

**Mitchell G. Ash\***

## **The natural sciences in the late Habsburg Monarchy: Institutions, networks, practices**

### **(1) Introduction**

It is generally agreed that the modern complex of scientific research institutions and research practices emerged in the nineteenth and early twentieth centuries. Recent research suggests that a number of processes were involved, including: the emergence of an expanding and ever more specialized network of research institutions, including university, extra-university state-funded and industrial laboratories; increasingly science-based professional training at higher education institutions; an increasing dependence of natural scientific research practices themselves on technology, particularly on specially designed instruments; and a corresponding tendency to organize industrial research in a manner analogous to that of experimental laboratory research in the natural sciences.<sup>1</sup>

All of these developments became increasingly visible in the Habsburg monarchy in the second half of the nineteenth century. As a result, many natural scientists, especially those who worked in the German-speaking parts of the monarchy, took advantage of the opportunity to participate in scientific training and research throughout German-speaking Europe, and beyond. The papers in this symposium focus in particular on how the emergence of an expanding network of research institutions and the increasingly science-based professional training at higher education institutions affected the careers and research topics of scientists.

These remarks introduce the following contributions by outlining what is known about this question at present and presenting a preliminary discussion of the central concepts involved. With regard to the category “mobility”, in particular, the paper distinguishes several levels of meaning: geographic mobility; social mobility; and cultural mobility. Put as provocatively as possible, the paper asks: Was there such a thing as a science system in the Habsburg Empire, within which scientists circulated freely, or are words like “system” or “network” no more than names for a collection of more or less self-contained institutions or localities, with mobility taking place largely within these local contexts?

In order to establish a basis for discussion, I begin by defining central terms from the title of the paper: Natural Scientists, Institutions, Networks and Practices.

### **(2) Natural scientists**

The natural sciences are understood here as part of a complex of academic disciplines that became increasingly differentiated during the last third of the nineteenth century. As is well known, the establishment of new scientific or technical disciplines did not proceed at the same speed in different fields or in different parts of Europe. A number of the following papers support this claim indirectly by giving quite different dates for the establishment of university professorships or other academic positions in specific disciplines at different locations. Moreover, for a variety of reasons that cannot be discussed in detail here, it was by no means clear from the beginning how new fields were defined or how research within these fields should be organized. For practical reasons, the discussion in the following papers is limited primarily to physics, chemistry and certain technical disciplines.<sup>2</sup> The vast field of life sciences and medicine must be left for another occasion.

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\* Department of History, University of Vienna, Austria; email: [mitchell.ash@univie.ac.at](mailto:mitchell.ash@univie.ac.at).

<sup>1</sup> Mitchell G. Ash, “Die Wissenschaften in der Geschichte der Moderne” (Antrittsvorlesung am Institut für Geschichte der Universität Wien, 2. April 1998), *Österreichische Zeitschrift für Geschichtswissenschaften*, 10 (1999), p. 105–129.

<sup>2</sup> For general studies of physics and chemistry that provide useful information for purposes of this discussion, see, for example, Christa Jungnickel & Robert McCormach, *Intellectual Mastery of Nature. Theoretical Physics*

### (3) Institutions

The discussion here is limited, again for practical reasons, to post-secondary educational institutions, meaning universities and higher technical schools. As simple as this may appear to be at first glance, it must be said that even here certain questions can be raised, for example, whether particular natural sciences were always assigned to the same Faculties. The following papers give at times quite different answers to this question. More interesting for discussions of mobility is another question, addressed directly by Sona Strbanova's paper in this group: whether universities were always receivers of natural scientists from higher technical schools, which would indicate a hierarchical relationship between them, or whether circulation could also proceed in the opposite direction.

At the beginning I spoke of a network of research and/or research institutions and asked whether such a network actually existed in the late Habsburg monarchy. Given the centralistic organisation of the Imperial administration, and the fact that permanent university appointments may have been proposed locally, but were made in Vienna, it seems obvious to assume, as scholars in the field usually have done, that the movement of scholars and scientists amongst institutions in the monarchy (or at least in the German-speaking parts of the Empire after the establishment of the Dual Monarchy in 1867) was deliberately organised from above. Strangely enough, this assumption appears never to have been substantiated, or even subjected to investigation in detail. In any case, the question of the actual existence of a planned and organised network of research and/or higher education institutions in the late Habsburg monarchy can hardly be separated from the question of who then spoke or now speaks of such a "network". Of special importance here is whether the idea of such a "system" was propagated by state officials responsible for financing the sciences, or by the scientists themselves. This issue is still very much an open question.

