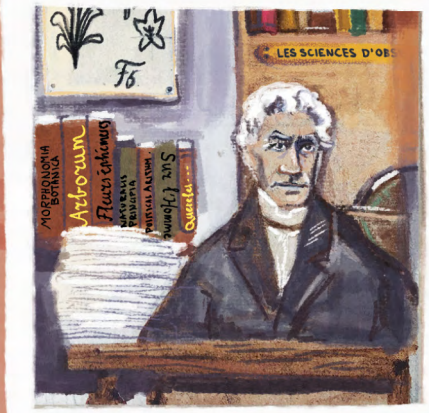
Observing Disciplines

Data Practices In and Between Disciplines in the 19th and Early 20th Centuries



Emma Mojet

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Observing Disciplines

Data Practices In and Between Disciplines in the 19th and Early 20th Centuries

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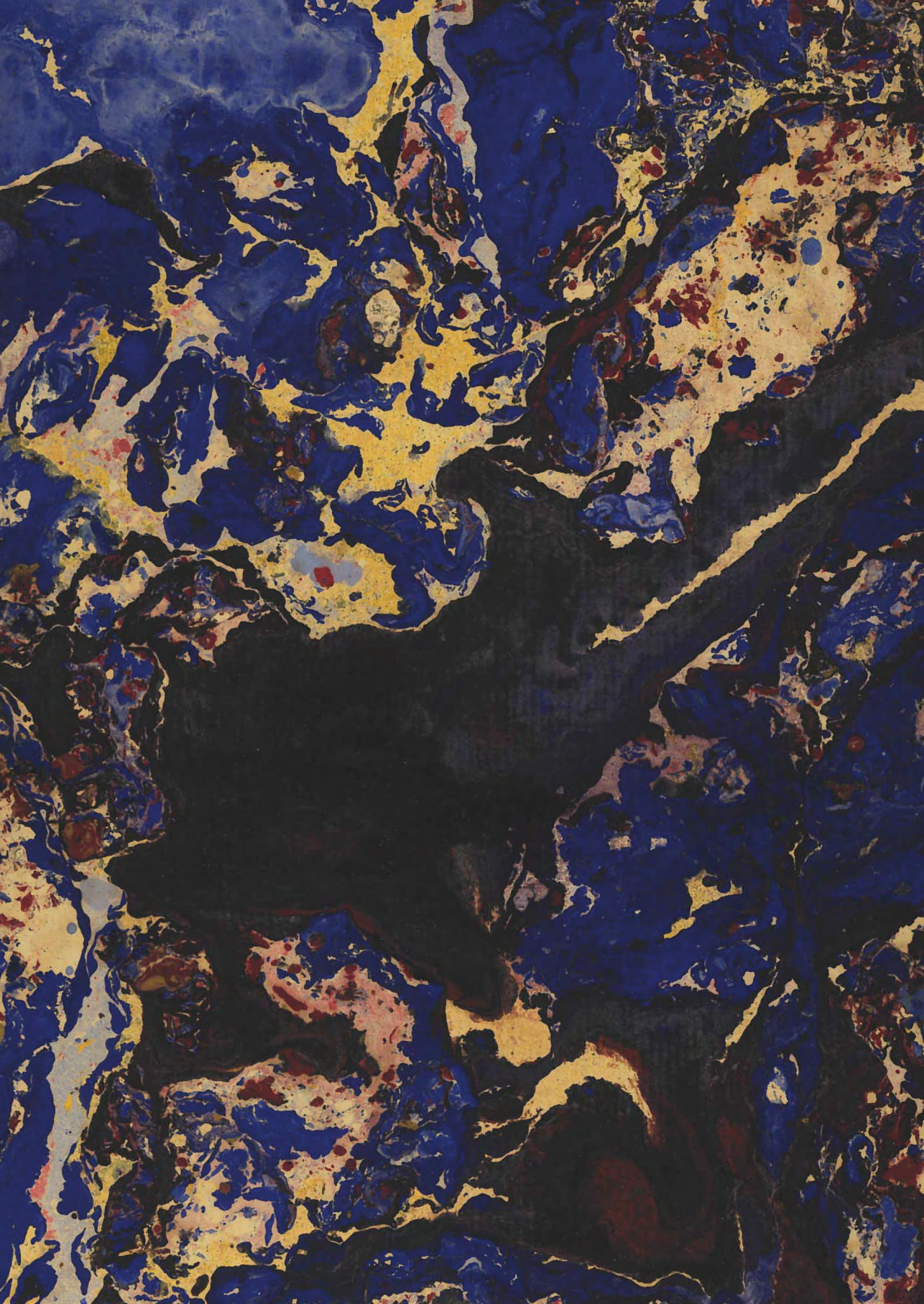
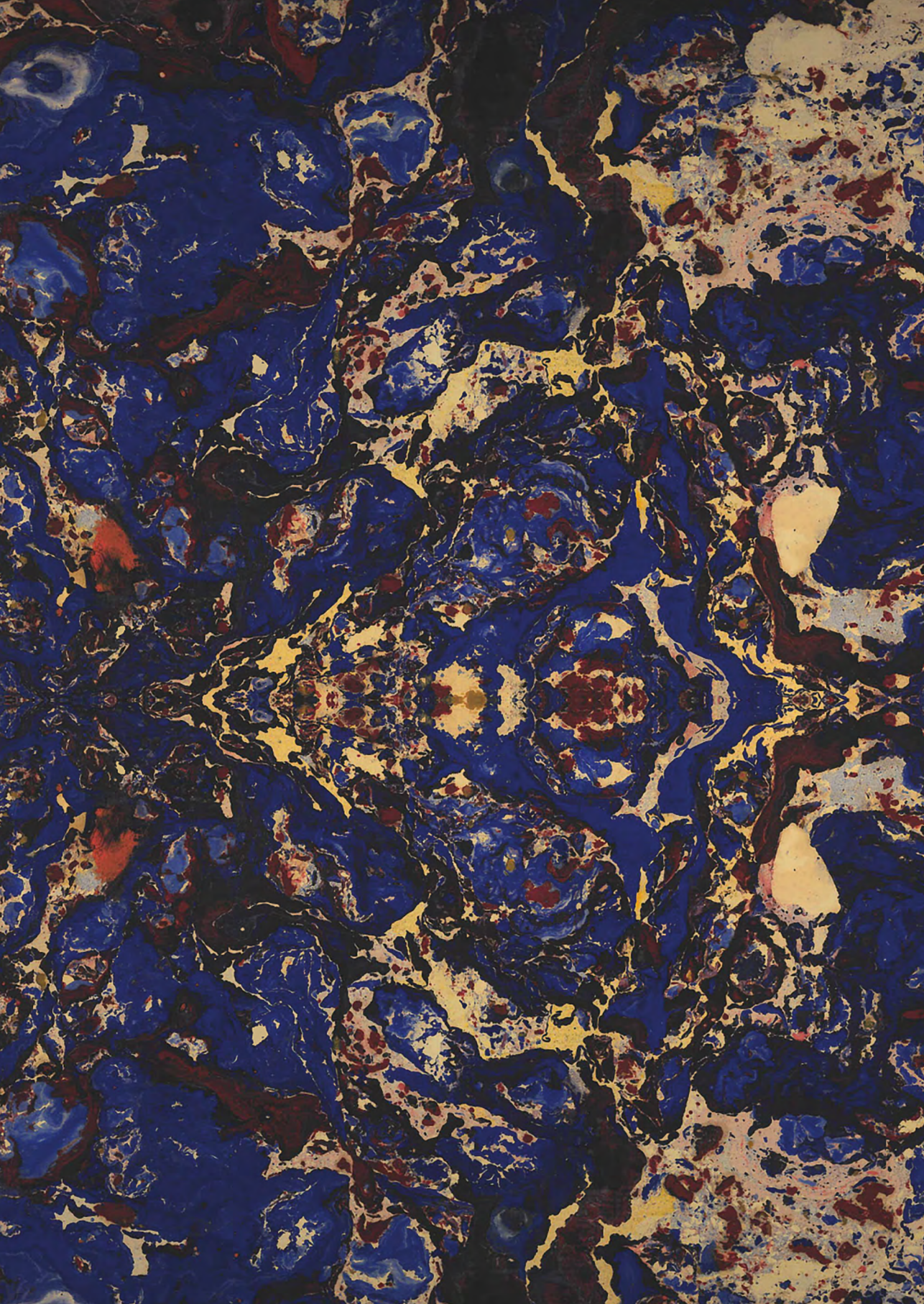
"le résultat de plus de quatre années consécutives de voyages en zigzag"

Jules Gilliéron & Edmond Edmont (1902) *Atlas linguistique de la France: Notice servant à l'intelligence des cartes*. Paris: Champion, p 3



Contents

Contents



Chapter 1

Introduction

1.1 Historicising Observation Practices

Observation practices have shaped the foundations of the modern sciences and humanities, providing the basis for arguments, evidence, or inspiration to scholars throughout all disciplines. As Lorraine Daston and Elizabeth Lunbeck have argued: "Observation is the most pervasive and fundamental practice of all modern sciences, both natural and human."[1] Yet the nature, role, and practice of observation changed historically. The famous anecdote of Cesare Cremonini allegedly refusing to look through Galileo Galilei's telescope because of his firm belief in Aristotelian philosophy suggests that observational practices had a different role in the seventeenth century than in modern scholarship. In this thesis, I want to provide a better understanding of the historical process of how observational practices became accepted and fundamental in different disciplines.

The term observation is broad and involves a large variety of practices. Daston and Lunbeck have defined scientific observation as: "a highly contrived and disciplined form of experience that requires training of body and mind, material props, techniques of description and visualization, networks of communication and transmission, canons of evidence, and specialized forms of reasoning."[2] This sets natural scientific observation apart from other forms of experience or seeing. Observation relies not only on the senses but also on tools and instruments, which are "designed to make the invisible visible, the evanescent permanent, the abstract concrete."[3] One can observe what cannot be seen. Specific methods, agreed-upon techniques, and tested tools are required to transform observations into data for research. These methods, techniques, and tools ensure that the observations are scientific, and differ from other experiences.

In other words, practices of observation in knowledge production cover many aspects, such as experiences, interpretations, instrumentations, and data practices. Historicising the practice of observation shows that these aspects are highly dependent on their social and historical context. What is observed and how this is done depends greatly on the context in which the research is executed and these contexts are subject to historical contingencies. In the nineteenth century, contexts in which scientific

1 Daston, L. & Lunbeck, E. (2011) "Introduction. Observation Observed" in: L. Daston & E. Lunbeck [eds] *Histories of Scientific Observation*. The University of Chicago Press, pp 1-9, p 1.

