe et XVIIIe siècles*, in *Mémoires de l'Académie Nationale de Metz*, Metz: Académie Nationale de Metz.

Miroudot, J. B. (1760), *Mémoire sur le Ray Grass ou Faux Seigle*, presenté au Roi de Pologne le 29 juin 1760, Nancy: La Veuve et Claude Leseure.

M.S.R.N. (1759), *Mémoires de la Société Royale des Sciences et Belles-Lettre de Nancy*, vol. IV, Nancy: Pierre Antoine.

Nouvelles découvertes… (*n.d.*), *Nouvelles découvertes pour l'avantage et l'utilité du public*, [S. Leszczyński], Nancy: Haener.

Pattullo, H. (1759), *Essai sur l'amélioration des terres*, Paris: Durand.

Précis des fondations… (1758), *Précis des fondations et etablissements, fait par sa Majesté le Roi de Pologne, Duc de Lorraine et de Bar*, Nancy: Pierre Alliot.

P.V. ms. (1751–1765), *Procès-Verbaux-manuscrits de la Société Royale des Lettres, Sciences et Arts de Nancy*, vols. I–III.

Rostworowski, E. (1998), *Historia powszechna*, Warszawa: PWN.

Sauvy, A. & Hecht, J. (1965), 'La population agricole française au XVIII siécle et expérience du marquis de Turbilly,' *Population*, vol. 20, no. 2, pp. 269–286. https://doi.org/10.2307/1526327

Skwarczynska [Durbas], M. (2005), *Ogrody króla Stanisława w Lotaryngii w latach 1737–1766*, Warszawa: DiG-Warszawa.

Słownik encyklopedyczny francusko-polski (1928), ed. by Z. Matkowski & S. Ciesielska-Borkowska, Lwów & Warszawa, p. 466.

Statuts de la Societé Royale des Sciences et Belles Lettres de Nancy (1751), Nancy.

Turbilly (1762), *Mémoire sur les défrichements par M. Le marquis de Turbilly (L. F. H., de Menon)*, Amsterdam: M.-M. Rey.

Voisine, J. (1974), "Henry Pattullo's Contribution to the French Enlightenment," *Canadian Review of Comparative Literature*, vol. 1, no, 2, p. 91–103. Retrieved from https://www.google.ee/search?q=Henry+Pattullo%E2%80%99s.+Contribution+to+the+French+Enlightenment&ie=&oe=# [accessed July 2017]

Małgorzata Durbas, associate professor at the Institute of History, Academy of Jan Dlugosz in Częstochowa, specialises in the modern history of Poland and the history of relationships between Poland and Lorraine. Her research touches upon the broadly understood cultural and social space of the Duchy of Lorraine and Bar at the time of integration with the House of Bourbon during the reign of King Stanisław Leszczyński. Her academic output includes analyses of many topics concerning the modernisation processes as well as the institutionalisation of academic research, artistic patronage and charity activity. Her current main area of research is the image of the functioning of academic life in the 18th century.

Acta Baltica Historiae et Philosophiae Scientiarum
Vol. 5, No. 1 (Spring 2017)
DOI : 10.11590/abhps.2017.1.05

25 Years of Change in Management Control Systems and Business Education in Estonia

Ülle Pärl

Estonian Business School
University of Tartu
Estonian University of Life Sciences
E-mail: ylle.parl@ut.ee

Abstract: During the last 25 years, the Estonian economy has transitioned from a centrally planned economy to a market-oriented, globally open, highly competitive economy. Although during these years there has been fast growth and Estonians could tell a lot of success stories, research shows that management practices are still less advanced compared to those in enterprises from developed countries. Increased competition, openness and innovation increased the significance of more sophisticated management control systems (MCS). Researchers accentuate the role of managers and their education and training in using and developing more sophisticated MCS in companies. The objective of the current paper is to better understand how changes in the business environment, managerial training and education are connected to developments in MCS in Estonia. This article provides an overview of the statistics and studies completed in Estonia over the last 25 years. As this study shows, the last decade has brought a different level of internationalization and development in the business environment and business education. The problems associated with developments in MCS, using cloud technology, business education and managerial training are the same in Estonia as in developed countries. To develop the business and economic environment in the country, Estonian entrepreneurs need high-level data processing, analytical and financial education, and practical training courses.

Keywords: *changes, education, Estonia, management control systems, manager, training*

Introduction

The globalizing business environment, shortening business cycles, developing information technology and increasing competition have been especially intensive over the last 25 years. In Estonia, as a post-Soviet country, the business environment has been expanding notably in connection to its reorientation from a centrally planned to a market economy at the beginning of the 1990s. Significant economic growth at the beginning of the 2000s, accession to the European Union in 2004, adopting the euro in January 2011 and introducing e-Residency in 2014 are landmark changes in Estonia during the last 25 years. However, despite e-Residency, e-signatures, e-(annual) reporting and e-government (see e-Estonia.com, 2016), organizations have limited ability to use information and cloud technology (Käsk, 2016), create knowledge-based added value through international cooperation (Eljas-Taal *et al.*, 2011) and are still less advanced compared to companies in developed countries (Alas *et al.*, 2015).

Increased competition, openness and innovation require an increase in managerial attention, coordination and control to guarantee alignment between activities and performance goals (Gordon & Narayanan, 1984; Mia, 1993; Chong & Chong, 1997; Tillema, 2005; Lääts, 2011). More sophisticated management control systems (MCS) have even increased their significance for successful management in the current environment (e.g., Ittner & Larcker, 2003; Pärl, 2006; Foss *et al.*, 2011; Afonina, 2015; Rajnoha & Lorincová, 2015; Mikkus & Žukovits, 2016; CGMA, 2016). Studies show that the training and experience of managers correlate positively with their use of more sophisticated measurement systems (Birnberg & Wilner, 1986; Mendoza & Bescos, 2001; Pärl & Haldma, 2010).

In Estonia, apart from the changes in the business environment, substantial changes have occurred in business education and training over the last 25 years (Kolbre *et al.*, 2006; Vadi *et al.*, 2011; Alas *et al.*, 2015). Consequently, it is important to analyse changes in MCS and in management education and training during the last 25 years in Estonia.

In Estonia, small and medium-sized enterprises (SME) make a significant contribution to GDP. SMEs bring a broad range of benefits in terms of growth in national income. For example, in 2015 SMEs produced 80 per cent of total profit (see Table 1). They provide important opportunities for employment (78 per cent of employment in 2015), and furthermore, they are a key source of and

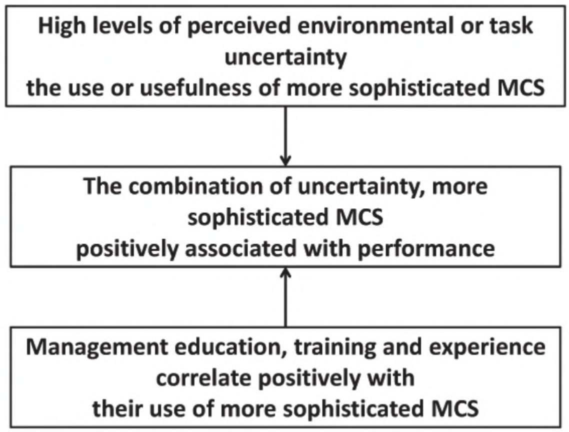

Figure 1. Links between the level of MCS, manager training and education and organizational performance
Source: Pärl & Haldma, 2010.

outlet for entrepreneurial creativity and ideas. In a small country such as Estonia, SMEs constitute 99.8 per cent of the country's companies.

Table 1. Number of companies, number of employees, turnover and profit in euros for companies of different sizes

	Number of employees		Turnover		Profit		Number of companies	
Company size	Number	%	Thousand €	%	Thousand €	%	Number	%
Micro	123,058	29%	15,659,072	29%	1,461,013	44%	109,722	93.5%
Small	107,372	25%	13,514,019	25%	556,183	17%	6,281	5.4%
Medium	104,287	24%	12,632,169	24%	649,910	20%	1,200	1.0%
Large	91,424	21%	11,661,623	22%	649,227	20%	195	0.2%
Total	426,141	100%	53,466,883	100%	3,316,333	100%	117,398	100%

Source: *Statistics Estonia, n.d.*

Compared to large organizations, SMEs' survival depends more on their ability to adapt to the business environment (McAdam, 2000); in addition, the entrepreneurs' ability, background and experience affect their performance significantly. This makes a better understanding of the connection between management education and uses of MCS more important for a small, open and highly entrepreneurial post-Soviet country such as Estonia.

