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ALGEBRA IN TRANSIT IN LATE MEDIEVAL AND EARLY MODERN EUROPE

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TABLE OF CONTENTS

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Abstract – Secord (2004) suggested that historians of science eradicate the distinction between the making and the communicating of knowledge. While highly influential, Secord's suggestion has rarely been applied to highly abstract bodies of knowledge, such as mathematics. The paper argues that the tradition of European late medieval and early modern practical arithmetic provides a significant case study to understand the development of new mathematical knowledge as emerging from processes of transmission, translation, application, and adaptation of knowledge. This approach makes it possible to understand the development of mathematical knowledge as an incremental process, and to shift our focus from primacy and innovation to transmission and evolution, and from individual innovators to distributed agency. First, the paper locates the emergence of proto-symbolic algebra within the broader exchanges in knowledge and technology that characterised the late medieval Mediterranean. It then reconstructs the evolution of proto-symbolic algebra in western Europe until the end of the sixteenth century as embedded in processes of knowledge transmission.

Introduction

In 2004, Jim Secord gave the keynote address of the *Circulation of Knowledge* conference in Halifax, Nova Scotia, jointly organised by the Canadian Society for History and Philosophy of Science, the British Society for History of Science, and the History of Science Society. The address was subsequently published in *Isis* with the title *Knowledge in Transit*.[1] Twenty years later, there is renewed interest in his theses.[2] Secord argued that many studies in

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1 Secord, 2004.

2 In August 2024, the Circulating Knowledge – 20 Years On conference was held in Halifax.

the history of science lacked 'unifying narratives.' The sociology of knowledge, the study of science as practice, and the attention to its situatedness, Secord asserted, had provided historians with key tools to deconstruct the grand narratives in which science advanced because of its inherent validity.

However, by stressing the locality of knowledge making, Secord argued that these approaches ran the risk of creating a series of highly detailed studies which do not add up to a coherent whole. This could have the paradoxical consequence of eschewing what, in Secord's view, is "the central question" for the history of science: to explain how knowledge moves from its local origins to becoming a "taken-for-granted understanding of much wider groups of people."[3] Quoting the words of Ophir and Shapin, he formulated this key question as follows:

> How is it, if knowledge is indeed local, that certain forms of it appear global in domain of application? Is the global – or even the widely distributed – character of, for example, much scientific and mathematical knowledge an illusion? If it is the case that some knowledge spreads from one context to many, how is that spread achieved, and what is the cause of its movement? Is its distribution a strong indication of its correspondence with reality, or is it properly read as reflecting the success of certain cultures in creating and spreading the very means and contexts of application?[4]

Secord's answer to this question was a call for historians of science to "shift our focus and think about knowledge-making itself as a form of communicative action" and to eradicate "the distinction between the making and the communicating of knowledge."[5] Such an approach, Secord argued, would make it possible to both take stock of the insights on the situatedness of knowledge making and, at the same time, to understand such reconstructions as embedded in processes of movement and transmission: "seeing how every local situation has within it connections with and possibilities for interaction with other settings."[6]

In this paper, I argue that it is possible to use Secord's framework to understand a key junction in the history of European mathematics: the emergence of – following Heeffer's definition – 'proto-symbolic algebra' in the late medieval and early modern period.[7] While Secord's framework has

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[3] Secord, 2004, p. 655.

[4] Ophir, Shapin, 1991, p. 16.

[5] Secord, 2004, p. 661.

[6] Ivi, p. 664.

[7] Heeffer, 2009.

been highly influential for studies in global history and in the geography and sociology of knowledge, it has rarely been applied to the history of mathematics.[8] Building on previous research on the tradition of European practical arithmetic and the history of algebra, I show how the emergence of 'proto-symbolic algebra' occurred as this body of mathematical knowledge travelled across time and space. In other words, I argue that we can understand the development of original mathematical knowledge as emerging from the process of its transmission, adaptation, and application from the late middle ages to the early modern period.

This exercise is interesting for at least four reasons. First, it applies Secord's framework to a period and a body of knowledge it has not often been applied to. Second, it allows us to understand the emergence of a paradigmatic body of knowledge with broad epistemological validity as embedded in processes of communication. European practical arithmetic is a particularly significant case for this argument, as this mathematics is attested in instructional texts that make it possible to bring forward the key place of communication also in the emergence of highly abstract bodies of knowledge. In so doing – third – this exercise offers a possible way to see epistemological novelty as emerging within wider processes of reproduction, translation, and communication of knowledge, and to shift our focus from primacy and innovation to transmission and evolution, and from individual innovators to distributed agency. As a result – four – this exercise makes it possible to see how the fundamental breakthroughs by traditional 'founders' of European algebra such as Descartes and Leibniz were rooted in over three centuries of transmission and experimentation with mathematical knowledge across linguistic, social, and geographical borders.

Proto-symbolic algebra and the tradition of practical arithmetic

As noted by Katz and Parshall, the question of what algebra is has received different answers in different times and places, which makes it possible to write histories of algebra that stretch as far back as ancient Egypt and Mesopotamia.[9] Standard histories of mathematics consider the foundational period for European algebra as starting from the seventeenth century,

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[8] See, for example, Finnegan, 2008; Gavroglu et al., 2008; Withers, 2009; Turchetti, Herran, Boudia, 2012; Moyn, Sartori, 2013; Keim, 2014; Rodriguez Medina, 2014; Lightman, 2016; Gänger, 2017; Poskett, 2019.

[9] Katz, Parshall, 2014, p. 11.