2 Idem, p 3.

3 Idem, p 1.

observational research was executed became increasingly institutional and organised in academic disciplines. This can be placed in a broader trend of significant developments in nineteenth century knowledge production, which has sometimes been called an "empirical turn" by historians of science.[4] The nineteenth century saw the emergence of disciplines such as sociology, geology, and biology, and existing disciplines such as history, physics, and chemistry underwent fundamental transformations.[5] Exemplary is also the coining of the term "scientist" by William Whewell in 1833, showing how developments in the nineteenth century shaped the organisation of knowledge production towards what we recognise today as modern, empirical, academic disciplines.

Besides transformations in the terms and concepts, the nineteenth century also saw changes in the practices of knowledge production. Methods and practices were adapted by scholars so as to fit with the research that was considered part of that discipline. As Lorraine Daston and Peter Galison have claimed, the century can be characterised by the emergence of objectivity as an important feature of what was considered good science and scholarship.[6] This had a great impact on the observation practices, since, as Daston and Galison have established, "[o]bservation is an enduring and essential scientific practice and is intimately bound up with the self of the observer."[7] Nineteenth-century scholars gave greater value to observations that were done passively, by eliminating themselves as much as possible, for instance by giving the task to an unschooled assistant. Such observations were seen as objective and, therefore, scientific. This stood in contrast with earlier observation practices where

4 Golinski, J. (1989) *Making Natural Knowledge: Constructivism and the History of Science*. Cambridge, Cambridge University Press, p 48; Cunningham, A. & Williams, P. (1993) "De-centring the 'big picture': *The Origins of Modern Science* and the modern origins of science" in: *The British Journal for the History of Science*, 26 (4), pp 407-432, p 428.

5 As an example of such fundamental transformation: Sjang ten Hagen has researched how the concept of 'fact' shaped the disciplines of history and physics in the nineteenth century: Ten Hagen, S.L. (2019) "How 'Facts' Shaped Modern Disciplines: The Fluid Concept of Fact and the Common Origins of German Physics and Historiography" in: *Historical Studies of the Natural Sciences*, 49(3), pp 300-337.

6 Daston and Galison define the nineteenth-century concept of objectivity as "*mechanical* objectivity" indicating the focus on how scholars aimed for observations without their own interference. The scholar themselves became a new kind of obstacle to knowledge. Daston, L. & Galison, P. (2007) *Objectivity*. Zone Books, Princeton, p 18 & p 34.

7 Idem, p 234.

scholars deemed it more important to be as truthful to nature as possible, but saw less need to limit their own involvement in the activity.[8] Agreed-upon methods were developed to ensure rigorous and objective data collection, management, and analysis.

In the cases presented in this dissertation, I show how some scholars indeed distanced themselves from the observing, either by collecting data from other observers or by using questionnaires, because they believed this would produce research which was scientifically rigorous. On the other hand, I show how other scholars believed their involvement was important to ensure the same scientific rigour. The observational practices described in my dissertation illustrate the complexity and multifaceted history of observations and how these various approaches to the shared practices were fundamental in creating and upholding disciplinary boundaries. Hence, the nineteenth-century developments in knowledge production, concerning the formation of disciplines and the turn towards empirical research, had an impact on and were impacted by the practices of observing. By taking a closer look at these observation practices I aim to also gain new insights in how knowledge production in the nineteenth and early twentieth centuries became organised in disciplines.

Historicising Academic Disciplines

Generally speaking, historians have connected the emergence of academic disciplines to the rise of modernity.[9] The time-period between 1750 and 1850 has often been pinpointed as a period of accelerated economic, social, and political changes in the West and historians have used the term *Sattelzeit* to characterise these developments. The effect of these accelerated developments is reflected in and shaped by certain

8 Idem, p 96. A similar argument is made in Daston & Lunbeck (2011), p3, on how observations differed from experiments in requiring a more passive role for the observer.

9 Much has been written about the history of disciplines and discipline formation. My presentation of this history is shaped mostly by Rudolf Stichweh's sociological historical work: Stichweh, R. (1984) *Zur Entstehung des modernen Systems wissenschaftlicher Disziplinen. Physik in Deutschland 1740-1890*. Surhkamp Verlag, Berlin; and idem (1992), "The Sociology of Scientific Disciplines: On the Genesis and Stability of the Disciplinary Structure of Modern Science" in: *Science in Context*, 5(1), pp 3-15. It is also influenced by Michel Foucault's view of disciplines as systems of control and training: Foucault, M. (1995) *Discipline and Punish: The Birth of the Prison*. Vintage Books, New York. These two authors are discussed concisely in the context of discipline formation and the rise of modernity by Johan Heilbron: Heilbron, J. (2004) "A Regime of Disciplines: Toward a Historical Sociology of Disciplinary Knowledge" in: C. Camic & H. Joas [eds] *The Dialogical Turn: New Roles for Sociology in the Postdisciplinary Age*. Rowan & Littlefield Publishers, Inc., Lanham, pp 23-42.

conceptual changes. One of the concepts whose meaning changed significantly is discipline.[10]

The term discipline is used in modern scholarship to designate a domain of knowledge that is recognisable due to a certain degree of specialisation, in which teaching, research, and professional organisation is established. This was not always how the term was employed, however. Stemming from the Latin *disciplina*, the term has been used for many centuries to designate educational contexts. This meaning of discipline was related to doctrine (*doctrina*) in the sense that discipline meant education from the viewpoint of the pupil and doctrine from the perspective of the master.[11] The educational tradition as part of a discipline has a clear continuation in

modern disciplines.[12] However, modern disciplines have also come to include research, experiments, observations, or any other form of empirical exploration and validation.[13] These transformations are often identified as developments in the nineteenth and early twentieth centuries, resulting in the emergence of the modern academic disciplines. This dissertation shows how observation practices played a role in these transformations.

Whilst Daston and Lunbeck and Daston and Galison have mostly focussed on scientific observations and science disciplines, the same can be said for observations

10 Koselleck, R. (2002) *The Practice of Conceptual History. Timing History, Spacing Concepts*, translated by Todd Samuel Presner and Others, Stanford University Press; Heilbron (2004), p 28. For a discussion on Koselleck's conceptual history to understand the relationship between concepts and social change, see Kayzel, T. (2021) *Prediction and Predicament: Historicity, the State and Socio-Economic Planning in the Netherlands, 1917-1999*. Dissertation, University of Amsterdam, pp 20-26.

11 Heilbron (2004), p 26.

12 This has led intellectual historian Donald Kelley to claim that the concept of discipline is "[w]hat gives concreteness, continuity, and intelligibility to the history of Western knowledge". Kelley, D. (1997) *History and the Disciplines: The Reclassification of Knowledge in Early Modern Europe*. The University of Rochester Press, Rochester, p 1. Also: Wegener, D. (2011) "Wetenschapsgeschiedenis op Lange Termijn: Flexibiliteit en Fragiliteit van Disciplines" in: *Studium*, 1, pp 16-30.

13 Heilbron (2004), p 27. For an overview of conceptualisations of disciplines and disciplinarity, see Sugimoto, C.R. & Weingart, S. (2015) "The kaleidoscope of disciplinarity" in: *Journal of Documentation*, 71(4), pp 775-794.

in the humanities.[14] Observation practices are especially interesting because of their occurrence across many disciplines, including in the humanities and social sciences. Dirk van Miert has claimed: "It was precisely the *practice* of observation that was common to such fields as philology and astronomy: the scholar turned his senses to a particular object or phenomenon, be it a manuscript, a planet or a person."[15] In this dissertation I want to understand how the meaning of these broad observation practices evolved to be fundamental for a variety of disciplines.

Not only do the practices occur in many different disciplines, they are also transferred between them. This dissertation gives multiple examples of such epistemic transfer, where observation practices are shared between disciplinary contexts. I look at how scholars adopted and adapted similar practices in different contexts, which resulted in discussions on what the standard practices of the discipline should be. These processes of standardisation played an important role in the formation of disciplines and disciplinary boundaries in the sciences and the humanities. The discussions on standardised methods and practices determined what research in particular disciplines was supposed to be. Scholars not adhering to these rules were considered as not part of the discipline. Through standardisation of practices the boundaries of disciplines were determined. Observation practices were embedded in disciplines in both the humanities and in the sciences, thus my focus on these practices can provide a means to study how processes of discipline formation occurred in these different fields.

Observation practices are not the only elements that are shared between disciplines: from the literature we find that more examples can be mentioned such as patterns or epistemic virtues.[16] The sharing of practices between disciplines shows that disciplinary boundaries are permeable, it does not tell us how they are

14 I use the terms scientific and scholarly combined to speak of knowledge production in the natural and social sciences as well as the humanities, as a kind of translation of the Dutch *wetenschap* or the German *Wissenschaft*. Unfortunately, English has no such neutral term to refer to the entire breadth of organised intellectual activity.

15 Van Miert, D. (2013) "Introduction" in: Van Miert, D. [ed.] *Communicating Observations in Early Modern Letters* (1500-1675). *Epistolography and Epistemology in the Age of the Scientific Revolution*. The Warburg Institute, London, pp 1-7, p 2.

16 For patterns in multiple disciplines: Bod, R. (2013) A *New History of the Humanities: The Search for Principles and Patterns from Antiquity to the Present*. Oxford University Press. For epistemic virtues in various disciplines: Van Dongen, J. & Paul, H. [eds] (2017) *Epistemic Virtues in the Sciences and the Humanities*. Boston Studies in the Philosophy and History of Science, Volume 321, Springer, Cham.

maintained. Practices of observation were shared between disciplines while disciplines also enforced certain boundaries. This tension between shared practices and dividing boundaries, between the disciplinary and interdisciplinary, is the central theme of my dissertation.

1.2 Research Questions

This dissertation thus asks: *How did comparable observation practices become part of different nineteenth and early twentieth-century academic disciplines*? By comparable I mean practices that significantly resemble one another because they have the same name or similar origins, for example. While the practices will be adapted when they are employed in different disciplinary contexts, there can still be recognisable similarities that let us call the practices comparable.

From this main question I derive two subsequent questions. The first is: *How did these practices develop in different disciplinary contexts*? The practices in question are embedded in new contexts and for this to be possible they need to be adapted to fit. The changes made to the practices–be it explicit or implicit–provide knowledge on processes of sharing and interaction but also show how divisions manifest themselves in scholarly practice. The second question is: *How were the different disciplines influenced by the sharing of these practices*? I am interested to explore whether the disciplines that participate in the sharing of practices change in the process. I want to investigate how and to what extent scholars attempted to uphold disciplinary boundaries while they were crossed by the sharing of observation practices.