The objective of the current paper is to better understand how changes in the business environment, managerial training and education are connected to developments in MCS in Estonia over the last 25 years during the journey from a centrally planned to open market environment oriented toward intensive global competition. Although there are studies of financial accounting and reporting developments in Estonia during 1990–2005 (Haldma, 2004; 2006), there are no researches published in English in widely available sources that cover the last 25 years and explore the relationships between the use of MCS and the education of the managers using those systems.

The paper is divided into the following sections. The first section explains the changes and developments in MCS during the last 25 years, the second section provides an overview of changes in managerial education and training during the same period. Finally, some concluding thoughts are expressed and suggestions made for future research.

Changes in management control systems in 1990–2015

In countries in transition from a centrally planned to a market economy, the business environment has been expanding considerably over the past 25 years, which has led to a higher level of uncertainty, fiercer competition, and increased openness and innovation. In Estonia, more intensive competition and high levels of perceived environmental uncertainty demand the application and use of more sophisticated MCS in companies.

The investigations show the development of MCS in Estonian medium and large companies from the second half of the 1990s. As revealed by Haldma and Lääts (2002), the majority of Estonian medium and large companies improved their MCS in the period 1996–1999, during the reorientation to a market economy and after substantial changes to financial accounting regulations were introduced since 1995.

Hammer and Karilaid (2002) studied the use of financial and non-financial indicators in Estonian companies. They found that in addition to financial indicators (profit and its growth, turnover and its growth, cash flow), managers relied on some nonfinancial measures (market share, customer satisfaction) in their decisions. Although there were essential changes in MCS during the last half of the 1990s, based on longitudinal research, Lääts

(2011, p. 175) concludes that in the period 1994–2001 MCS in Estonia was still in its infancy.

Research conducted by Hammer and Karilaid (2002) in Estonia shows that at the beginning of the 2000s there was a willingness to use more sophisticated and integrated MCS compared to the financial and retrospective systems that managers used in that period. For the future, managers were planning to use more nonfinancial indicators and focus more on measuring customer and employee satisfaction. Estonian managers believed that profit and its growth, turnover and its growth, and liquidity ratios were among the measures they would be using less in the future (Hammer & Karilaid, 2002).

Based on research (Lääts *et al.*, 2011; Lääts, 2011; Lääts & Haldma, 2012), we can argue that the wider conceptual management accounting changes in Estonian medium and large companies took place in the period 2000–2007. The studies by Lääts once again certify that during these years, companies with higher levels of perceived market dynamics had applied more sophisticated MCS. For example, these companies reflected a greater use of flexible budgeting and rolling forecasting, as well as a balanced scorecard approach and market share as a performance indicator. Lääts *et al.*, (2011) and Lääts (2011) revealed that for 2004–2007 the changes in MCS were associated with the increased use of mid-term business planning, strategic planning and performance-based incentive systems.

The survey conducted by Pärl in autumn 2002 (Pärl, 2006) involved managers of Estonian small and medium-sized companies and shows that managers consider it extremely important to monitor financial accounting indicators like revenue, net profit and accounts receivable. At the same time, the managers of more successful companies value more highly observations of more sophisticated information including external information like their customers' cost- and profitability-related data, as well as non-financial, quality-related indicators directed away from the company. The research shows that the important needs for information, notably regarding the degree of customer satisfaction and the characteristics of competitors, are not satisfactory for managers (Pärl, 2006).

In the years 2007–2009, during the economic recession, most companies were fighting to survive and tried to improve their business models as well as their MCS (Vadi *et al.*, 2011); however, the survey of Estonian management practices in 2010 (Vadi *et al.*, 2011) shows that the planning horizon in most companies was still short and most companies did not use a more sophisticated and integrated

MCS at the end of the first decade of the new millennium. Different tools (e.g., budgets and reports) were not usually integrated and the balanced scorecard-type framework was not popular in Estonian companies. Most companies with Estonian owners relied on formal financial indicators adding some sales indicators, though not in an integrated way.

One reason for the slow development of integrated and more sophisticated MCS could be the lack of knowledge about contemporary management control tools. As revealed in research conducted by Talvet (2013), about 60 per cent of small company managers participating in the study did not know about the balanced scorecard framework. This meant they did not have a tool for selecting relevant information and using it in an integrated way for everyday management processes.

Unfortunately, the recent study by Alas and others (2015) showed similar findings. This study showed that the planning horizon in 2015 is still short in companies belonging to Estonian owners. The most widespread management practice used is a one-year rolling budget that is renewed monthly or quarterly. However, research mentions that determining the long-term vision of the company is gaining importance at a slow pace, vision and values are also being formulated in a more mature way and the long-term goal and principles of performance are being considered more carefully.

The situation in 2010 in companies with foreign owners was quite different (Vadi *et al.*, 2011). These companies used more integrated, balanced scorecard-type MCS. In addition to financial indicators, these companies used more non-financial and personnel oriented indicators. One reason for these findings could be the size of the companies. The most common internal factor that has been examined in relation to MCS is organizational size. The results of these studies confirm that company size and more sophisticated MCS are positively correlated. Companies owned by foreign capital are usually larger than those owned by locals.

Based on the study of SMEs (Pärl, 2006) and medium and large companies (Lääts, 2011), it was pointed out that, in the future, MCS in Estonian companies should include more sophisticated, both financial and non-financial, accounting data. The studies also emphasize that MCS will become more detailed and more indicators will reflect business environment information. These changes could increase the need for managers to analyse at a higher level of abstraction. As a result of information system integration, a growing amount of relevant data can be included into an MCS, which means more well-trained and experienced accounting staff and more up-to-date information technology will be needed.

However, a more recent study (Mikkus & Žukovits, 2016) shows that only 41 per cent of Estonian companies use more sophisticated MCS. They say that small companies use less sophisticated MCS based mainly on financial indicators such as cost-benefit, costing, comparisons of budgets and plans, and customer profitability. They argue that about 13–14 different indicators and control tools can offer an integrated view of the company's processes and resources. Small Estonian companies usually use only 4–8 indicators, which provide a very narrow overview of the processes and resources.

However, their study shows that medium and large companies in Estonia use more sophisticated MCS. Large companies use, on average, 17–19 indicators and tools to obtain an integrated holistic overview of processes and resources. They also found a strong positive correlation between the level of MCS and performance.

Advances in information technology is a key force in developing more sophisticated and integrated MCS. Nowadays, it is already possible to use cloud-computing services almost anytime, anywhere and at a relatively low cost. Cloud computing is internet-based computing that provides shared processing resources and data to computers and other devices on demand. We can say that cloud computing is a utility like water or electricity. Using cloud technology, it is possible to access files and software from any device at any time. The key benefits in addition to elasticity, flexibility and accessibility are increased security as well as costs savings. This last factor is extremely important to SMEs, because they are not able to incur the costs of hosting and maintaining their own information systems and are more likely to be interested in adopting cloud technology to access the cost and efficiency benefits in the short term (Strauss *et al.*, 2014, p. 3). We can conclude that for the Estonian economy, as a small open economy in an entrepreneurial environment, adopting cloud technology is vital.

Although the benefits associated with cloud computing sound enormous, most Estonian companies are unsure of how to proceed with the migration into the cloud (Käsk, 2016). In addition, many enterprises in Estonia as well as in Germany have resisted cloud computing due to a lack of knowledge, security concerns and privacy issues (Käsk, 2016; Strauss *et al.*, 2014). As they concluded, managers see security problems and privacy issues because they do not have enough information or an understanding of the new technology. For Estonia, this means that to be able to compete globally, more training and education in information technology and especially cloud computing is urgently needed. The key to developing more sophisticated MCS, especially for SMEs, is cloud technology and its access to business intelligence and ERP type software at a reasonable cost and high security level.