### (4) Career paths and mobility

I treat both terms here together, because they are linked in specific ways, to be defined shortly. If one speaks of career paths and mobility as linked with one another, at least the following levels or kinds of mobility can and should be differentiated from one another:

*Geographic Mobility.* The central issue here is an empirical one; are career paths primarily local or regional, limited for example to the German-speaking parts of the Habsburg monarchy called *Cislatheiniem* or extended throughout the German-speaking universities, including territories outside the monarchy? With respect to the universities in the German states and later in the German Empire, Marita Baumgarten refers to a "system" that can be structured hierarchically (to some extent on the basis of contemporary perceptions, but mainly after the fact) with at least three levels: "Beginner" institutions usually in provincial locations such as Erlangen, Gießen or Rostock; "Intermediate" stops along career paths, such as Bonn, Marburg, Freiburg, Heidelberg, Breslau, or Halle; and "Final Destinations" at the top of the hierarchy, particularly Leipzig, Munich and Berlin.<sup>3</sup> Of course, this is a highly schematic classification based on broad quantitative data, which may not apply to career paths in all disciplines. Nonetheless, it seems plausible at least to ask whether such a differentiated "system" also emerged in the Habsburg monarchy after central features of the "German" university model were adopted there from 1848 onward. Unfortunately, Baumgarten does not include any German-speaking institutions outside Germany itself in her study, nor does she include technical institutions even within Germany. Thus, it remains an open question whether or to what extent higher education institutions in the German-speaking parts of the Habsburg monarchy can or should be merged with the German institutions to form a single system for the circulation of scientific and scholarly elites.

The papers that follow appear to suggest that such a merger of the German and Habsburg systems makes sense, if at all, primarily for mobility at the entry-level. Many scientists who were born in provinces of the Habsburg monarchy appear to have studied in German institutions, then returned to Austria or

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from *Ohm to Einstein*, 2 vols. Chicago: University of Chicago Press, 1986; and Robert Rosner, *Chemie in Österreich 1740–1914. Lehre, Forschung, Industrie* (Vienna: Böhlau Verlag, 2004).

<sup>3</sup> Marita Baumgarten, *Professoren und Universitäten im 19. Jahrhundert. Zur Sozialgeschichte deutscher Geistes- und Naturwissenschaftler* (Kritische Studien zur Geschichtswissenschaft, vol. 121; Göttingen: Vandenhoeck & Ruprecht, 1997); idem., Professoren- und Universitätsprofile im Humboldt'schen Modell 1810–1914, in: Rainer C. Schwinges (ed.), *Humboldt International. Der Export des deutschen Universitätsmodells im 19. und 20. Jahrhundert* (Basel: Schwabe & Co. 2001), pp. 105–130.

another province of *Cislatheinen* to begin their careers and remained in the “Austrian” system thereafter. Of course, we are all familiar with famous scientists such as Ludwig Boltzmann, Albert Einstein, or Erwin Schrödinger, who circulated among German-speaking universities and across political boundaries almost at will — or so it seems at first glance. However, once we begin to look more broadly at the careers of scientists of all ranks, as do the papers that follow, then the limits of such apparently “free circulation” become clear quite quickly. Already at this preliminary stage of investigation it seems valid to suggest that it is a fundamental mistake to take the careers of the most famous, and / or more peripatetic, natural scientists to be in any way normal or representative of geographical mobility. Indeed, many of the following papers suggest something close to the opposite — that the geographical range of scientists’ career paths was far more narrowly localized than the careers of such “stars” have led us to think.