To operationalise these research questions, I concentrate on the practices of dealing with data from observations by nineteenth-century and early twentieth-century scholars through two historical cases. Observation practices often involve data practices: observations are noted down, ordered, collected, and analysed in a particular way such that they can be considered as data. Employing these data practices can bring the scholar from general observations to particular conclusions. Moreover, data practices are textual while observation practices involve more than just text and, hence, data practices are easier to trace across different research contexts.

Data Practices

Transforming observations into data and the consequent interpretation of these data in research involve practices specific to disciplinary contexts. These practices are dependent on the standards of scientific and scholarly research of the particular discipline. While these standards differ for particular disciplinary contexts, the data practices employed to deal with observations still show similarities between disciplines. Hence, data and observation practices can be used to examine histories across disciplinary boundaries or in contexts where disciplinary boundaries are unclear.[17] Focussing on data practices uncovers continuities between various fields of academic knowledge production.

Data practices have played a continuous role in the production of knowledge: they are distinguishable in early modern scholarship as well as the nineteenth and early twentieth century disciplines which are discussed in this dissertation. They come in many different forms. Early modern data collection involved data on observations from the natural world, from the worlds of the past, and from foreign worlds and peoples. Data practices such as the questionnaire method are rooted in these historical methods. By the nineteenth century it had become increasingly interesting to collect data on people and nations, in line with the emergence of the nation-state. The centralisation of nation-states made it conceivable and even indispensable to gather data on its inhabitants. Such data were used directly in the day-to-day administration of a country.[18] All these different types of data—social and natural, political and scholarly—involve practices of collection, organisation, and analysis.

By placing the focus on the concept of data and data practices, new connections and discussions between those different contexts become possible. The approach of data history has been adopted by a number of studies on the concept of data, in both

17 Research using a focus on observations to transcend disciplinary boundaries has been conducted in the aforementioned studies, for example.

18 Randeraad, N. (2010) *States and statistics in the nineteenth century. Europe by numbers*. Manchester University Press, Manchester, p 5.

the sciences and humanities.[19] By focusing on data, these histories have sketched an overview of the concept's definition and practice in a variety of contexts. What makes data a useful concept for historical inquiry is that the historical actors also used the erm, albeit with varying meanings and interpretations, similar to observation.[20] One of the main goals of previous data histories has been to historicise the modern ideal of data-driven research, and put current and historic practices in relation with one another.[21]

The focus on data has enabled the inclusion of topics which other histories of the sciences or the humanities might miss. By placing data at the centre of inquiry, these historians have attempted to connect earlier historiographies in new ways. Data historians have, for instance, emphasised the materiality of data practices, studying counting cards, diagrams, or census archives. Materiality is significant as it fixes the meaning of data practices, making it possible to study them.[22] Additionally, a focus on data necessitates the study of a larger community than just scientists and scholars; many actors have participated in the collection and creation of data, including those that are traditionally excluded from historiography. Practices of data collection are also inherently political, including questions about who decides on which data are collected and which information is left out. In this way, the research on data histories

19 In the past couple of years, three special editions of the history of science journals have been published with data histories as their theme and can be said to have been programmatic in this respect: Aronova, E., von Oertzen, C., & Sepkoski, D. [eds] (2017) "Special Issue: Data Histories" in: *Osiris*, 32; Borck, C. (2017) "Big Data" in: *NTM Zeitschrift für Geschichte der Wissenschaften, Technik und Medizin*, 25(4), *Themenheft: Big Data*, pp 399-405; De Chadarevian, S. & Porter, T.M. [eds] (2018) "Special Issue: Histories of Data and the Database" in: *Historical Studies in the Natural Sciences*, 48(5). The modern sciences rely heavily on data practices and a study of their history might tell us something about what we are seeing in the present, as Cathryn Carson has argued here: Carson, C. (2020) "Clouds of Data" in: *Historical Studies of the Natural Sciences*, 50(1-2), pp 81-89. Examples from the history of humanities include amongst many others: Gamsa, M. (2016) "Two Million Filing Cards: The Empirical-Bibliographical Method of Seme Vengerov" in: *History of Humanities*, 1(1), pp 129-153; Donato, M.P. (2018) "A Science of Facts? Classifying and Using Records in the French Imperial Archives under Napoleon" in: *History of Humanities*, 2(1), pp 79-100.

20 Rosenberg, D. (2018) "Data as Word" in: *Historical Studies of the Natural Sciences*, 48(5), pp 557-567.

21 Aronova *et al.* (2017), p 8.

22 Often, data histories involve interesting questions about visualisation techniques: Sepkoski, D. & Tamborini, M. (2018) " 'An Image of Science': Cameralism, Statistics, and the Visual Language of Natural History in the Nineteenth Century" in: *Historical Studies of the Natural Sciences*, 48(1), pp 56-109.

connects a number of different perspectives on knowledge production and crosses conventional historiographical boundaries.

Not only are the data practices comparable across disciplinary contexts, they also move between them. Data practices are not confined by the bounds of disciplines: they are shared and borrowed, leading to interesting epistemological questions of how the similar practices were applied to varying sets of data. Apparently, scholars from different disciplines had a shared sense of what can be seen as data and the realisation that similar methods and practices can be employed.[23] How was this shared sense of data formed? How were these practices shared? And how did scholars apply similar practices in different contexts? These questions become even more meaningful when studied in the context of nineteenth-century disciplines and the formation of disciplinary boundaries.

The current literature on data histories has presented a great range of how data played a role in various fields of knowledge and how our ideas about Big Data have formed, yet they have not explicitly thematised the role of data in disciplinary contexts.[24] The research has shown clearly how data histories open perspectives towards understanding disciplinary dynamics, yet it has not thematised or analysed the formation of the modern disciplinary system with this material, or questioned the existence of these disciplinary boundaries. This dissertation picks up on that challenge: it shows how comparable data practices are employed, developed, and shared in different disciplinary contexts and how this played a role in the formation of disciplinary boundaries.

23 Soraya de Chadarevian and Theodore Porter have also recognised the sharing of data practices across disciplinary boundaries. They study this by focussing on the materiality of data practices, which was similar in various disciplinary contexts. My approach is to focus on two particular data practices as they are shared between disciplines. De Chadarevian *et al.* (2018), p 554.

24 For example: Von Oertzen, C. (2018) "Datafication and Spatial Visualization in Nineteenth-Century Census Statistics" and Sepkoski, D. (2018) "Data in Time: Statistics, Natural History, and the Visualization of Temporal Data" in: *Historical Studies in the Natural Sciences*, 48(5), pp 581-593 and pp 568-580; Sepkoski, D. (2013) "Towards 'A Natural History of Data': Evolving Practices and Epistemologies in Paleontology, 1800-2000," *Journal of the History of Biology*, 46(3), pp 401-444; Müller-Wille, S. (2017) "Names and Numbers: 'Data' in Classical Natural History, 1758-1859", and Kaplan, J. (2017) "From Lexicostatistics to Lexonomics: Basic Vocabulary and the Study of Language Prehistory" in: *Osiris*, 32, pp 109-128 and pp 202-223.

Case Studies

The data practices discussed in this dissertation are the use of statistics in Chapter 2 and the use of the questionnaire in Chapter 3. Chapter 2 examines the statistical methods developed within Belgian astronomer and statistician Adolphe Quetelet's (1796-1874) research programme. It shows that these practices were incorporated in many different research projects and disciplines. Quetelet's practices enabled scholars to analyse concrete data on varying abstract phenomena, which relate to human societies as well as to the natural world, including stars, weather phenomena, and plants. Quetelet's research reached a large range of disciplines, including botany, physics, and history. Through the case of Quetelet, his student and fellow observer Charles Morren (1807-1858), and the discipline of botany I show how such statistical methods became embedded in disciplines where observations play an important role. The disciplines' appropriation of these methods enabled internationalisation and standardisation which influenced the establishment of disciplinary boundaries.

Statistical methods were used to analyse and interpret a large range of data. Quetelet's application of these methods, which he had learnt as an astronomer, meant the methods could be used on many different projects involving observations, spread out over different disciplines. The collection of data from observations was done within those research projects, according to the rules of observation depending on the object of study. The consequent management, analysis, and interpretation of these data, however, were done following Quetelet's statistical methods. Quetelet had given advice of how to collect data and which data to collect, but this was not adopted to the same extent as his analytical methods were. Therefore, in this case study, I consider Quetelet's statistical methods as data practices to analyse and interpret data.

In contrast to the data practices of Chapter 2 which were used to analyse data, Chapter 3 investigates how the questionnaire was developed as a tool to collect data in the field of language sciences. The questionnaire was employed to systematically collect and manage data on a particular research topic. The appearance, aim, and approach of the research method varied in different contexts and in Chapter 3 I consider the use of questionnaires to collect data on dialects and variations of language.
Two influential research projects—the *Atlas linguistique de la France* and the *Sprachatlas*, led by Jules Gilliéron (1854-1926) and Georg Wenker (1852-1911) respectively—illustrate how the questionnaire was adapted to the purpose of the specific research. The questionnaires enabled the scholars to not only collect data on spoken language, but also on various social factors which were believed to influence differences in language. Indeed, the questionnaire method was not only part of language studies, as I show, but

also employed in social science research such as sociology, ethnology, and psychology.

The development of standards for the scientific and scholarly collection, analysis, and management of data from observations coincides with the development of disciplinary boundaries: the agreed-upon methods and practices are separated from other practices. Yet this leads to a tension: data practices that are shared lead to divisions being created. To understand this tension, I investigate what happens when data practices are shared and embedded in different disciplinary contexts.

1.3 The Mesolevel: Level of Flow and Disciplines

Relationships between disciplines and the sharing of concepts, theories, and methods are rather abstract things to study. To grasp the tension between the sharing of practices between disciplines and the formation of disciplinary boundaries, a new set of historiographical tools and concepts is needed.

Studying disciplines systematically involves an abstracted analysis of individual actions. Here it is helpful to make a distinction between various levels of historiographical analysis: a micro, meso, and macrolevel. At the microlevel the histories of individuals are situated, these are interactions between specific people at a certain place and time such as a conference discussion.[25] The aggregate result of these microlevel interactions is the mesolevel.

The mesolevel is the level of analysis which involves social entities like societies, disciplines, and shared practices. On this level, it becomes feasible to cross geographical, social, temporal, and, importantly, disciplinary boundaries. The last step then, the macrolevel, consists of disciplinary systems, an even more abstracted view of knowledge where details and context of the underlying processes are easily lost. Hence, to study the dynamics of disciplines the mesolevel should be employed. Lorraine Daston and Peter Galison have argued in favour of a mesolevel analysis so as to "reveal the spread of techniques across disciplinary and geographical lines".[26] Whereas I am less interested in the crossing of geographical boundaries, I do intend to research the sharing of practices between disciplines and therefore mesoscopic analysis is relevant.