The Chartered Global Management Accountant (CGMA, 2016) has pointed out the importance of an integrated approach to using MCS, which includes active collaboration between leaders and employees. As emphasized by Strauss *et al.* (2014, p. 1): "By cloud technology any manager with a laptop or smart device can access business information systems, and this may contribute to faster and more collaborative decision making". Surprisingly, the recent survey of Estonian management practices by Alas and others (2015) shows that engagement has even decreased in the management of Estonian companies during the last five years. The survey shows that the role of specialists, middle and junior managers has decreased remarkably in strategic planning. This lack of increased cooperation and collaborative decision making is not only occurring in Estonian companies, but as a German study shows (Strauss *et al.*, 2014, p. 6), the use of cloud technology has not dramatically changed the level of cooperative involvement in decision making. Of the respondents, 77 per cent answered that cloud technology had not changed the level of collaboration in decision making (Strauss *et al.*, 2014, p. 6).

To conclude the topic of changes in MCS during the last 25 years in Estonia, it is possible to distinguish different periods and patterns. Although the lines between the different periods are not very clear and strict, it is possible to identify the following five periods for the extension and development of MCS:

- 1990–1995: departure from planned economy, the period of turmoil;
- 1996–1999: rapid reorientation, the period of "infancy";
- 2000–2006: the greatest changes, reaching "puberty";
- 2007–2009: surviving the recession, desperate attempts to innovate MCS;
- 2010–2015: reaching the "comfort zone", "adulthood" and stabilization.

The developments in MCS bring managers to more sophisticated and integrated information systems, which may contain a large variety of indicators (CIMA, 2009; CGMA, 2016). Looking at the research, the main organizational factors that facilitate developments in MCS in Estonian companies are support for the top management and the availability of competent financial staff (Lääts, 2011,

p. 175), (lack of) knowledge, security concerns and the privacy issues of cloud computing (Käsk, 2016). The key to developing and using more sophisticated and integrated MCS is training and educating managers. It is important to analyse developments and changes in business education and training over the last 25 years in Estonia.

Changes in management education and training in 1990–2015

In her research, Silvola (2005) concluded that the education of the manager (CEO) is an important factor in driving the adaptation of more sophisticated management control systems in the company. One reason given by Mendoza and Bescos (2001) is that, based on their research, better trained and financially experienced managers have a better grasp of modern accounting methods; therefore, they have better access to information and are more content with the management control information in their possession. Already thirty years ago, Birnberg and Wilner (1986) reached a similar conclusion. They claimed that managers with a financial background are better equipped to notice and understand changes in accounting data. Furthermore, experience allows them to develop more sophisticated financial models that allow them to confront information overflow by identifying priorities and understanding their problems more quickly. Several studies (Einhorn, 1974; Libby & Frederick, 1990; Lord & Maher, 1990) have came to the conclusion that inexperienced managers have difficulties in recognizing pertinent causal relationships in a given situation. Their mental models are not as precise, and they are less able to act on the primary causes. Therefore, developing and using more sophisticated MCS depends on education and training of the managers.

Comparing the educational level of Estonian managers with the general international level, it has been said that the former has been rather high. A survey conducted in Estonia in 2006 (Kolbre *et al.*, 2006) revealed that slightly more than 50 per cent of the managers had a higher education, whereas 57 per cent of entrepreneurs in highly developed countries had an education level above secondary education (Minitti, 2005). The survey, however, shows that the managers of Estonian enterprises lack economic, managerial and marketing knowledge. Among the managers of small enterprises, merely 14 per cent had a special business or managerial education (Kolbre *et al.*, 2006).

It can be assumed that contemporary training in business administration was started in Estonia at the beginning of the 1990s, when the shift from a centrally planned economy towards a market economy began. However, it is important to mention that there were opportunities in Estonia to cooperate and work with Western and US universities already since the 1960s. Estonia was referred to as "the West" in the Soviet Union. According to Janno Reiljan (2015), Dean of the School of Economics and Business Administration at Tartu University in 1993–1996, there were opportunities already in the 1960s but increasingly since the 1980s to work as visiting scholars in Western and US universities. For example, Professor Raoul Üksvärav (1928–2016) worked as a visiting researcher in the US through 1963–1964 and in Finland in 1984. Üksvärav is the author of management textbooks first published in the early 1970s. Professor Madis Habakuk (1938–2016) studied and worked at US universities and at international organizations from the 1970s. Habakuk established the first private business school in Estonia in 1988, now known as Estonian Business School. Of course, at the beginning of the 1990s, "the doors opened" and more scholars had opportunities to study and work abroad. For example, in summer 1993, 35 Estonian academics attended seven-week training courses at Bentley University in the US.

In transition countries a bias still exists that a business education from the Soviet era under the centrally planned economy is not as valuable as a business education that started in the second half of the 1990s. In 2005, the research conducted by Pärl and Haldma (2010) surprisingly does not support the hypothesis of the better quality of the "new" education; that is, the use of more sophisticated MCS and measurement models by managers of SMEs who graduated in 1995–2005, compared to managers who graduated during the Soviet period and the very early 1990s. One reason could be that the difference is not as relevant as assumed or that the business or/and financial experience is more important than formal education. Managers who graduated before 1995 had had at least ten years of business or financial experience by the time the research was carried out in 2005. There is a large field for future research.

However, at the beginning of the 1990s, the business administration curriculum was officially replaced by a market-economy oriented curriculum in Estonian state universities. Simultaneously, several private universities aimed at delivering business and management curricula. As a result of these changes, the number of students of business administration rose dramatically through 1993–1999. The increase in the number of students continued steadily for the next ten years until 2009 (Fig. 2).

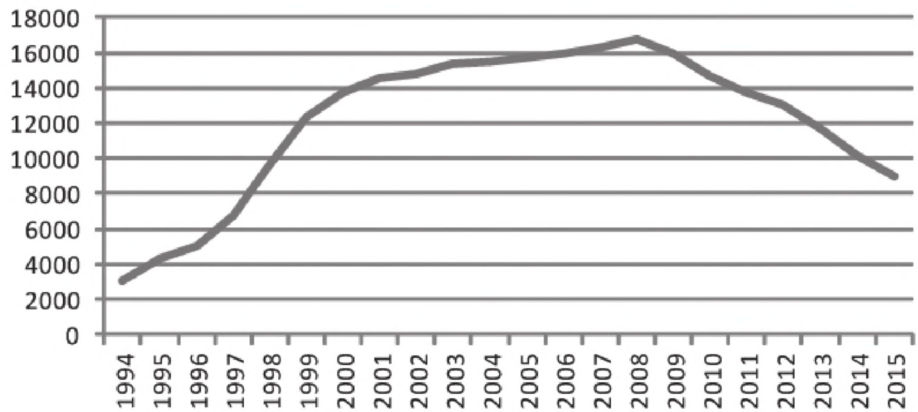

Figure 2. The number of students of business administration in Estonia, 1994–2015
Source: *Statistics Estonia, n.d.*

As a consequence, in Estonia, with a population of 1.3 million, the number of business and economics students in 1993 was 3,800 (Kolbre *et al.*, 2006); by 1999 it had grown to 12,400 (*Statistics Estonia*, *n.d.*), increasing during these years by about 30–40 per cent per year. In the following years, 2000–2008, the number of business administration students increased slightly but otherwise stabilized, and was approximately 16,800 by 2008 (*Statistics Estonia, n.d.*). Since 2009, the number of students started to decrease and dropped to 9,000 students by 2015.

In 2015–2016, the Estonian Qualifications Authority carried out a survey on the requirements of labour and skills in accounting. Based on this survey, approximately 50 per cent of business administration students studied subjects connected to accounting and finance (OSKA, 2016); that is, the subject connected to developing and using MCS in business.

If we look only at aggregated information on the number of business students, it is easy to reach the wrong conclusion, as interest in education in business administration has decreased since 2009. If we look at Figure 3, we can see that the number of students at the postgraduate level has increased steadily in the last 25 years; only in the last three years has there been a slight decrease, approximately 5 per cent per year compared to the previous year. This means that interest in a higher-level business education has increased continually for the last 25 years.