*Social Mobility.* Here, too, it is possible to distinguish three levels: (1) Mobility measured by social origins, generally fixed operationally by referring to the father’s occupation. Here the important research questions are: (a) from what social strata were scientists recruited — that is, were they the same as or different from the strata from which humanists came?; and (b) was entry into one of the scientific disciplines an indication of upward, lateral or downward social mobility? Research on the recruitment of university scholars and scientists in nineteenth-century Germany indicates that what sociologists call “self-recruitment” took place in most fields, meaning that the large majority of scholars’ fathers came from the educated middle classes or *Bildungsbürgertum*. A significant exception to this is chemistry, which alone among the natural sciences appears to have become a path to upward social mobility in Germany by 1900.<sup>4</sup> We have as yet no significant studies of this question for academic scientists and scholars in the Habsburg monarchy. (2) Transfer from one discipline to another and/or change of institution in the same geographical location. This could be discussed under the heading of geographic mobility, discussed above, but to the extent that such shifts may also be linked with upward career moves they acquire a dimension of social mobility. (3) Generational cycles of supply of and demand for academics, as analysed by Harmut Titze for Germany.<sup>5</sup> Such cycles were already visible during the period under discussion, but here, too, data on this issue are lacking at present for the Habsburg monarchy.

*Cultural Mobility.* Given commonplace talk of German-speaking universities as centres of a shared academic culture, and given conventional claims that natural scientific knowledge is international, if not universal, it would appear that this category has little or no place in this discussion. Nonetheless the topic is of fundamental importance particularly for the history of sciences in the Habsburg Monarchy. This is obviously the case with regard to the language issue, which became highly acute in the political sphere during the period under discussion. This was the formative era for national cultural self-consciousness in many regions of the Habsburg lands, and the resulting controversies directly impacted the careers of higher education teachers and researchers in all disciplines, including the natural sciences.

However, the question of cultural mobility — and its limits — is by no means limited to the language issue. Scientific practices can and should be seen in this connection not only or even primarily as methods in the classical sense described in scientific textbooks, but as tacit knowledge (for example, about how and why to handle certain pieces of equipment) of a kind that is in a quite literal sense constitutive of scientific cultures, specifically including material culture, as it has been called for some time.<sup>6</sup> Thus, it is not only possible but necessary to speak of a cultural history of scientific research practices, and to ask how these “travel” across space and time.<sup>7</sup> Seen in this light, we can well ask to

<sup>4</sup> Lewis Pyenson & Douglas Skopp, “On the Doctor of Philosophy Dynamic in Wilhelminian Germany,” *Informationen zur Erziehungs- und Bildungshistorischen Forschung*, 4 (1976), pp. 63–82; idem., “Educating Physicists in Germany circa 1900,” *Social Studies of Science*, vol. 7 (1977), pp. 329–366.

<sup>5</sup> Harmut Titze, *Der Akademikerzyklus. Historische Untersuchungen über die Wiederkehr von Überfüllung und Mangel in akademischen Karrieren* (Göttingen: Vandenhoeck & Ruprecht, 1990).

<sup>6</sup> See, e.g., David Gooding, Trevor Pinch & Simon Schaffer (eds.), *The Uses of Experiment: Studies in the Natural Sciences* (Cambridge, England: Cambridge University Press, 1989); Hans-Jörg Rheinberger & Michael Hagner (eds.), *Die Experimentalisierung des Lebens* (Berlin: Akademie Verlag, 1993); Hans-Jörg Rheinberger, *Experimental Systems and Epistemic Things* (Stanford: Stanford University Press, 1999).

<sup>7</sup> Tim Lenoir, “Practice, Reason and Context. The Dialogue between Theory and Experiment,” *Science in Context*, vol. 2 (1988), pp. 3–22; Andy Pickering (ed.), *Science as Practice and Culture* (Chicago: University of Chicago Press 1992), and the many studies that have followed in this direction. On “travelling” cultures of

what extent and how cultures of scientific practice “travelled” within the Habsburg monarchy. This, too, is an open question, but one that promises to yield exciting results if pursued carefully.

## **(5) Conclusion**

These remarks are intended to outline a wide field of research, and have therefore raised questions rather than presenting a summary of results. They should be read in that spirit; comments, and participants in this common project, are welcome!

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precision measurement, see M. Norton Wise (ed.), *The Values of Precision* (Princeton: Princeton University Press, 1994).