25 For a reflection on the relevance of microhistories: Ginzburg, C., Tedeschi, J., Tedeschi, A.C. (1993) "Microhistory: Two or Three Things That I Know about It", in: *Critical Inquiry*, 20(1), pp 10-35.

26 Daston, L. & Galison, P. (2008) "Response: 'Objectivity' and its Critics" in: *Victorian Studies*, 50(4), pp 666-677, p 677.

1.3 THE MESOLEVEL: LEVEL OF FLOW AND DISCIPLINES

Flow of Cognitive Goods

In order to study the sharing of elements between disciplines with a systematic approach I employ the historiographical framework of "flow of cognitive goods."[27] This general historiographical framework aims to describe interactions and epistemic transfers between disciplines, transcending the confines of disciplinary boundaries, location, and the short term. Furthermore, it aims to do so in a systematic way, such that different cases can be compared and analysed.

To do this, we introduce an inclusive concept that serves to capture what moves between disciplines: "cognitive goods." Cognitive goods are the shared epistemic tools of knowledge-making disciplines that can be transferred across disciplinary boundaries. Cognitive goods include methods, concepts, models, metaphors, formalisms, principles, modes of representation, argumentative and demonstrative techniques, technical instruments, institutional arrangements, and intellectual, theoretical, and epistemic virtues. In this dissertation the cognitive goods are the statistical methods developed by Adolphe Quetelet to analyse data on periodical phenomena and the questionnaire method to collect data in linguistics by linguists such as Jules Gilliéron, Georg Wenker, and Antoine Meillet (1866-1936).

For these cognitive goods to travel, or to "flow," they need to have a certain degree of autonomy: they need to be recognisable. Nevertheless, cognitive goods are not immutable and are dependent on the context in which they are used: they are defined by and used in a community of users.[28] Flows of cognitive goods can show the direction of epistemic transfer, including a source and destination. This is not always possible, however, for epistemic transfer can also occur when clearly defined disciplinary structures or research contexts are not yet in place, as my research cases show. Therefore, in my interpretation of the framework which I apply in this dissertation, flow means that cognitive goods are shared between multiple contexts.

A similar interpretation is presented by Sjang ten Hagen, who uses the flow of cognitive goods framework to examine the historical relationship between the

27 This framework has been presented in a programmatic paper published in *Isis*. Much of the current section is based on work in this paper. Bod, R., Van Dongen, J., Ten Hagen, S.L., Karstens, B., & Mojet, E. (2019) "The Flow of Cognitive Goods: A Historiographical Framework for the Study of Epistemic Transfer", *Isis*, 110(3), pp 483-496.

28 The flow of cognitive goods can be compared to Mary Morgan's "travelling facts", having sufficient autonomy to be mobile without losing their integrity of meaning. Morgan, M.S. (2011) "Travelling Facts", *How Well Do Facts Travel? The Dissemination of Reliable Knowledge*, Howlett, P. & Morgan, M.S. [eds], Cambridge University Press, pp 3-39, p 15.

disciplines of physics and history. His interpretation is to consider these disciplinary histories as "entangled" in order to grasp the interactive dynamics between the two contexts.[29] He understands flows as the sharing of cognitive goods just as I do, to emphasise the active participation of the disciplinary contexts involved.[30] In my research cases, I focus on how certain shared practices, or cognitive goods, are embedded in a particular discipline and hence I have opted not to employ the concept of entangled history in my dissertation.

The term cognitive goods can have some unintended connotations. First, due to the adjective cognitive it might seem as if we only refer to the realm of ideas and metaphors. Yet cognitive goods can also be material, social, or institutional; it is an umbrella term for a tool to describe elements of knowledge shared between disciplines, which can be many things. The production of knowledge has a strong cognitive component, while still being social, material, and institutional. Here we have referred to work done in cognitive sciences by Nancy Nersessian, who has placed scientific practices "within the broader framework of human cognitive activities" and this "makes it possible to move beyond the specifics of the case to more general conclusions about the nature and function of the scientific practices."[31] It is exactly this more general, broader framework that this dissertation examines. A second inadvertent connotation could stem from the "goods" part of the term. This can have something to do with an economic perspective and, indeed, cognitive goods can be objects of negotiation and transaction with phases of production, circulation, and consumption. However, this analogy should not be taken too far, for we do not wish to consider cognitive goods as something with a particular value, which might be another connotation with the word good, namely that it is something to strive for. Instead we have interpreted the term good in a neutral, nonevaluative way.

The sharing of cognitive goods occurs on the mesolevel and enables the study of connections between particular historical cases and broader disciplinary developments. At the microlevel only the particular context can be found and the macrolevel is too extensive and all-encompassing. Since the mesolevel consists of a bundling of interactions at the microlevel, it is necessary to link the meso and microlevels in order to be able to attain the analytical level of disciplines. Instances at which this happens

29 Ten Hagen, S.L. (2021) *History and Physics Entangled: Disciplinary Intersections in the Long Nineteenth Century*. Dissertation, University of Amsterdam, p 30.

30 Ten Hagen (2021), p 32.

31 Nersessian, N.J. (2008) *Creating Scientific Concepts*, MIT Press, Cambridge, p 9.

are during an international disciplinary congress or through the common use of a certain set of instructions. When we study these historical events using the analytical tool of cognitive goods, we can trace the flows of how certain practices, methods, or theories are shared between disciplinary contexts. This dissertation "observes disciplines," while disciplines cannot be seen but can be inferred, using agreed-upon historiographical methods.

Discipline Formation

As mentioned above, the modern meaning of discipline, encompassing both training and research, is relatively recent, emerging in the first half of the nineteenth century and following structural transformations of the university systems. The attempt to categorise knowledge production into distinct areas is not new or modern: for centuries scholars have attempted to organise the various areas of knowledge production, creating distinctions, hierarchies, and order.[32] These categorisations differed from the modern disciplinary system, however, and to speak of disciplines would be misleading, since that would not cover the historical practices involved. Instead, I use the concept of "epistemic genre," following Gianna Pomata.[33]

In literary theory, a genre can be defined as a standardised textual format with recognisable conventions of style and content. Genres are "handed down by tradition for the expression and communication of some kind of content. In the case of epistemic genres, this content is seen by authors and readers as primarily cognitive in character."[34] Texts can be recognised as belonging to a certain epistemic genre by applying the associated conventions: a mathematical text would employ a recognisable, mathematical, method, for instance.

Such textual conventions have an intrinsically social element, as Pomata has explained: "contributing to a genre means consciously joining a community. Indeed, some genres are eminently instruments of 'community building', tools for the establishment

32 In the *Interactive Historical Atlas of the Disciplines* Raphaël Sandoz has collected various classifications of the sciences and visualised the evolution of disciplinary boundaries, starting from Antiquity to modern day disciplines. See: http://atlas-disciplines.unige.ch/ [last visited February 2022]. Also: Blair, A. (2008) "Disciplinary Distinctions before the 'Two Cultures'" in: *The European Legacy*, 13(5), pp 577-588.

33 Pomata, G. (2011) "Observation Rising: Birth of an Epistemic Genre, 1500-1650" in: L. Daston & E. Lunbeck [eds] *Histories of Scientific Observation*. The University of Chicago Press, Chicago, pp 45-80, p 48.

34 Pomata (2011), p 48.

of a collective scholarly endeavour as a social and intellectual shared space."[35] For early modern scholars it was clear what to read and how to write in order to be part of the production of knowledge. An eighteenth-century scholar would write about their observations in such a way that it was recognisable as belonging to their genre. In other words, it did not matter what the observations were about, but how they were conducted, described, and discussed. The scholars who adhered to the same genre, formed a community in which these characteristics were shared, but these communities were not professional: contrary to the later, professionalised disciplines, the contributors to a certain genre could have different and multiple professions. Epistemic genres can help us to understand specialisation and different types of knowledge in early modern knowledge categorisations without an anachronistic use of the term discipline.

Early modern epistemic genres were divided hierarchically into three layers, based on the type of method used by the epistemic genre: a mathematical, philosophical, and historical level.[36] These methods are recognisable through their textual characteristics as part of a certain epistemic genre. To apply these labels one should let go of any modern connotations of mathematics as a science of mathematical objects and problems, or of history as the study of diachronic processes. Instead, mathematical methods were universal methods of knowledge, principles which could be applied to any topic, and historical methods meant the description and ordering of knowledge from facts on individual things. When tracing back modern disciplines to early modern predecessors this can have the consequence that one has to consider various strands of the discipline, a historical and a philosophical, for instance. A telling example here is the modern discipline of biology which has a historical root in the collection and taxonomy of plants and a philosophical root in the understanding of plant development.[37]

These genres based on differences in method were transformed into disciplines that were focused around an object of study. The disciplines displayed various degrees of specialisation and were no longer hierarchical. The question then remains

35 Ibidem.

36 Stichweh (1984), p 15.

37 For more on the transformation between epistemic genres and academic disciplines and how different strands end up in one discipline, see the first chapter of Stichweh (1984), pp 7-93. See Ten Hagen (2019) which uses this approach in historical research.

how these disciplines were formed and the literature on this topic is vast.[38] Discipline formation is often characterised as a process of specialisation, as differentiation between disciplines towards increasingly specific objects of study. For instance, scholars would no longer observe all of nature but specific plants instead.[39]

Discipline formation as specialisation can also involve the combination of or cooperation between different research groups to form a discipline. This particular process has been called hybridisation, when previously separated fields or research projects interact and combine to form a new discipline.[40] Many examples of hybridisation can be found in social science disciplines, such as social psychology, political economics, or sociolinguistics. As Bart Karstens has argued, hybridisation can involve not only similar processes to specialisation, in which increasingly specific topics are studied, but it can also show how disciplines are developed as multiple building blocks coming together.[41] This is an addition to the process of specialisation, since it offers the perspective of combinations and connections made in new disciplinary contexts.

Specialisation and hybridisation mainly concern the forming of disciplines through the refining of ideas, theories, or objects of study. Another important aspect of the construction of disciplinary boundaries is how practical activities are elevated to the status of academic discipline.[42] Neither hybridisation or specialisation, however, describe the activity involved to create certain practices and methods: for this perspective the process of professionalisation can be employed. An example of this process is the discipline of botany where the distinction that was made between amateur observers of plants and the scientific, botanical observations. Professionalisation involves the training of scholars to use certain methods, such as through education,

38 See for example Heilbron (2004); Weingart, P. (2010) "A Short History of Knowledge Formations" in: R. Frodeman *et al.* [eds] *The Oxford Handbook of Interdisciplinarity*. Oxford University Press, Oxford, pp 3-14; Olesko, K.M. (2017) "The Great Transition" in: *Isis*, 108(4), pp 841-845.

