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Modern Algebra and the Rise of Mathematical Structures by Leo Corry

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this period has been neglected, with attention paid primarily to male practitioners such as Hopkins, now portrayed as the ‘father of biochemistry’. Barnett and Weatherall explore a no less neglected aspect of the history of science, namely the shifting power relations between scientific practitioners and the consuming public. Where there was no overarching voice of authority on health matters, the public was not obliged to prefer one set of nutritional claims over another. Weatherall reveals how 1910s nutritional reform programmes were driven by the media and by the claims to expertise of consumers, not physicians or government administrators, and Barnett’s title, ‘Every man his own physician’, tells a similar story. Scientists today who, concerned with the ‘public understanding of science’, fulminate over eaters who waver between the health principles proposed by government experts and those of ‘alternative’ food reformers, might be depressed to learn that the brown bread and fresh fruit ‘fads’ of the 1910s are the government recommendations of the 1990s.

Vast projects of urban hygiene and nutritional education demarcated the scientific permeation of Western society at the end of the nineteenth century. Daily life was arguably more affected by the patterns of manufacturing, advertising, buying and selling characteristic of the new commercial society. The advertising of foods must have transformed the meaning of individual food items and their appreciation of consumers. Food choices, as Weatherall points out, are a relatively new possibility; prior to the twentieth century most were confined to the consumption of necessities and especially bread. Industrial society offered new possibilities of feeding Western populations even while it created the conditions for mass poverty and malnutrition: artificial fertilizers (invented by Liebig), mechanized agriculture, factory food production. Industrial nutrition scientists, in claiming to have unlocked the secrets of food, could promise improved diet for all. But the possibility of changing diet was viewed by many contemporaries as putting public health at risk and as encouraging moral degeneracy among the poor, as Smith and Nicolson indicate. Horrocks reveals how industrial food scientists were attacked as ‘sophisticating’ foods by academic nutritionists while

they portrayed their own activities as ‘improving’ upon nature. Perhaps for the first time, even middle-class consumers began to perceive government interventions in the food supply as putting public health at risk. Nutrition science was thus a distinctly industrial science. In a remarkable study of the fate of scientific claims attached to a commercial factory-produced food item, Liebig’s meat extract, Finlay shows how the business of pinning down the scientific meaning of a food had now become the task of the manufacturer rather than the scientific practitioner, a tale borne out by Horrocks. Somehow, then, the identity and authority of nutrition scientists and the aims of commercial entrepreneurs were continually being interwoven in the period. We know that this was also a period when laboratory scientists were fiercely defending their claims to independence from political and commercial concerns, and the volume would have benefited from the inclusion of a study of the peculiar position of nutrition scientists in that regard.

‘Western society has become’, the editors claim, ‘a nutrition culture’. What becomes abundantly clear in this volume is that, during the period covered, many cultures of nutrition emerged in the West, exemplifying concerns about the decadence of Western societies, about shifting gender relations, about the transformation in eating habits resulting from the development of commercial structures and media forms which we now take to be characteristic of our society. This book demonstrates the historical groundedness of many debates about food which are still of burning significance today, and which, a century on, are often expressed in terms first invoked before the First World War.

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LEO CORRY, *Modern Algebra and the Rise of Mathematical Structures*. Basel: Birkhäuser, 1996. Pp. 460. ISBN 3-7643-5311-2. DM 178.00.

It is a widely shared opinion that the general development of modern mathematics is a continuous and straight evolution towards increasing levels of abstraction. The idea is that interest

has gradually shifted from concrete mathematical *objects*, say, for example, the natural numbers, to the study of abstract ‘structures’, say the *system* of the natural numbers. Thus, the modern mathematician does not investigate merely the properties of the natural numbers, but the very general features of the system of rules by which they can be defined. The influence of the modern, ‘structural’ approach has been strong, and it has interested even some non-mathematical disciplines. Nevertheless, the historian of science should always be very careful when coming across such ‘teleological’ reconstructions, typically characterized by the scarcity of historical material and the vagueness of the conceptual tools.

In this work, Corry tries to make clear the origins of the pervading concept of ‘mathematical structure’, and the historical reasons for its growing importance. To this end, he employs a basic methodological distinction between two domains of discourse: the ‘body of knowledge’ and the ‘image of knowledge’. The first ‘includes statements that are answers to questions related to the subject matter of the given discipline’, and the second ‘includes claims which express knowledge about the discipline *qua* discipline’ (p. 3). The ‘images’ determine the answers to meta-questions such as what are the more interesting problems, the more relevant arguments, the borders of the discipline, the legitimate methodologies, the appropriate university curriculum, and so forth. Then, given a certain image, it will determine a particular selection of interesting problems and methods in the body of knowledge. But, as Corry properly emphasizes, this schematic separation is not a rigid one. In fact, it is subject to continuous shifts, and a main task for the historian should be to define the limits of the two regions at a given period, and then to study their interactions and their transformations. In the case of mathematics, the interactions between images and bodies are particularly interesting, because of the ‘reflexive character of mathematics’, that is to say, the ‘possibility of formulating metastatements [...] from *within* the body of mathematical knowledge’ (p. 4).