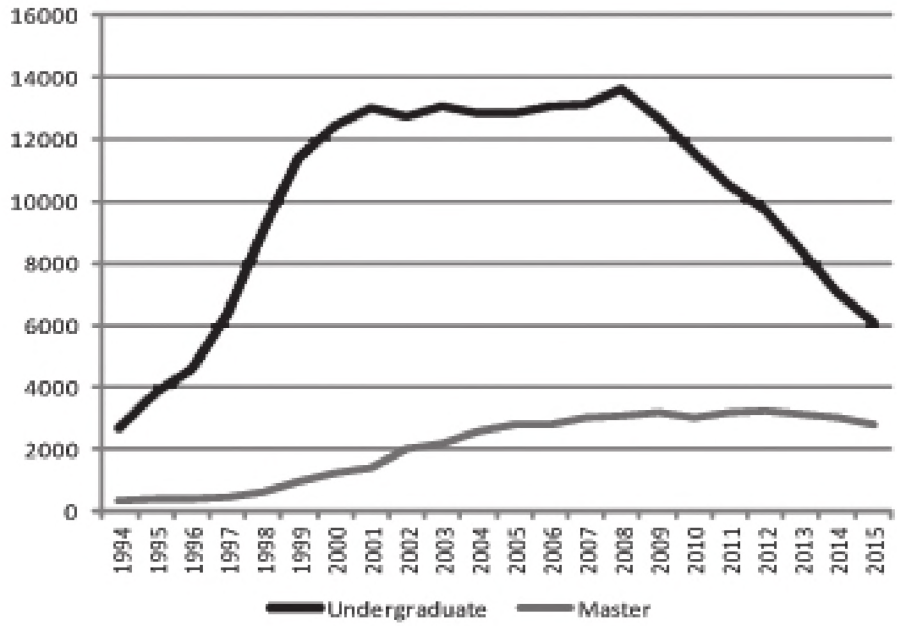

Figure 3. The number of undergraduate and master's degree students, 1994–2015
Source: *Statistics Estonia, n.d.*

The fall in the number of undergraduate students is explained by the huge demographic changes during the period 1988–1998. As we can see from Figure 4, there has been a fall in the number of births from 25,000 in 1988 to 13,500 in 1995 (the minimum was in 1998 with 12,200 births). We can see the same fall in the number of undergraduate students 20 years later. This means that there is no decrease in interest in business and economic education—just a fall in the overall number of undergraduate students. The explanation of the slight decrease in the number of master's degree students during the last years could be the same. The smaller generation has just reached the age of the average master's level student.

To conclude, the number of undergraduate students stabilized compared to the population, and the number of master's degree students is even slightly increasing. This could mean that experienced adult people nowadays value formal postgraduate business education at Estonian universities and the life-long study concept is (hopefully) introduced slowly in Estonia.

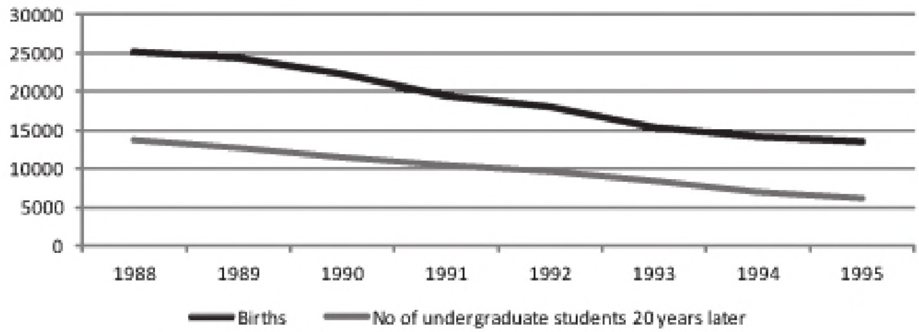

Figure 4. The number of births, 1988–1995, and the number of business students, 2008–2015
Source: *Statistics Estonia, n.d.*

In addition to formal academic education, there were remarkable changes in training methods and management literature during 2010–2015 (Alas *et al.*, 2015):

- Formerly, the managers of the Estonian branches of international companies adopted the practices of the other branches of the company, while today learning has become mutual—more and more representatives from other branches of the group come to learn from the practices of the Estonian units.
- The format of executive training and consultations has changed. During the past five years, Estonian companies have been increasingly participating in the international qualification training market.
- Estonian corporations have sent a number of their managers to study at top universities (INSEAD, LSE, LBS, IMD, IESE, St. Gallen).
- The programmes offered to managers at Estonian universities have gradually gained in popularity.
- There is a remarkable fall in the purchase and reading of management books in the Estonian language, which is the reason for a decrease in the number of authentic and translated books and their circulation figures.
- Estonian managers read more management literature in English.
- Participation in managerial conferences and fairs for practitioners has been steadily increasing.

Therefore, we can distinguish between three periods in the development of business education in Estonia during the last 25 years:

- 1990–1998: explosive interest in business education;
- 1999–2009: controlled developments in curricula, and stabilization;
- 2010–2015: internationalization, practice-oriented training.

Conclusions

During the last 25 years, the Estonian economy has transitioned from a centrally planned economy to a market oriented, globally open, highly competitive economy. Although during these years there has been fast growth and Estonians could tell a lot of success stories, research shows that management practices are still less advanced compared to those in enterprises from the developed countries.

Studies (e.g., Pärl, 2006; Mikkus & Žukovits, 2016; CGMA, 2016) have suggested that the integration of sophisticated MCS with innovation strategies would benefit performance. The more intensive competition and high levels of perceived environmental uncertainty in Estonia demand the application and use of more sophisticated MCS in companies.

Investigations show the development of MCS in Estonian companies from the second half of the 1990s onward. As revealed in a number of studies (Haldma & Lääts, 2002; Hammer & Karilaid, 2002), after a rapid departure from the centrally planned economy in 1990–1995, the majority of Estonian companies improved their MCS in 1996–1999 (see Table 2). However, as concluded by Lääts (2011), at the beginning of the 2000s the application of MCS in post-Soviet countries (including Estonia) was still in its infancy. The wider conceptual management accounting changes in Estonia took place in 2000–2007. During this period, companies introduced, for example, flexible budgeting and rolling forecasting, as well as a balanced scorecard approach and market share as a performance indicator.

In the years 2007–2009, during the economic recession, most companies were fighting for survival and tried to improve their business models as well as their MCS (Vadi *et al.*, 2011). Unfortunately, most of them still did not use more sophisticated and balanced scorecard-type integrated MCS at the end of the first decade of the 2000s. The study by Alas and others (2015) showed that the planning horizon in 2015 is still short in companies belonging to Estonian owners, and only 41 per cent of Estonian companies use more sophisticated MCS (Mikkus & Žukovits, 2016). Their results support the findings that small companies use less sophisticated MCS based mainly on financial indicators. Small Estonian companies usually use only 4–8 different indicators, which gives only a very narrow overview of the company's processes and resources.

Advances in information technology is a key force in developing more sophisticated and integrated MCS. Unfortunately, most Estonian companies are unsure of how to proceed with a migration into the cloud due to a lack of knowledge, security concerns and privacy issues (Käsk, 2016). This means that, for Estonia to compete successfully internationally, more training and education in information technology and especially cloud computing is urgently needed.

Table 2. Changes in MCS and business education in Estonia for 1990–2015

Period	Changes in MCS	Period	Changes in education
1990–1995	Departure from centrally planned economy, the period of "turmoil"	1990–1998	Explosive interest in business education
1996–1999	Fast reorientation, the period of "infancy"		
2000–2006	The biggest changes, reaches "puberty";	1999–2009	Controlled developments in curricula and stabilization
2007–2009	Surviving the recession, desperate attempts to innovate MCS		
2010–2015	"Growing up", stabilization	2010–2015	Internationalization, practice-oriented training

The current research once again emphasizes that the main factor facilitating management control developments in Estonian companies is the education and experience of the (top) management. As revealed from a research conducted by Talvet (2013), one reason for the slow development of integrated and more sophisticated MCS could be the lack of knowledge about contemporary management control tools. For example, about 60 per cent of small company managers who participated in the study did not know about the balanced scorecard framework.