39 This example is one of the arguments towards a discipline of botany in Chapter 2 of this dissertation.

40 The perspective of discipline formation as hybridization has also been developed in: Karstens, B. (2012) "Bopp the Builder: Discipline Formation as Hybridization: The Case of Comparative Linguistics" in: R. Bod, J. Maat, & T. Weststeijn [eds] *The Making of the Humanities, Vol. 2: From Early Modern to Modern Disciplines*, Amsterdam University Press, pp. 103–127. The process has a tradition in the social sciences: Dogan, M. (1996) "The Hybridization of Social Science Knowledge" in: *Library Trends*, 45(2), pp 296-314.

41 Karstens (2012), p 105.

42 Heilbron (2004), p 35.

which consequently leads to decisions on who is part of the discipline and who is not. It shows how discipline formation was also active: scholars were actively creating the boundaries for the disciplines.[43]

Discipline formation is multifaceted: social, political, and institutional factors play a role in decisions of what is considered part of the discipline or outside it. The content of the research, the methods or objects of study, also clearly play a role in the forming of an academic discipline. Scholars decide on the topics of their disciplinary research, and these decisions involve social and political factors as well. They also decide on the methods and techniques that need to be mastered in order for research to be part of their discipline. These methods become part of the disciplinary education which functions as a safeguard for the standards of the discipline and the preservation of quality of its research.[44] Nevertheless, while these standards seem to be set, disciplines are flexible and ever-changing, involved in and influenced by interdisciplinary interactions, for example. In this sense, discipline formation is a continuous process and disciplinary boundaries remain permeable. I want to analyse disciplinary divisions from the perspective of the sharing and appropriation of cognitive goods, more specifically data practices from observations.

1.4 Disciplinary Activity

Cognitive goods flow between disciplines and become embedded into their new disciplinary context. The transfer of a concept or a method or an object between disciplines has consequences for the disciplines which are crossed and that which is crossing. As Julie Thompson Klein has argued, "disciplinarity and interdisciplinarity are productive tensions in a dynamic of supplement, complement, and critique."[45] The disciplines which share cognitive goods will each give their own meaning and purpose to that which is shared in order for it to belong within the agreed-upon boundaries. The embedding of certain research practices into a discipline involves the redefining and

43 An example of how the construction of disciplinary boundaries was an active process can be seen in Thomas Gieryn's analysis of how scientists distinguish their scientific discipline from pseudo-sciences. Gieryn, T.F. (1983) "Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists", *American Sociological Review*, 48(6), pp 781-795. I return to Gieryn's analysis of boundary work in the Methods section.

44 Wegener (2011), p 25.

45 Thompson Klein, J. (1996) *Crossing Boundaries: Knowledge, Disciplinarities, and Interdisciplinarities*. The University of Virginia Press, Charlottesville, p 4.

evaluating of the disciplinary boundaries–in other words, which topics, methods, or authorities should be maintained to produce knowledge specific to that discipline–and this is an on-going process. To describe this active process, I use the term "disciplinary activity", borrowed from Libby Schweber who first coined it in her book *Disciplining Statistics* (2006).[46]

Schweber has examined the organisation of the social sciences into distinct, institutionalised disciplines that became embedded in the university system in the late nineteenth century. To this end, she has compared how scholars working in French demography and British vital statistics attempted to create academic disciplines for their own research. These efforts, she has described as disciplinary activity. Disciplinary activity preceded the institutionalisation of the disciplines and consisted of several decades in which "new disciplinary categories and projects were introduced, contested, and elaborated. Some were institutionalised in university-based disciplines, others incorporated into other political or disciplinary projects, and still others abandoned altogether."[47] Schweber has claimed that disciplinary activity "remains a central feature of knowledge production. New projects such as bioethics, cognitive science, and even science studies involve explicit attempts to gain specifically disciplinary recognition."[48] Hence, Schweber's definition of disciplinary activity comprises of the efforts of scholars to create a discipline for their research project.[49]

In this sense, disciplinary activity resembles Thomas Gieryn's "boundary work," with which he has analysed the practice of scientists creating boundaries for their disciplines.[50] Gieryn has defined this as "their attribution of selected characteristics to

46 Schweber, L. (2006) *Disciplining Statistics: Demography and Vital Statistics in France and England, 1830-1885*, Duke University Press.

47 Idem, p 2.

48 Schweber (2006), p 8.

49 Dorothy Ross has used the term project to describe discipline formation in the social sciences: "To call the formation of social science disciplines a project is to locate it within the contingencies of history. Disciplines were not a product of the automatic progress of science, nor were they 'natural' categories. They had to establish themselves as authoritative purveyors of descriptions of the world." While project, indeed, acknowledges the participation of scholars and scientists involved, it is less active than disciplinary activity and therefore I prefer Schweber's term. Ross, D. (2003) "Changing Contours of the Social Science Disciplines" in: T.M. Porter & D. Ross [eds] *The Cambridge History of Science, Volume 7: The Modern Social Sciences*. Cambridge University Press, Cambridge, pp 205-237, p 206.

50 Gieryn (1983).

the institution of science (i.e., to its practitioners, methods, stock of knowledge, values and work organisation) for purposes of constructing a social boundary that distinguishes some intellectual activities as 'non-science'."[51] Gieryn has illustrated the boundary work which scientists do to distinguish between science and folklore, myths, politics, religion, or other knowledge-producing activities. These distinctions have been actively carved out of the intellectual ecosystem, explained Gieryn, and the creation of these distinctions is an ongoing process.[52] The resulting distinctions are not only analytical or functional, they have a direct social dimension as well. "Demarcation is not just an analytical problem: because of considerable material opportunities and professional advantages available only to 'scientists,' it is no mere academic matter to decide who is doing science and who is not."[53] Disciplines are social entities: their boundaries are defined through social processes and activities. Through the defining of boundaries, scholars and scientists decide what is part of their discipline and, especially, what is not.[54]

Another instance of disciplinary activity can be found in the practices of ensuring who was allowed to be part of a certain discipline or community and who was to be excluded. The sharing of methods and practices, as I study in this research, had as a consequence the creation of a community of those included in the sharing and those excluded from it. The establishment of standards for observations and measurements meant that other observations were excluded. A distinction came into being between the group of people who were invited for and attended disciplinary congresses, where decisions pertaining to the boundaries of disciplines were made, and those who were excluded from this discussion and consequently had trouble to be included in the discipline. This meant that only certain people were included in knowledge production, and these were mostly well-educated, upper-class men. Indeed, the cases I have studied evolve around the lives of mostly male actors and this is no coincidence. As Ann B. Shteir has argued, specifically for the discipline of botany: "Gender, in fact, was integral to discipline formation in nineteenth-century botany. (…) The exclusionary practices

51 Idem, p 782. Gieryn has not extended his analysis towards any humanities or social science disciplines.

52 Idem, p 783.

53 Gieryn (1983), p 781.

54 A modern example of boundary work can be found in the debates between theoretical physicists on string theory, see Van Dongen, J. (2021) "String theory, Einstein, and the identity of physics: Theory assessment in absence of the empirical" in: *Studies in History and Philosophy of Science*, 89, pp 164-176.

of self-defining elites are a powerful part of the history of women and science."[55] These exclusionary practices are also part of disciplinary activity and involved, for example, institutional changes or changing narratives of scholarly literature at the time.

Disciplinary activity does not stop once certain boundaries have been established. I will extend on Schweber's use of disciplinary activity in my research, as the same efforts and activity remain important even when a discipline might be said to have been established. This disciplinary activity, and to a certain extent, disciplinary formation, is therefore an ongoing process. Accepted boundaries, established research topics, and even standardised methods are often re-evaluated and discussed contributing to the same activity as Schweber has described. I will therefore continue to use the term disciplinary activity to examine what happens within and between disciplines after they have been formed. Disciplinary activity describes the efforts of scholars and scientists to determine the research methods, topics, and projects belonging to their discipline, for example because these were once seen as part of a different discipline. Disciplinary activity is involved in order for these to fit in a certain disciplinary context.

By studying flows of cognitive goods it becomes clear that disciplines are not fixed, static entities but ever-changing, with permeable boundaries. When cognitive goods are shared between disciplines they cross disciplinary boundaries. Once in a new disciplinary context, they need to be adapted in order to fit with the discipline's standards and agreed-upon rules. This work is done by scholars within their own research: it is therefore at the microlevel and can be described using disciplinary activity. Hence, the flow of cognitive goods framework can be used to describe the sharing of practices between disciplines, while the concept of disciplinary activity can be employed when talking about divisions between disciplines and the upholding of disciplinary boundaries.

Botany, Linguistics, and the Emergence of Social Sciences

This dissertation zooms in on two disciplines in particular: botany and linguistics, though activity in and with other disciplines is also considered. Both show instances of redefining their boundaries in the nineteenth and early twentieth-century and undergo several transformations. In Chapter 2, I show how botany developed from a broad and accessible study of plants to an institutionalised and specialised discipline. The discipline of botany came to include more laboratory-oriented research

55 Shteir, A.B. (1997) "Gender and 'Modern' Botany in Victorian England", *Osiris*, 12, pp 29-38, p 29. Also: Shteir, A.B. (1999) *Cultivating Women, Cultivating Science: Flora's Daughters and Botany in England, 1760 to 1860*, Johns Hopkins University Press.

and quantitative methods to analyse the data botanists collected. In Chapter 3 I show how the standardisation of practices of linguistic research was discussed at the First International Congress of Linguists held in the Netherlands in 1928, which involved debates on the boundaries of the linguistic discipline: the research methods and topics of linguistics were discussed and the possibility of a general linguistics discipline was considered.

Besides botany and linguistics, both cases consider the emergence of the social science disciplines in France and Belgium over the course of the nineteenth and early twentieth century. The French perspective is quite distinct from the development of the social sciences in other countries. [56] At German speaking universities, the social sciences relied on a strongly descriptive tradition.[57] National contexts had an especially large impact on the development of the social sciences because of their close ties with politics. This can be traced to the second half of the eighteenth century when the term "moral and political science" was used to describe the scholarly study of the foundations of society, combining moral philosophy and political thought.[58] Political science had previously been considered merely state affairs and not an intellectual endeavour, but this attitude changed when it became linked to moral philosophy. The phrase moral and political science—also shortened to moral sciences—remained in use throughout the nineteenth century, while the term social sciences also entered the literature already in the last decade of the eighteenth century, first in France

56 Moreover, in North America, for example, social science disciplines grew much faster than at the traditional universities of Europe. Ross (2003), p 213; Wittrock, B., Heilbron, J., & Magnusson, L. (1998) "The Rise of the Social Sciences and the Formation of Modernity" in: J. Heilbron, L. Magnusson, & B. Wittrock [eds] *The Rise of the Social Sciences and the Formation of Modernity. Conceptual Change in Context, 1750-1850*. Springer, Dordrecht, pp 1-34, p 4; Heilbron, J., Guilhot, N. & Jeanpierre, L. (2008) "Toward a Transnational History of the Social Sciences" in: *Journal of the History of the Behavioural Sciences*, 44(2), pp 146-160.