Taking this as a starting point, Corry finds it useful to consider the *structural approach* itself as a particular image of knowledge, that ‘evolved

from a particular historical process’ (p. 8). In the first part of the book, Corry follows the development of algebra (a discipline that has been particularly transformed by the structural approach) between 1860 and 1930, and the interactions between its growing body of knowledge and the images that guided the research of the principal mathematicians. Through the analysis of the algebraic works of Dedekind, Hilbert, Emmy Noether and others, including some lesser-known textbooks of algebra, Corry reconstructs the complex shift from the classical image of algebra to the structural one. The classical image assumes systems of numbers to be the basic mathematical entities, whose properties underlie the algebraic research (so that the *fields* are the proper subject of the theory of algebraic numbers, whereas other non-numerical entities such as *groups* and *rings* are considered only as useful tools). According to the structural image, algebra is the discipline studying abstract constructions, number systems being defined as particular cases of them (the hierarchical order is then completely reversed). Corry places van der Waerden’s textbook *Modern Algebra*, published in 1930, at the end of the development of this shift. Obviously this should be considered mainly as a symbolic indication, given that the adoption of the structural image of algebra cannot ‘be associated to a single idea, nor to a single publication, nor even to the work of an individual mathematician’ (p. 221).

The second part of the book is devoted to the ‘reflexive’ attempts to study the non-formal concept of ‘mathematical structure’ *in* the body of knowledge. Corry presents three main attempts to develop a formal theory of structures, namely those of Oysten Ore, of Bourbaki, and category theory. They are attempts to transform what was an image into a body of mathematical knowledge. Of particular interest is the chapter on Bourbaki’s formalization of structures. Corry makes evident the ‘ideological’ necessity for Bourbaki to work at this formalization, but, at the same time, the superfluity of the structural apparatus (structures, mother-structures, their hierarchical order) with respect to the body of knowledge presented in Bourbaki’s *Eléments*. Such apparatus does not play any important operational role in the *Eléments*, and its use is mainly an *ad hoc* one. Significantly,

the structure-related concepts played (and continue to play) a much more important role in the popular articles and in the philosophical debates. Here it is ‘as if they [the structures] in fact provide a solid, reflexive foundation of Bourbaki’s images of mathematics’ (p. 342). A more positive judgement is given by the author about the category theory’s results, even if ‘the mathematical reality is much more varied than even a good generalizing theory like category theory can exhaust’ (p. 372).

Corry, then, through the use of a few clear metamathematical tools, offers the reader a convincing and well-documented historical reconstruction of the rise of the structural image of algebra, and of the idea that mathematics as a whole should be the science of ‘structures’ (a very ambiguous term indeed). Moreover, this reconstruction makes evident that at any point of the evolution of algebra, the body of knowledge could have been organized in very different ways, depending on the different images of knowledge held by the mathematicians involved in the research (and in the publication of textbooks). That is to say, any mathematicians wishing to reorganize a certain body of knowledge always have to face a basic *choice* between different images that they could assume as leading principles in their work. And on this choice will depend the legitimate aims and methods of the discipline. In fact, considering the example of algebra, Corry notes that the body of knowledge ‘did not in itself determine the change of images of knowledge that implied the adoption of a structural approach’ (p. 402).

Corry’s book, by reason of its historical approach, could be associated with the so-called ‘new historiography of mathematics’. But, unlike some of these works, it is a very good example of the fine balance between historical data and philosophical interpretation.

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ANTONI MALET, Ferran Sunyer i Balaguer. Barcelona: Societat Catalana de Matemàtiques and Societat Catalana d’Historia de la Ciència i de la Tècnica, 1995. Pp. 306. ISBN 84-7283-286-4.

In presenting the life and the works of the

Catalan mathematician Ferran Sunyer i Balaguer (1912–67), the author faces the scarcely studied problem of the relations between the Spanish scientific community and Franco’s regime. Sunyer was certainly an atypical figure in the Spanish academic panorama. An autodidact, suffering a serious physical handicap, a fierce supporter of Catalan culture and language, he was never integrated into Spanish academia. This was in spite of his being an internationally recognized mathematician (his speciality being theory of functions), and a referee for the most important international journals. In fact, in post-war Spain the few mathematicians who were internationally recognized were marginalized by the national scientific community. In the case of Sunyer, marginalization manifested itself as resistance to an autodidact, with no academic degree. In the cases of Ernest Corominas (1913–92) and Ricardo San Juan (1908–69), the only real colleagues of Sunyer, the process of marginalization was more subtle, but equally effective.

On the basis of a rich documentation, the author dissects Sunyer’s relations with Corominas, San Juan, the other Spanish mathematicians and his colleagues from abroad. In doing this, he also describes the general working of the Spanish research institutions. A whole chapter is devoted to the ideology and the structure of the Consejo Superior de Investigaciones Científicas (CSIC), which was the principal institution for scientific research during Franco’s regime. This allows the author to challenge a standard opinion, according to which, during the regime, scientific research was damaged by the lack of economic resources. The author maintains, on the contrary, that the scarce productivity of Spanish academics cannot be explained as a mere consequence of financial limitations: it depended on certain deeper, cultural reasons. This lessening of the role of economic factors, ‘gives a new importance to the cultural, political and moral factors which conditioned the working of the scientific community’ (p. 101). In a similar way, we are shown that the isolation of the Spanish mathematical community did not derive merely from physical restrictions. It was ‘much more a spiritual than a material phenomenon’ (p. 243). The isolation consisted, in fact, in the lack of conformity of the