By the end of 2016, the situation has changed dramatically, compared to the 1990s. As this study shows, the last decade has brought a different level of internationalization and development in the business environment and business education. As the recent study by Alas and others (2015) has shown, more and more representatives from other branches of international companies are coming to learn from the practices of Estonian units. In addition, during the past five years, Estonian companies have been increasingly participating in the international qualification training market, at fairs and at conferences. Many Estonians have also studied at top universities (INSEAD, LSE, LBS, IMD, IESE, St. Gallen). Furthermore, Estonian managers read more management literature in English and attend international management conferences. The problems associated with developments in MCS, using cloud technology, business education and managerial training are the same in Estonia as in developed countries.

This article provides an overview of statistics and studies completed in Estonia over the last 25 years, analysing and summarizing information from several studies. The most fruitful studies made during and about this period include the longitudinal study completed by Lääts (2011), and two large surveys of Estonian management practices initiated and commissioned by Enterprise Estonia (EAS) in 2010 and 2015.

This study has implications for research, practice and society. The important practical implication of the study is the conclusion that the education of individuals and especially top managers plays an important role in developing MCS in organizations. It is important to offer high-quality education and training courses to managers because information-based management and the value of information will be among the main competitive advantages. To develop the business and economic environment in the country, Estonian entrepreneurs need high-level data processing, analytical and financial education, and practical training courses.

This study offers an overview of the developments during the last 25 years in MCS and business administration education. The resulting analysis and periodization helps better understand the changes and developmental stages. Getting a better overview of the past helps us plan and orientate for the future. The article serves mainly as a literature review that provides a record of a management issue related to transition and globalization in a post-Soviet country. This could stimulate further study of potential ways to improve the use of MCS in the region and beyond.

References

Afonina, A. (2015), 'Strategic management tools and techniques and organizational performance: Findings from the Czech Republic,' *Journal of Competitiveness*, vol. 7, no. 3, pp. 19–36. https://doi.org/10.7441/joc.2015.03.02

Alas, R.; Eomois, E.; Furman, J.; Kaarelson, T.; Rillo, M. & Uudelepp, A. (2015), *Eesti juhtimisvaldkonna uuring 2015*, Tallinn: Ettevõtluse Arendamise Sihtasutus (EAS).

Birnberg, J. & Wilner, N. (1986), 'Methodological problems in functional fixation research: criticism and suggestions,' *Accounting, Organization and Society*, vol. 11, no. 1, pp. 71–80. https://doi.org/10.1016/0361-3682(86)90019-X

Chong, V. K. & Chong, K. M. (1997), 'Strategic choices, environmental uncertainty and SBU performance: a note on the intervening role of management accounting systems,' *Accounting and Business Research*, vol. 27, pp. 268–276. https://doi.org/10.1080/00014788.1997.9729553

CGMA (2016), 'Joining the dots decision making for the new era.' Retrieved from http://www.cgma.org/resources/DownloadableDocuments/Joining%20The%20Dots%20-%20Report.pdf [accessed 7 Oct 2016]

CIMA (2009), 'Management accounting tools for today and tomorrow.' Retrieved from http://www.cimaglobal.com/Documents/Thought_leadership_docs/CIMA%20Tools%20and%20Techniques%2030-11-09%20PDF.pdf [accessed 7 Oct 2016]

e-Estonia.com (n.d.), *The Digital Society*. Retrieved from https://e-estonia.com/ [accessed 20 Aug 2016]

Einhorn, H. J. (1974), 'Expert judgement: some necessary conditions and an example,' *Journal of Applied Psychology*, vol. 59, no. 5, pp. 562–571. https://doi.org/10.1037/h0037164

Eljas-Taal, K. (2011), *Mini Country Report Thematic Report 2011 under Specific Contract for the Integration of INNO Policy Trend Chart with ERAWATCH (2011–2012)*, December 2011, Technopolis Group.

Foss, N. J.; Laursen, K. & Pedersen, T. (2011), 'Linking customer interaction and innovation: The mediating role of new organizational practices,' *Organization Science*, vol. 22, no. 4, pp. 980–999. https://doi.org/10.1287/orsc.1100.0584

Gordon, L. & Narayanan, V. K. (1984), 'Management accounting systems, perceived environmental uncertainty and organization structure: an empirical investigation,' *Accounting, Organization and Society*, vol. 9, pp. 33–47. https://doi.org/10.1016/0361-3682(84)90028-X

Haldma, T. (2004), 'Development of the Estonian Accounting Policy within the European Framework,' *Economic Policy Perspectives of Estonia in the European Union: XII teadus- ja koolituskonverentsi ettekanded-artiklid; Tartu – Värska; 01.–03.07.2004.* Berlin & Tallinn: Berliner-Wissenschafts-Verlag GmbH, Mattimar OÜ, pp. 544–555. https://doi.org/10.1006/mare.2002.0197

—— (2006), 'Factors affecting accounting development in the harmonization process with the international framework: the case of Estonia,' in G. N. Gregoriou & M. Gaber (eds.) *International Accounting: Standards, Regulations and Financial Reporting*, Oxford & Burlington: Elsevier, pp. 457–482.

Haldma, T. & Lääts, K. (2002), 'Contingencies influencing the management accounting practices of Estonian manufacturing companies,' *Management Accounting Research*, vol. 13, no. 4, pp. 379–400.

Hammer, H. & Karilaid, I. (2002), 'The theory and practice of corporate finance – evidence from the field: Survey in Estonia,' in I. Karilaid (ed.) *The Choice in General Method of Investment and Performance Evaluation*, Tallinn: Tallinn Technical University Press.

Ittner, C. D. & Larcker, D. F. (2003), 'Coming up short on non-financial performance measurement,' *Harvard Business Review*, November, pp. 88–95.

Käsk, H. (2016), *Pilveteenuste kasutamise uuring Eesti väikestes ja keskmise suurusega ettevõtetes* [The study on using cloud services in Estonian SMEs], Working paper, Estonian Business School, Tallinn, Estonia.

Kolbre, E.; Piliste, T. & Venesaar, U. (2006), 'Ettevõtlusalane haridus Eestis' [Business education in Estonia], Paper presented at the First Conference of Estonian Economic Association (Eesti Majandusteaduse Selts, EMS), 20–22 January, Pärnu, Estonia.

Lääts, K. (2011), *Management accounting change in a dynamic economic environment based on examples from business and public sector organizations*, Tartu: Tartu University Press.

Lääts, K. & Haldma, T. (2012), 'Changes in the scope of management accounting systems in the dynamic economic context,' *Economics and Management*, vol. 17, no. 2, pp. 441–447. https://doi.org/10.5755/j01.em.17.2.2164

Lääts, K.; Haldma, T. & Moeller, K. (2011), 'Performance measurement patterns in service companies: an empirical study of Estonian service companies,' *Baltic Journal of Management*, vol. 6, no. 3, pp. 357–377. https://doi.org/10.1108/17465261111167993

Libby, R. & Frederick, D. M. (1990), 'Experience and the ability to explain audit findings,' *Journal of Accounting Research*, vol. 28, no. 2, pp. 348–367. https://doi.org/10.2307/2491154

Lord, R. G. & Maher, K. J. (1990), 'Alternative information-processing models and their implications for theory, research and practice,' *Journal of Management Review*, vol. 15, no. 1, pp. 9–28. https://doi.org/10.1108/02656710010306166

McAdam, R. (2000), 'Quality models in an SME context: A critical perspective using a grounded approach,' *The International Journal of Quality and Reliability Management*, vol. 17, no. 3, pp. 305–323.

Mendoza, C. & Bescos, P. L. (2001), "An explanatory model of managers' information needs: implication for management accounting," *The European Accounting Review*, vol. 10, no. 2, pp. 257–289. https://doi.org/10.1080/713764598

Mia, L. (1993), 'The role of MAS information in organisations: an empirical study,' *Britain Accounting Review*, vol. 25, pp. 269–285. https://doi.org/10.1006/bare.1993.1026

Mikkus, K. & Žukovits, A.-M. (2016), *Organisatsiooni diagnostika rakendamine ja mõju organisatsiooni tulemuslikkusele Eesti organisatsioonides* [Application and influence of organizational diagnosis on the efficiency of the organization in Estonia], Tallinn: Estonian Business School.

Minitti, M. (2005), 'Characteristics of the Entrepreneur,' *Global Entrepreneur Monitor*, London: Babson College.