57 Prussian statisticians adhered to statistics as a historical science longer than anywhere else in Europe. Von Oertzen (2018), p 573. See also: Echterhölter, A. (2016) Data, Diplomacy, and Liberalism: August Ferdinand Lueder's Critique of German Descriptive Statistics (c. 1810)", *Bulletin of the German Historical Institute*, 59, pp 83-102; and Sepkoski & Tamborini (2018). More on statistical traditions in Chapter 2.

58 The term was coined in France, probably in the circle of the physiocrats: French scholars who developed an economic theory based on agriculture and land development. Wittrock *et al.* (1998), p 3; Heilbron, J. (2003) "Social Thought and Natural Science" in: Porter, T.M. & Ross, D. [eds] *Cambridge History of Science*, Volume 7, Cambridge University Press, pp 40-56, p 41.

and later in England and Germany.[59]

Originally, French social science encompassed a broad science of government and legislation, which was formulated by liberal elites. While the ideological spectrum of social scholars widened during the nineteenth century, these upper-class liberals continued to play a central role in the establishing of social science, who saw social science as a means to understand, observe, and possibly control society.[60] Social scientists developed numerical methods of representing groups and comparing these groups, without references to specific particularities. It required epistemological changes to conceive of such groups as entities and that these entities could be represented by numbers in a meaningful way.[61] These epistemological changes established a new entity that could be acted upon: a society that was observable and measurable. Chapter 2 of this dissertation illustrates this development.

Historiography on the development of social science disciplines has often been written with a strong focus on the development of social theory, while, as has been argued elsewhere and is illustrated in this dissertation, social sciences were from the beginning based on making observations and collecting data.[62] This dissertation thus

59 Heilbron (2003), p 41. A third term for similar subject matter is human sciences. This term has been in use in the English language since the seventeenth century to refer to the study of human life and is generally seen as being an interdisciplinary framework overarching the natural and social sciences as well as the humanities. It derives from the French *sciences humaines*, which was used instead of *humanités* to define those branches of knowledge that use criticism as method. This is quite distinct from the social sciences. On *science humaines* and the humanities see Solleveld, F. (2018) *The Transformation of the Humanities: Ideals and Practices of Scholarship between Enlightenment and Romanticism, 1750-1850*. Dissertation, Radboud Universiteit Nijmegen.

60 Ross (2003), p 208.

61 More on how numbers came to represent real entities can be found in Porter, T.M. (1995) *Trust in Numbers. The Pursuit of Objectivity in Science and Public Life*. Princeton University Press, Princeton. In Chapter 2 I return to this topic when I discuss the rise of quantification and statistical thinking in science and society.

62 Porter, T.M. (2011) "Reforming Vision: The Engineer Le Play Learns to Observe Society Sagely" in: L. Daston & E. Lunbeck [eds] *Histories of Scientific Observation*. University of Chicago Press, Chicago, pp 281-300, p 299. This could mean many things such as comprising lists of death dates to determine life expectancy, or the number of houses in a street to estimate population size, or suicide rates to investigate the morals behind such an act. Already from the seventeenth century onwards these data had been subjected to calculations, which were called political arithmetic, and those interested in these calculations were mainly economists, politicians or from law related fields. Chapter 2 discusses this in more detail.

offers a multidisciplinary and practice-oriented approach to the history of the social sciences. Chapter 2 describes the rise of quantification and use of statistics in various disciplines, especially botany. Through the development of statistical methods in these disciplines it became possible to measure and observe such abstract concepts as a society or a population. Chapter 2 thus demonstrates a connection between the natural sciences and the social sciences through a shared use of data collection practices. Chapter 3, in addition, displays a relationship between the humanities and the social sciences through the use of the questionnaire method in linguistics and various social sciences such as sociology, ethnology, and psychology. The development of the questionnaire to collect data on regional dialects involved an increasing focus on the social situations of the speakers, providing a direct link between these disciplines. The institutionalisation of social science disciplines played an influential role on the debates evolving around the linguistic questionnaire method as data collection practice.

1.5 Comparing the Cases

Disciplinary Congresses

In both cases international disciplinary congresses are important sites of disciplinary activity: questions on the preferred methodology of a discipline are discussed explicitly here. The discussions lead to establishment of disciplinary boundaries. Moreover, the congresses show how disciplines became more international. Decisions were made about who was invited to the congresses determining who should and who should not participate. Scholars in both research chapters of my dissertation are influential in organising these interactions: Quetelet took up a leading role in the organisation of the International Statistical Congresses and Meillet was the driving force behind the first International Congress of Linguists.[63] At these international congresses standardisation of methods was a main aim and these sites can thus showcase disciplinary activity. Disciplines set standardised methods and rules for observation.

Organising congresses is part of organising a discipline, congresses can be used to display disciplinary activity: through the organisation of a congress scholars claimed

63 In the following blogpost I have also discussed the phenomenon of international congresses in general before focusing more specifically on the first International Congress of Linguists: Mojet, E. (2018) "Discussing Disciplinary Development: The role of the First International Congress of Linguists (1928) in the formation of the discipline of general linguistics." *History and Philosophy of the Language Sciences.* https://hiphilangsci.net/2018/02/14/first-international-congress-of-linguists/ [link accessed March 2021].

a space for their discipline. Moreover, by discussing certain problems or topics, the congress participants determined the workings of their discipline, defining which methods, objects, or practices were to be considered. Importantly, the congresses enabled scholars to decide on the standardisation of these disciplinary methods and practices. Thanks to the international organisation of the congresses, this could be done on an international scale. While scholars had always communicated and visited each other individually, nineteenth-century infrastructure enabled an international gathering of scholars on a larger scale than before.

While the organisation of the first international congresses for a particular discipline had a clear purpose in the development of that discipline, these congresses also staged interdisciplinary interactions. Multiple perspectives were discussed at the congress, including those from scholars with backgrounds in different disciplines. This resulted in the sharing of methods and practices—of cognitive goods—between disciplines. At the congress, scholars decided on how these cognitive goods were to be embedded in their discipline. International congresses can thus be considered as communication sites between different disciplines as well as within a particular discipline.[64] They are both a collection of microscopic interactions between scholars as well as offer analysis on a mesoscopic, disciplinary level. This is how international congresses then tie in with the central theme of my dissertation on the tension between interdisciplinary interactions and the creating of disciplinary boundaries.

The scholars assembling at international congresses were diverse, both with respect to nationality and disciplinarity. While they shared interest in the topic of the congress, they often worked or were trained in different disciplines. Indeed, the first international congress of a certain discipline signalled a step in the professionalisation and organisation of a discipline, meaning that not all scholars were trained or worked as professionals in that discipline. The congresses offered an opportunity to assemble and discuss certain issues from various perspectives. At the congress, scholars from different subfields met and exchanged ideas, research and methods.

In my dissertation, the various international congresses provide the opportunity to study empirically how shared practices become part of particular disciplines and

64 James Secord has argued to understand science as a form of communication, see: Secord, J. (2004) "Knowledge in Transit" in: *Isis*, 95(4), pp 654-672.

how this influences the disciplines involved.[65] The congresses provide me with historical sources of interactions between individual scholars through their debates and discussions, but also show how these interactions had an effect on the discipline as a whole. Congresses therefore enable an examination of how microlevel interactions have an effect on the mesolevel. Moreover, congresses illustrate the social factors involved in defining disciplinary boundaries and how this is done in an active manner. I see congresses as sites of disciplinary activity, while they also provide insights into interdisciplinary interactions involving the sharing of practices. From this perspective, the congresses become historical case studies to illustrate the tension between sharing practices and forming boundaries between disciplines.

Observing Disciplines

The case studies in my dissertation show that at times disciplinary activity would not prevail or would be opposed by other members of the discipline. I have studied scholars who were interested in an approach to research best described as "general": these scholars attempted overarching and often abstract research projects. This is the case in Chapter 2 where I look at Quetelet's plans for a project of "observation sciences" (*les sciences d'observation*)[66] which involved the collection of observations from many different observers on a large variety of topics. Quetelet was interested in all kinds of data and he attempted to develop one set of methods to be able to manage and analyse any type of data he received. He wrote instruction manuals and organised congresses in his attempts to agree on a standard set of methods.

65 Only a handful of historical literature treats the phenomenon of international congresses systematically, while there are numerous works and monographs on specific congresses. For more the general literature on congresses see: Feuerhahn, W. & Rabault-Feuerhahn, P. (2010) "Présentation: la science à l'échelle internationale" in: *Revue germanique internationale*, 12, pp 5-15; Fuchs, E. (2002) "The Politics of the Republic of Learning: International Scientific Congresses in Europe, the Pacific Rim, and Latin America" in: E. Fuchs & B. Stuchtey [eds] *Across Cultural Borders: Historiography in Global Perspective*. Rowman & Littlefield, Lanham, pp 205-244; Randeraad, N. (2015) "Triggers of Mobility: International Congresses (1840-1914) and their Visitors" in: *Jahrbuch für Europäische Geschichte*, 16, pp 63-82. A special edition of the journal *Mil neuf cent: Revue d'histoire intellectuelle* was dedicated to international congresses: "Les congrès lieux de l'échange intellectuel 1850-1914", volume 7, 1989.

66 Quetelet, A. (1846) *Lettres à S.A.R. le Duc Régnant de Saxe-Coburg et Gotha, sur la théorie des probabilités, appliquée aux sciences morales et politiques*. M. Hayez, Brussels, p 2.

In Chapter 3, multiple scholars of linguistics attempted a discipline of "general linguistics" which had as a goal to ask general questions about language.[67] These linguists, however, did not quite agree on how to go about this general discipline and I analyse multiple interpretations of this general approach to language in Chapter 3. Both cases show debates on how to form a kind of general discipline.

While Quetelet's observation sciences failed because his colleagues were more interested in specific knowledge about specific objects than in general observations, his methods to analyse data spread far and wide. Yet the scholars were interested in too broad a range of topics and interpretations to be united in one discipline.[68] And while the modern overarching discipline of linguistics remains difficult to position with many various approaches to languages as subdisciplines, the different scholars do call themselves linguists even though they employ a wide variety of methods.

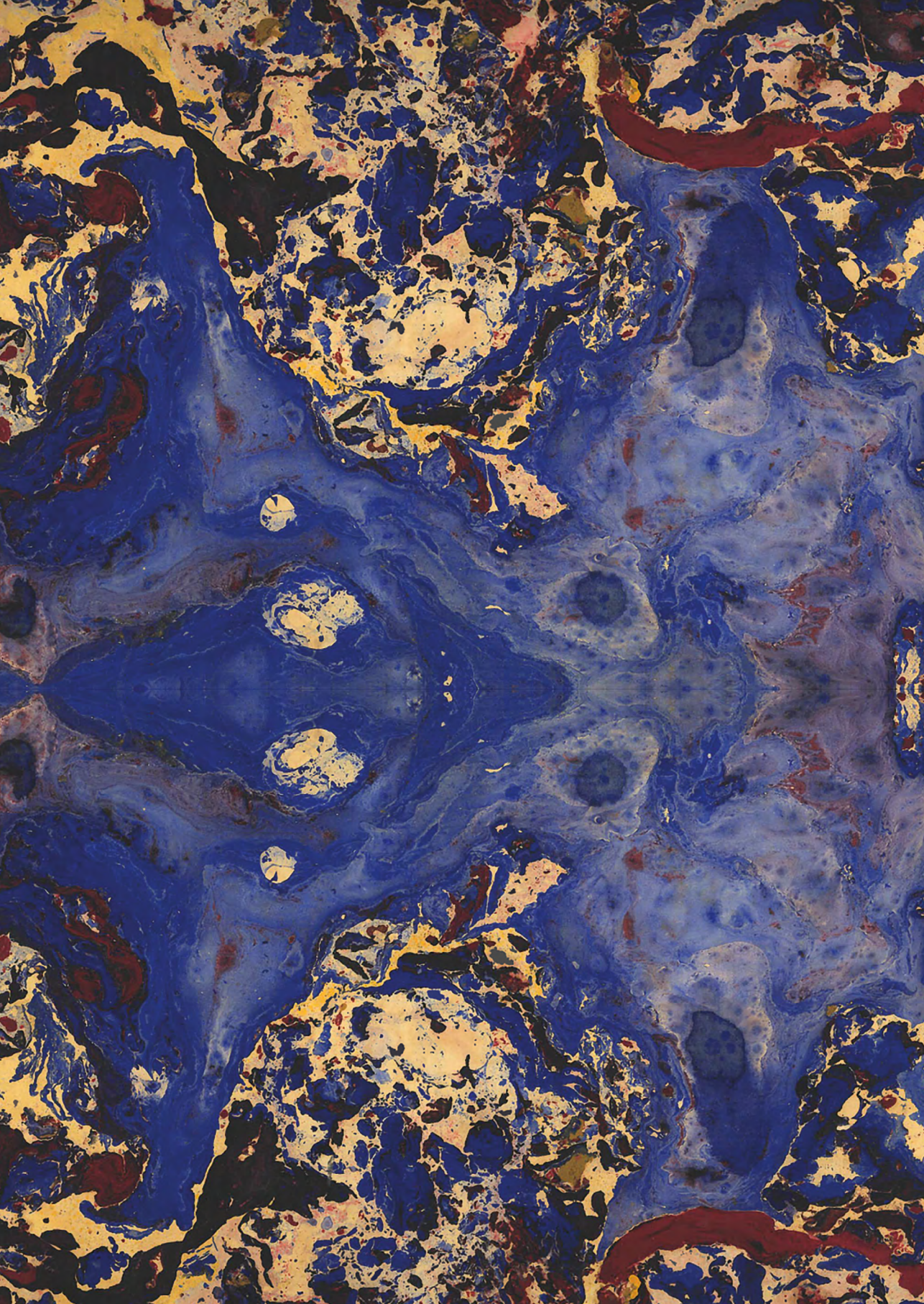
Attempts to create "general" disciplines give insights into what disciplines are and how they are managed: apparently, some balance between specific topics and big questions is required. Moreover, the cases cast a new light on our discussion of discipline formation mentioned above on how hierarchical, method-based epistemic genres were transformed into object-based academic disciplines around the turn of the nineteenth century. In this sense, Quetelet can be seen as old-fashioned, since his new discipline of observation sciences was a method-based discipline. This proposal was eventually rejected, as I show in Chapter 2, because scholars were more interested in information on specific objects. Hence, the distinction between method-based and object-based disciplines becomes clear. In the case of the linguists of Chapter 3 who attempted to structure a discipline around various approaches to the object of language, the unified method was lacking. This makes the method-based or object-based distinction more complex: object-based disciplines also require a clear, agreed-upon method. The research in my dissertation nuances this distinction.

All in all, my research offers a new perspective on how observational practices became fundamental in different disciplines. Because I research both cases using the same historiographical framework of flow of cognitive goods, the combination of the

67 In the invitation letter to the first International Congress of Linguists, the invitees were told that the goal of the congress was to come together for the first time and talk about general linguistic questions. *Actes du Premier Congrès de Linguistes. Tenu à la Haye du 10-15 Avril, 1928* (1930). A.W. Sijthoff, Leiden, p v-vii.

68 This argument is also brought to the fore by Nico Randeraad in his analysis of why the statistical congresses between 1853 and 1876 had failed to produce a clear outcome. Randeraad, N. (2011) "The International Statistical Congress (1853-1876): Knowledge Transfers and their Limits" in: *European History Quarterly*, 41(1), pp 50-65.

two cases can also lead to a comparison between them. A comparison will provide new insights in how processes of both sharing practices as well as creating disciplinary boundaries took place and influenced one another. This can tell us more about how disciplines work in practice, about discipline formation, and about the work to maintain and consolidate their boundaries. With the two case studies, this dissertation provides an in-depth perspective on disciplinary dynamics in the nineteenth and early twentieth century. I show how the age of discipline formation was also an age of connections and interactions between disciplines. Besides, the sharing of practices to deal with data from observations resulted in divisions between groups of scholars. The tension between interdisciplinary sharing and creating disciplinary boundaries is the central theme of my dissertation, which I will be observing in the following chapters.



Chapter 2

Statistics and Botany

2.1 Introduction

At the first International Congress of Horticulture and Botany, held in Brussels in 1864, the French botanist Jules Émile Planchon (1823-1888) delivered a talk entitled "On the abuse of thermometric averages as an expression of temperature in relation to vegetation."[69] Planchon concluded his speech by enjoining his audience to "use the thermometer as an indispensable aid; but let us not enthrone in our gentle [*aimable*] science *the methods of calculation that are the pride of astronomy and physics*. Let us ask the plants: they will be able to answer us in a language that is less harsh and more accurate."[70]

For Planchon, it was necessary to draw a clear distinction between the methods used in the study of physics and those used in the study of plants. Botanists, he held, should observe plants directly and collect data from these observations, rather than through methodologies of calculation. In fact, Planchon argued for the preservation of traditional botany, with its foundation in physiology, to study the domain of life, "whose root cause is hidden, but whose external phenomena command our eternal admiration."[71]

Planchon's speech, however, raises some questions. Why, for example, did he feel the need to emphasise the difference between a botanical method and one which

69 Planchon, J.E. (1864) "De l'abus des moyennes thermométriques comme expression de la température dans ses rapports avec la végétation" in: *Bulletin du Congrès International d'Horticulture qui a été réuni à Bruxelles, les 24, 25 et 26 avril 1864, sous les auspices de la Fédération des Sociétés d'Horticulture de Belgique, en coïncidence avec l'exposition universelle d'horticulture, organisée par la société royale de flore*. C. Annoot-Braeckman, Ghent, pp 70-72. Four years after the congress, Planchon became famous for saving the French wine production from an exotic species of pest. For more on this history of Planchon see Campbell, C. (2006) *The Botanist and the Vintner: How Wine Was Saved for the World*, Algonquin Books.

70 Planchon (1864), p 72. "Botanistes, horticultures, servons-nous du thermomètre comme d'un auxiliaire indispensable; mais gardons-nous d'introniser dans notre aimable science les méthodes de calcul qui font le juste orgueil de l'astronomie et de la physique. Interrogeons les plantes: elles sauront nous répondre dans un langage moins aride et plus exact." (my translation and italics)

71 Idem, p 72. "Des physiciens ont montré, dans ces derniers temps, la prétention d'apprendre aux botanistes les règles de la méthode expérimentale. Repoussons ces conseils superbes dans ce qu'ils ont de dédaigneux et d'injuste. A côté de la physique végétale, dont l'école matérialiste voudrait faire l'équivalent de la botanique toute entière, conservons notre bonne et chère botanique traditionnelle, où la physiologie, de plus en plus éclairée par les sciences physiques, reste néanmoins maitresse de son vrai domaine, celui de la vie, dont la cause profonde se dérobe, mais dont les phénomènes extérieurs commandent notre éternelle admiration." (my paraphrasing and translation)

would more properly pertain to physics? What did he mean by the methods of calculation that come from the domains of physics and astronomy? How could such methods be of use to botanical research in the first place?

A related topic was discussed during the same congress, some sessions after Planchon's own contribution. Karl Fritsch (1812-1879), a congress member from Vienna, gave a talk on "the dynamics of plants and the periodical phenomena of vegetation, the influence of temperature on the germination, foliage, flowering, and fruiting of-plants, and flowerings that are either early (forced) or untimely (upwelling etc.)."[72] Here, Fritsch gave an explanation of the observations that he had been doing at the Central Institute for Meteorology and Geomagnetism in Vienna, in which he had followed the instructions of the Belgian astronomer and statistician Adolphe Quetelet (1796-1874).[73] These were methods that had been the topic of discussion at the third International Statistical Congress in Vienna, in 1857, and Fritsch's argument was that the combination of such statistical methods with botanical research would prove highly fruitful.

Statistical methods in the nineteenth century frequently differed depending on the context in which they were used.[74] For Fritsch, the statistical method involved the calculation of averages and deviations from these averages, and originated in the discipline of astronomy. There was, however, another trend among statisticians, which did not involve calculations or numbers at all, but which saw statistics as a descriptive science. Over the course of the nineteenth century, these differences in interpretation gave rise to a varied set of statistical methods.

The contradictory presentations given by Planchon and Fritsch at the Botanical Congress serve to illustrate the tension that existed within the discipline of botany between sharing and dividing: while some botanists were keen to make use of methods from different fields, others sought to consolidate their discipline's boundaries.

Generally speaking, statistical methods are employed to interpret and analyse

72 *Bulletin du Congrès International d'Horticulture* (1864), p 113. For more on the botanical congresses see: Stafleu, F.A. (1969) "A Century of Botanical Congresses" in: R.C. Starr [ed.] *XI International Botanical Congress, University of Washington, Seattle, USA, August 24 – September 2, 1969. Proceedings.* XI International Botanical Congress, Inc., Washington, pp. 9-21.