OSKA (2016), *Tulevikuvaade tööjõu ja oskuste vajadusele: arvestusala*. Uuringu terviktekst [Future perspectives on the need for labour force and skills. Full report], Tallinn: SA Kutsekoda. Retrieved from http://oska.kutsekoda.ee/wp-content/uploads/2016/04/Arvestusala-Raport-sisukorraga.pdf [accessed 7 Oct 2016]

Pärl, Ü. (2006), 'Choice of measures for performance measurement models on the example of successful Estonian companies,' in T. Mets, J. Andrijevskaja, U. Venesaar & E. Kolbre (eds.) *Entrepreneurship in Estonia: Policies, Practices, Education, Research and Perspectives*, Tartu: Tartu University Press, pp. 228–247.

Pärl, Ü. & Haldma, T. (2010), 'Choice of performance measurement indicators in Estonian SMEs,' in J. W. Kramer, G. Prause & J. Sepp (eds.), *Baltic Business and Socio-Economic Development 2007: 3rd International Conference; Tallinn, Estonia; June 17–19, 2007*, Berlin: Berliner Wissenschafts-Verlag, pp. 340–360.

Rajnoha, R. & Lorincová, S. (2015), 'Strategic management of business performance based on innovations and information support in specific conditions of Slovakia,' *Journal of Competitiveness*, vol. 7, no. 1, pp. 3–21.
https://doi.org/10.7441/joc.2015.01.01

Reiljan, J. (2015), 'Dekaanide vaade. Janno Reiljan,' in J. Sepp (ed.) *Majandusharidus ja -teadus Tartu Ülikoolis* [Business education and studies at the University of Tartu], Tartu: Eesti Ülikoolide Kirjastus, pp. 237–252.

Silvola, H. (2005), 'Management accounting practices. A contingency perspective based on the organizational life cycle and venture capital investors,' Paper presented at the Annual Congress of the European Accounting Association (EAA), May, Gothenburg, Sweden.

Statistics Estonia (n.d.) [Home page]. Retrieved from http://www.pub.stat.ee [accessed 7 Oct 2016]

Strauss, E.; Kristandl, G. & Quinn, M. (2014), 'The effect of cloud technology on management accounting and decision making,' *Research executive summary series*, vol. 10, no. 6, London: CIMA.

Talvet, S. (2013), *Strateegiline juhtimine ja juhtimismudelite kasutusvõimalused Eesti väikeettevõtetes* [Strategic management and applications of management models in Estonian SMEs], Tartu: Tartu Ülikool.

Tillema, S. (2005), 'Towards an integrated contingency framework for MAS sophistication. Case studies on the scope accounting instruments in Dutch power and gas companies,' *Management Accounting Research*, vol. 16, pp. 101–129. https://doi.org/10.1016/j.mar.2004.12.001

Vadi, M.; Tepp, M.; Reino, A.; Ahonen, M.; Kaarelson, T.; Killumets, E.; Leimann, J.; Parts, V.; Rillo, M.; Zernand-Vilson, M. & Türk, K. (2011), *Eesti juhtimisvaldkonna uuring*, Tallinn: EAS.

Ülle Pärl earned her first degrees in Business Administration at the Estonian University of Life Sciences and in Economics at the University of Tartu. Her PhD degrees are from the University of Tartu (in Economics) and from the University of Tampere, Finland (in Business Administration and Accounting). She is an associate professor of Accounting at the Estonian Business School, University of Tartu and Estonian University of Life Sciences. Ülle Pärl has been interested in the communication and interpretation aspects of information and accounting. More recently her research projects have focused on integrated thinking and reporting. She has worked as CFO, management accounting specialist and CEO for more than twenty years. She is a founder of Estonian Accounting Teachers Association.

Acta Baltica Historiae et Philosophiae Scientiarum
Vol. 5, No. 1 (Spring 2017)
DOI : 10.11590/abhps.2017.1.06

BOOK REVIEWS

Moktefi, Amirouche & Abeles, Francine F., eds. (2016), *'What the Tortoise Said to Achilles'. Lewis Carroll's Paradox of Inference*, special double issue of *The Carrollian, The Lewis Carroll Journal*, no. 28 (November 2016), 136pp, ISSN 1462 6519, also ISBN 978 0 904117 39 4.

There is a remarkable similarity between the works of Kurt Gödel and Charles Dodgson, perhaps better known to the general audience as Lewis Carroll. Both had this cunning ability to write short papers, one, two pages maximum, that were easily and quickly read and then made you think for years to come. This special double (!) issue of *The Carrollian*, *The Lewis Carroll Journal*, is entirely devoted to such a short 'story' of Carroll, entitled 'What the Tortoise Said to Achilles' (WTSA from here on), published in *Mind* in 1895. In the A5-format of *The Carrollian* it takes up three pages. (So one is entitled to deduce that the paper is part of this issue.) The odd thing is that what the problem is, is easily explained but how to deal with it, seems to be the deep issue. As the editors write in their introduction: "What is more remarkable is that in the articles that have appeared in journals and books for over 120 years, there has been no accepted resolution to the problem Carroll posed in WTSA." (p. 2) And they should know for the editors are Amirouche Moktefi and Francine F. Abeles. The former is lecturer in Philosophy at Tallinn University of Technology in Estonia, having obtained his PhD in Strasbourg in 2007 and, most important of all, an expert on matters Carrollian. The latter is professor emerita at Kean University in Union, NJ, USA. She too is an expert in history of logic, especially the period wherein WTSA is situated. So, yes, indeed they should know.

What then is the problem, also known as Lewis Carroll's Paradox of Inference? Suppose we have a logical proof that shows that from some premises A_1, A_2, …, A_n a conclusion B follows. There are two options to doubt the truth of B. On the one hand because not all premises are true or on the other hand one disputes the logical rule that allows the transition from the premises to the conclusion. In the former case there need not be a problem: the proof itself can still stand even though one does not accept the conclusion. If I prove that from the premises 'I am a bird' and 'All birds can fly' the conclusion necessarily follows that I can fly, then surely this is correct although I should better not try to jump out of the window. But in the latter case the question must be raised: how could one be convinced that the rule is acceptable? And here Carroll's reply is that it certainly does not help to include (a verbal expression of) the rule among the premises for that only begs the question: why should one accept the conclusion of a similar argument, augmented with an additional premise? If one is not careful, one is trapped in a *regressus ad infinitum* and that precisely happens to poor Achilles and, as Carroll writes, understandably "there was a touch of sadness in his tone".

A different way of formulating the problem is this: suppose you derive B from A. Then one seems entitled to write down the hypothetical 'If A, then B'. We now have three elements: A, B and 'If A, then B'. Question: is the hypothetical statement acceptable, even if A is false? The present-day answer, probably taught in any logic course in the West, is a simple 'yes', because a material implication is always true if the antecedent is false. Not so in Carroll's days. There was a quite interesting dispute going on. In fact, it is related to a lesser known paper by Lewis Carroll, also printed in *Mind* before WTSA in 1894, titled 'A logical paradox'. The central point is whether two statements of the form 'If A, then B' and 'If A, then not B' can be compatible, given that A is false. (Which is precisely what we would conclude today, namely that 'not A' follows from both statements.) The five contributions in this volume all deal with these problems and the end result is quite fascinating and instructive. In fact, nearly all authors seem to agree, though they disagree among themselves—see, for example, footnote 11 on page 87 in Pascal Engel's paper disputing the mistaken interpretation that Mathieu Marion attributes to him—that it is not clear what exactly the problem is that has been raised by Carroll (and so my presentation above therefore needs to be read as a first-order formulation in need of amendment), especially since he himself did not provide an answer. Here is a short survey of the issue.

The first contribution is by the editors themselves: "The Making of 'What the Tortoise Said to Achilles': Lewis Carroll's Logical Investigations Toward a Workable Theory of Hypotheticals". As the title indicates, their focus is first and foremost historical and in fact my historical summary above is largely based on their contribution. One of the important conclusions of their paper is: "Hence, 'A logical paradox' and 'What the Tortoise said to Achilles' were the results of this ongoing investigation and not accidental contributions." (p. 40). This reviewer must confess that he too believed WTSA to be a literary 'folly', my sole argument being that it was published under his literary pseudonym. I stand happily corrected!

Next comes Mathieu Marion's paper, entitled "Lessons from Lewis Carroll's Paradox of Inference". In the first part he focuses on the first reactions to WTSA, involving John Cook Wilson, Gilbert Ryle and Bertrand Russell. An important point that he emphasizes is that the paradox is already present, also in the form of an infinite regress, in Bernard Bolzano's (1837) *Wissenschaftslehre*. In the second part he looks at later developments with a special focus on W. V. O. Quine. And, finally, he also addresses issues in how the history of logic is (mis)presented by authors such as I. M. Bochenski.

In his delightful contribution 'What Did Lewis Carroll Think the Tortoise Said to Achilles?' George Englebretsen presents a personal journey how he changed his mind about what WTSA is all about. One of the important points he emphasizes is that any attempt to understand Carroll's intentions and aims has to take into account the time period or, as Englebretsen expresses it, that "Carroll was a *Victorian* logician" (p. 80) Incidentally, he is the only author in this volume who has already published in *The Carrollian*, to be precise, its forerunner known as *Jabberwocky*—I will not reproduce here the Carrollian reference to this mythical animal—in 1974 and 1994, precisely about WTSA.

The broadest scope is offered by Pascal Engel in his paper "The Philosophical Significance of Carroll's Regress". Four themes are discussed: "(a) the nature of logical inference, (b) the nature of our understanding of logical rules and logical knowledge, (c) the justification of logical rules, (d) the nature of normative guidance in both theoretical and practical reasoning" (p. 84). As one might expect, the famous Wittgensteinian concept of 'rule-following' plays a crucial role and "invites us to draw parallels between logic and ethics, and between epistemology and meta-ethics. It is a litmus test for many of the most interesting issues of contemporary philosophy." (p. 105) The implications of this invitation are really quite serious for it means that to use a 'simple' *modus ponens* in an argument or proof ceases to be an 'innocent' act.

Finally, 'Required by Logic' by John Woods is close in spirit to Englebretsen's paper. What the reader is offered is a close examination of WTSA to understand what is going on in a diagnostic fashion. It is perhaps not surprising if one knows his work that Woods is drawing our attention to the dialogical nature of the presentation. After all, it is one thing that the Tortoise puts forward a particular claim and challenges Achilles to defeat this claim but it is quite another thing to come up with an effective strategy to reach that goal. So, a sequel to WTSA could be WASHRT, 'What Achilles Should Have Replied to the Tortoise'.

It is rather striking that, if one lists the logicians and, by extension, the philosophers mentioned in this volume, one obtains a list of all major twentieth-century contributors, ranging from Bolzano, Russell, Ryle and Braithwaite to Dummett, Wittgenstein, Prior and Quine. Two conclusions can be drawn from this observation. The first, already mentioned, is that the problem that Carroll so casually wrote down in the form of a dialogue deals in fact with deep issues in the philosophy of logic. The second is that agreement is (still) largely lacking, precisely because it involves fundamental processes such as inference, (logical) proof, grasping and applying a rule.

Finally, it must be mentioned that the volume contains two extras: a selective bibliography and the correspondence with George Frederick Stout, the editor of *Mind* at that time. As to the latter, these letters, three in total and published as a whole for the first time in this volume, actually are apparently the only occasion where Carroll expresses some of this thoughts specifically about WTSA and the related 'A logical paradox'. As to the former, the bibliography, put together by one of the editors, Amirouche Moktefi, and research librarian Clare Imholtz, is divided in two sections. The first deals with reprints and translations of WTSA and the second with works devoted to WTSA, not meant to be exhaustive. A somewhat curious feature of this list is that its order is chronological and not by name of author.

In summary, this double issue of *The Carrollian* is a welcome addition to the literature on WTSA that, probably, many among us know because of Hofstadter's (1979) classic, *Gödel, Escher, Bach. An Eternal Golden Braid*. However, the surplus value of this volume is that, as mentioned repeatedly in this review, it shows that far more than just a rather amusing puzzle, it is really about a deep problem in the heart of philosophical logic and thus should merit our full attention.

References

Bolzano, B. (1837), *Wissenschaftslehre*, Sulzbach: J. E. v. Seidel.

Hofstadter, D. (1979), *Gödel, Escher, Bach. An Eternal Golden Braid*, New York: Basic Books.

Jean Paul Van Bendegem

Center for Logic and Philosophy of Science,
Vrije Universiteit Brussel
Pleinlaan 2,
Brussels 1050, Belgium
E-mail: jpvbende@vub.ac.be

Jean Paul Van Bendegem is professor of Logic and Philosophy of Science at the Vrije Universiteit Brussel and director of the Center for Logic and Philosophy of Science (http://www.vub.ac.be/CLWF). His research fields are strict finitism and the philosophy of mathematical practice. He is a great admirer of Sherlock Holmes.

Style guide for
Acta Baltica Historiae et Philosophiae Scientiarum

When submitting an article to *Acta Baltica Historiae et Philosophiae Scientiarum*, please ensure that all articles are formatted to conform to the guidelines below. Please do not hesitate to contact the Editorial Office if you are unsure of any style points or if you have any queries.

I Statement policy

Acta Baltica Historiae et Philosophiae Scientiarum is a peer-reviewed open access journal, specializing in the history and philosophy of science and scholarship in the Baltic area. Preference is given to original contributions that are of general scholarly interest.

II Submission and preparation of manuscript

- No submission fees are charged. Authors are not entitled to royalties for publication.
- Articles should be submitted in Times New Roman 12 points, and all text should be 1.5-spaced. All manuscripts must be written in English.
- Submitted articles should not exceed 60,000 characters with spaces and footnotes (30 double-spaced pages) as a rule. Exception is granted only to papers commissioned by the Editorial Office. As a general rule, contributions to 'Book (or Conference) reviews' and 'Short communications' sections should not exceed 18,000 characters (7 pages) as a rule.
- All documents reproduced should be given in the language of the original with translation provided, if necessary.
- Both US and UK spellings are allowed but consistency throughout the paper is strongly encouraged.
- Manuscripts should be submitted in electronic form (on a CD or as a file attachment sent to the editorial board) as MS .doc or .rtf files (submitting documents in .docx or .odt files is not encouraged). All photos and figures should be submitted as separate .tif files or as hard copies.
- Each manuscript should be submitted with the authors' names, institutions of origin, addresses, and e-mail addresses. Authors should also provide a short biographical note of approximately 50 words.
- All contributions are reviewed. Authors are notified about the acceptance or rejection of their papers within three months since the day their paper has been received by the Editorial Office. The authors can familiarize themselves with the content of reviews; however the Editorial Office does not comment on or discuss its decisions.

III General specifications

Parts of paper

Title

In the paper title, capitalize the first letter of the first and last word and all the nouns, pronouns, adjectives, verbs, adverbs, and subordinating conjunctions. Suggesting a short title for inclusion on running heads by the author is desirable.

All *financial support* for the work in the paper is listed in the first footnote, the reference to which is placed at the end of the title.

Abstract

Please include a brief abstract of no more than 300 words. The abstract should be one paragraph in length and should not be divided into sections, nor should it contain abbreviations or footnotes. Abstracts are not required for short communications articles.

Keywords

Please include up to eight keywords in alphabetical order, separated by commas, no capitalization of keywords, except for proper nouns or conventionally capitalized terms.

Text section headings

Section headings should be brief and self-explanatory. Enumeration of section heads is desirable, but not required. The author's preference may be followed. However, the choice must be consistent throughout the paper.

Figures and tables

Tables and figures should be numbered consecutively (in arabic numerals) and uploaded as a separate file. The approximate position of tables and figures should be indicated in the manuscript.

All tables must have explanatory legends. Please include original source of table/figure if not your own. All citations of figures and tables in text must be in numerical order. Citations to figures in parentheses or in footnotes always carry the abbreviation "Fig." followed by the figure number, elsewhere please use the full word followed by the figure number.

Quotations

All quotations from other sources should be given in double quotation marks with an appropriate reference. A reference to a published source should include the page where the cited text first appears; a reference to an archival manuscript should contain all relevant information (the archive's name, collection, inventory, file and the sheet number on which the original text appears). Lengthy quotes (four lines or more) should be displayed and indented, with a line space above and below. In quotations, all omissions should be marked with points of ellipsis in parentheses; all comments and explications should be given in square brackets.

Footnotes

Footnotes should be numbered in consecutive order throughout the text. The footnote number, in superscript, should be placed at the end of the sentence or quotation after the punctuation. Footnotes should be placed at the bottom of the page on which they are cited.

Acronyms, use of italics

All non-English words should be in italic script, and along with all non-English names, they should be spelled with accents and diacritical marks included. Anglicized words (ad hoc, per cent, a priori, coup d'etat, per capita, etc.) should be Roman with no accents. Define acronyms the first time they appear in the Abstract as well as the first time they appear in the body of the paper, written out as part of the sentence, followed by the acronym in parentheses.

Transliteration of Cyrillic

The journal uses the Library of Congress transliteration method, without diacritics. Exceptions may be made for names of well-known people where a different spelling has become conventional, e.g., Yeltsin, Trotsky.

Permissions

The author is responsible for obtaining permission in writing to quote copyrighted material (including figures and tables). Authors are personally responsible for ensuring that all information, quotations, dates and names given in their papers are correct. All figures (illustrations) should be supplemented with references to their provenance and copyright holder.

IV References

Full details of references should be provided in a section under the heading *References* at the end of the manuscript.

- References should use the Harvard system for published works, i.e., author's name, date of publication, and page numbers (if required) in parentheses in the text.
- For books, references should give author's last name and initials, date of publication, title of book, place of publication and publisher. If multiple places of publication are cited, use & (e.g., New York & London, Delhi: Basic Books). If there are more than 3 authors use *et al.*, e.g., (Kahk *et al.*, 1998). For edited volumes, use (ed.) for single editor; (eds.) for joint editors. Double initials should be separated by a space (e.g., J. K.)
- For book chapters, references should give author's last name and initials, date of publication, title of book chapter, book, editor's last name and initials, date of publication, book title, place of publication and publisher, chapter page numbers.
- For articles, references should give author's last name and initials, date of publication, article title, name of journal, volume and issue numbers, article page numbers.
- Titles of journals should be given in full.
- References to works that are themselves of historical significance should have the date of first publication in the text and the list of references, with a supplementary note if page references are made to a later edition.
- English title translations of foreign works should be given in square brackets, in lower case, e.g., *Lietuvos savivalda* [Lithuanian self-government].
- Archival material should be included as part of the reference list, providing information on its date, title or description of the nature of the material, archival

code (in the format established by a given archive), the name of the archives in English and its location. In-text references of the archival material should be presented in the form of abbreviation of the archive's name (corresponding to the archive's language) followed by date (or date range), e.g. (EAA, 1803–1814).

Reference examples

Books, monographs

Barnard, C. (2007), *The Substantive Law of the EU. The Four Freedoms*, Oxford: Oxford University Press.

Horvath, T. (ed.) (2000), *Decentralization: Experiments and Reforms*, Budapest: Local Government and Public Service Reform Initiative, OSI Publications.

Chapters in edited volumes

Groenendijk, K. (2007), 'The Long-Term Residents Directive, Denizenship and Integration,' in A. Baldaccini, E. Guild & H. Toner (eds.) *Whose Freedom, Security and Justice? EU Immigration and Asylum Law and Policy*, Portland, OR: Hart Publishing, pp. 429–450.

Articles in journals

Brubaker, R. (1992), 'Citizenship struggles in Soviet successor states,' *International Migration Review*, vol. 26, no. 2, pp. 269–291.

Newspaper articles

Financial Times (1998), 18 August 1998.

The Times (2009), 'Latvian fears lead to bank protection,' 8 October 2009.

Milne, R. (2012), 'A Leaning Tower of Perils,' *Financial Times*, 28 March 2012.

Institutional authors

WHO (2006), *World Health Statistics,* Geneva: World Health Organisation.

Working papers

Holm, U. & Joenniemi, P. (2001), *North South and the Figure of Europe: Changing Relationships*, Working Paper 11, Copenhagen: Copenhagen Peace Research Institute.

Conference proceedings

Mägi, V. (2007), 'From the 17th century to the present-day in Estonia: evolution of exact and natural sciences,' in *The Global and the Local: the History of Science and the Cultural Integration of Europe: Proceedings of the 2nd International Conference of European Society for the History of Science*, Cracow: European Society for the History of Science, pp. 920–924.

Conference papers

Joenniemi, P. (2008), "The EU is Not What it Used To Be: Once a 'Peace Project', and Now a 'Force for Good'," Paper presented at BRIT IX conference, Victoria, Canada, 12–15 January 2008.

Unpublished works

Rudi, E.; Mägi, M.; Link, E.-G. & Maimets, A. (2000), *Eesti roheliste kadumine poliitiliselt maastikult* [Disappearance of Estonian Greens from the political scene], [Unpublished manuscript] Department of Political Science, University of Tartu.

Archival materials

EAA (1803–1814), *Kontrakte, Protokollextrakte und Briefwechsel mit den Beamten des botanischen Gartens, dem Kurator des Dorpater Lehrbezirks u.a. über die Errichtung und Versetzung des Gartens, den Verkauf des alten Gartens u.a.*, EAA f 402, n 5, s 52, Estonian Historical Archives, Tartu.

Government acts

Identity Documents Act (1999), Isikut tõendavate dokumentide seadus, *Riigi Teataja,* RT I 1999, 25, 365.

Groenendijk, K. (2007), 'The Long-Term Residents Directive, Denizenship and Integration

EU documents

The Stockholm Programme – An Open and Secure Europe Serving and Protecting the Citizens (2010), Notices from European Union Institutions, Bodies, Offices and Agencies, *Official Journal of the European Union*, C 115/01, 4.05.2010.

Council Directive 2000/43/EC implementing the principle of equal treatment between persons irrespective of racial or ethnic origin, *Official Journal of the European Union*, L 180, 19.07.2000, pp. 22–26.

Dissertations

Tohvri, E. (2009), *Valgustusideede mõju Tartu arhitektuurikultuurile 19. sajandi alguses. Dissertationes Historiae Universitatis Tartuensis*, [Ph.D. thesis] Tartu: Tartu Ülikooli Kirjastus.

Websites

European Financial Facility (2012), [Home page] Retrieved from http://www.efsf.europa.eu [accessed 20 Apr 2012]

Järlik, R. (2004), 'Balti vabaduse tee,' *Maaleht*. Retrieved from http://www.maaleht.ee/?page=Arvuti&grupp=artikkel&artikkel=1686 [accessed 21 Sep 2011]

Legal materials

María Martínez Sala v Freistaat Bayern [1998], ECR I, C-85/96, p. 02691.

Call for papers

Acta Baltica Historiae et Philosophiae Scientiarum

ISSN 2228-2009 (print)
ISSN 2228-2017 (online)

Estonian Association for the History and Philosophy of Science was founded in 1967 with the aim of promoting the study of the history of science with the focus on the Baltic Sea region in general and Estonia in particular as well as the philosophy of science in the broad sense.

The association in close cooperation with Latvian and Lithuanian Associations of the History and Philosophy of Science is publishes an English-language peer-reviewed, open-access journal ***Acta Baltica Historiae et Philosophiae Scientiarum***. The biannual journal publishes academic papers in English. The main publication criterion will be scientific excellence, evaluated according to the criteria in effect in international journals. Beside original research papers, book reviews, conference overviews, other short communications will be considered for publication. We believe this will make the journal more dynamic and more attractive. The journal is advised by a prestigious international Editorial Board, composed of philosophers and historians of science from Estonia, Latvia, Lithuania, Finland, Denmark, Germany, France, UK, USA, Bulgaria, Russia, Hungary and China.

How to submit:
No length limit is imposed. However, the editors can refuse papers judged too long. The manuscripts submitted for the journal must be anonymous. Therefore the author must avoid any reference that could help the two referees to identify her. If the paper is accepted, the author will have to provide a version of the paper in the style required by the editors.

Please send all contributions (incl. an abstract and keywords added to a longer article) to Peeter Müürsepp at peeter.muursepp@ttu.ee, Amirouche Moktefi at amirouche.moktefi@ttu.ee.

ISSN 2228-2009