73 Fritsch, K. (1864) "De la dynamique des végétaux et des phénomènes périodiques de la végétation. Influence de la température sur la germination, la feuillaison, la floraison et la fructification des végétaux. Des floraisons anticipées (forcées) et intempestives (remontantes et autres)" in: *Bulletin du Congrès International d'Horticulture*, pp 113-117, p 117.

74 Porter, T.M. (1986) *The Rise of Statistical Thinking* 1820-1900. Princeton University Press, Princeton.

data so that they can be used in specific research. Data collected from observations, whether in the form of measurements of an object of study, surveys distributed amongst participants, or any other means of data collection, can be subjected to analysis and interpretation through statistical methods. I thus consider statistical methods to be data practices that enable the analysis and interpretation of data.

As discussed in Chapter 1, data practices can be a part of observation practices. For example, a researcher may use certain instruments, tools, or techniques to both observe a given object and produce a record of their observations. These records are then used within the research as data, having undergone various practices of collecting, ordering, and managing, as well as analysis and interpretation. It is at the analysis stage that statistical methods are employed, once the data has been collected, though the choice of how such methods are used and the rules which the data need to satisfy depend on the research context.

Quetelet's Statistical Methods and Botanical Research

This chapter discusses statistical methods as they came to be embedded in botany during the nineteenth century. The botanical use of these methods was brought to bear on data from a range of observations involving plants and their development, as well as external factors that were believed to influence this. These methods were shared between disciplines, and in terms of flow of cognitive goods, I consider statistical methods to flow between different disciplinary contexts.

Data practices, including statistical methods, were shared between disciplines while the disciplines themselves became increasingly distinct from one another over the course of the nineteenth century. This caused tensions between processes of sharing on the one hand and of discipline formation on the other. As explained in Chapter 1, the present work examines precisely this tension. I study how these data practices came to be adopted by and within different disciplines, and how they were changed in the process.

This chapter investigates how the field of botany came to use the statistical methods developed by Adolphe Quetelet. In addition to providing an explanation of how these methods changed during this process, however, I also consider the extent to which their inclusion was influenced by or had an influence on the formation of botany as a discipline. This involves looking at how statistical methods as data practices became embedded and were developed within different disciplines, and this chapter will illustrate these dynamics through an examination of the work of Quetelet, arguably one of the most well connected scientists of the nineteenth century.

Quetelet was trained as an astronomer, and attempted to use the statistical

methods that he had learnt in astronomy as data practices to undertake multiple and various observations, ranging from a soldier's arm span to annual rainfall, and from the flowering of lilies to national suicide rates. Quetelet discovered certain statistical regularities in the data that he used averages to analyse, consequently calculating these averages over periodic intervals. The averages demonstrated regularities over these intervals, and to Quetelet these were statistical laws.

In his view, it was necessary to collect a large amount of data in order to understand these laws, and Quetelet proposed the creation of a new discipline for this purpose, to be called social physics. While Quetelet's work covered many different fields of research, he is perhaps most famous for his influence on social and human statistics, and this is how he is often described in the academic literature: as "the one-man band of nineteenth-century statistics."[75] Yet, as I show in this chapter, Quetelet worked on the observation of periodical phenomena in all areas and realms, and believed in the application of the same method for any observation, whether natural or social.

An example of how Quetelet's approach was put into practice is to be found in the work of his former student and colleague, the Belgian botanist Charles Morren (1807-1858). Morren helped Quetelet with his data collection, but also criticised Quetelet's approach to periodical phenomena. Morren, having started out as an observer of many different phenomena, eventually turned to the field of botany, and as a botanist he believed that Quetelet's approach required a change in focus in order for his statistical methods to be of use to botanical research and include more plant-related measurements and data. As we shall see, this particular case shows how Quetelet's practices were transferred and recontextualised according to the disciplinary context: Morren had specific aims and projects for which Quetelet's broader programme was unsuitable without modification. This case also demonstrates the tension that sharing methods between disciplines, and having to determine a project of research within one discipline, can produce.

There are many cases such as that of Morren, as Quetelet had an influence on a

75 Desrosières, A. (1998) *The Politics of Large Numbers. A History of Statistical Reasoning*. Translated by C. Naish, Harvard University Press, Cambridge, p 74. Other authors also pinpoint Quetelet as a pivotal figure in nineteenth-century statistics, see for example: Porter (1986), p 7; Schweber, L. (2006) *Disciplining Statistics: Demography and Vital Statistics in France and England, 1830-1885*. Duke University Press, Durham, p 172; Donnelly, K. (2015) *Adolphe Quetelet, Social Physics, and the Average Men of Science, 1796-1874*. University of Pittsburgh Press, Pittsburgh, p 7; Prévost, J.G. & Beaud, J.P. (2012) *Statistics, Public Debate and the State, 1800-1945*. Studies for the International Society for Cultural History, Number 1, Pickering & Chatto, London, p 49.

significant array of disciplines. This broad influence stems from the latter's efforts to establish international projects for the collection of observations which, in order to be successful, needed to be comparable. The organisation of a network of observers thus involved agreements and standardisation concerning how to collect and analyse data. To this end, Quetelet published his *Instructions for the Observation of Periodical Phenomena* in 1842.[76]

Besides textual instructions, Quetelet also organised a series of international congresses to allow observers to meet, discuss their work, and agree on standards. In the span of a decade, Quetelet was involved in international meteorological (1853), statistical (1853), and botanical (1864) congresses. As I claim in this dissertation, international congresses played a major role in setting disciplinary boundaries: scientists could come together to produce uniform methodologies and establish the authorities in their field. Not only did these congresses provide meeting places, however, they also functioned as a platform for the international dissemination of knowledge, and this resulted, for example, in the establishment of scholarly organisations in countries where they did not yet exist.[77] Quetelet sought to use the congresses as a means to create an international community of observers who were to employ the same set of data practices through their use of statistical methods.

Quetelet's work in this regard fits my definition of disciplinary activity as seen in Chapter 1, where I used it to describe how scholars actively consolidate the boundaries of their discipline. As will become clear in this chapter, Quetelet's attempt to forge a discipline involving observations of a wide variety of different phenomena did not succeed. From Quetelet's work and its eventual failure, however, we can learn a great deal about the nature of disciplines and the multifaceted process of discipline formation.

Through a discussion of the case of Quetelet, I will begin to answer my research questions from Chapter 1. I want to better understand how comparable practices become part of different disciplines, and how these practices and disciplines are themselves changed in the process. In this chapter, I look specifically at statistical methods as data practices, and section 2.2 discusses the history of these statistical methods in the nineteenth century. Special attention will be paid to Quetelet's important role in this history. Section 2.3 gives a historical overview of the use of data practices within

76 Quetelet, A. (1842) *Instructions pour l'observation des phénomènes périodiques*. Académie Royale de Bruxelles, Brussels.

77 Heilbron, J., Guilhot, N. & Jeanpierre, L. (2008) "Toward a Transnational History of the Social Sciences" in: *Journal of the History of the Behavioural Sciences*, 44(2), pp 146-160, p 148.

the discipline of botany, and examines how Quetelet's statistical methods were taken up by the discipline. The case of Morren is key in showing the tension that lies between sharing data practices on the one hand, and establishing disciplinary boundaries on the other, which is the topic of section 2.4. Section 2.5 takes a look specifically at the development of disciplinary boundaries within both botany and statistics. The concluding section 2.6 then considers what this case can tell us about data practices and disciplines, as well as how to study them.

2.2 Statistical Methods as Data Practices

This section focuses on the use of statistical methods as data practices. I show how these methods were developed in multiple disciplines and for various purposes. In order to understand this development, I first discuss how nineteenth-century scholars increasingly sought regularities in numerical observations, and what this meant for the field of statistics. While the rise of quantitative research was a broader development, I will mainly focus on the French case: French academics embraced the use of quantitative data in their research and this approach spread widely to multiple disciplines. I place the Belgian astronomer and statistician Adolphe Quetelet within this context. This section will help us to gain an understanding of how such data practices changed and developed as part of different disciplines.

Searching for Regularities

The emphasis on regularity and correlation in numerical observations stems from the natural sciences, and primarily from astronomy. The history of the 'method of least squares' is illustrative here. This is a standard approach in statistics to finding the best fit for a data set to a linear equation. The method involves calculus and linear algebra, and was first transcribed in full by French mathematician Adrien-Marie Legendre (1752-1833), in an appendix to his 1805 work *Nouvelles méthodes pour la détermination des orbites des comètes*.[78] The method became an important tool in astronomy and geodesy, because it was based on the easy-to-understand notion of best fit.[79]

The method of least squares was employed to analyse different data sets, like for example those created using data from state censuses. The belief that methods from

78 The appendix was entitled "Sur la Méthode des moindres quarrés", pages 72-80.

79 Stigler, S.M. (1986) *The History of Statistics: The Measurement of Uncertainty before 1900*. Harvard University Press, Cambridge, p 40.

astronomy could be used in the social and political domain was already widespread in the first decades of the nineteenth century. Indeed, the French mathematician and astronomer Pierre-Simon Laplace (1749-1827) called for the application "to the political and moral sciences the method founded upon observation and upon calculus, the method that has served us so well in the natural sciences."[80] Laplace aimed to broaden the reach of methods taken from the natural sciences towards the political and moral sciences, as an attempt to bring order to the increasingly chaotic world around him.

For the same methods to be applicable across such multifarious kinds of data, however, the data in question needed to be graspable in similar ways. This could only be possible when the data were extracted using similar types of observation, and managed according to shared standards. The researchers would therefore need to agree on the required accuracy of their measurements, as well as on common expressions of uncertainty in their values.[81] For astronomy, such a set of agreements was already in place, but for other fields, especially the political and moral sciences, this posed a challenge.

Throughout the nineteenth century, statistical methods were developed in such a way as to make their application to several types of data possible. This made statistical methods useful for a great many kinds of research. Jason Hansen has recognised the shared importance of statistical methods for multiple fields of study in the nineteenth century, such as the subject of his study, cartography, writing that "If statistics

80 Porter, T.M. 1994) "From Quetelet to Maxwell: Social Statistics and the Origins of Statistical Physics" in: I.B. Cohen [ed.] *The Natural Sciences and the Social Sciences: Some Critical and Historical Perspectives*. Boston Studies in the Philosophy of Science, volume 150, Springer, Dordrecht, pp 345-362, p 345.

81 Stigler (1986), p 1.

represented a powerful tool of analysis, it was equally valuable for the wide range of its applicability."[82]

Nevertheless, the analysis of different objects of research resulted in different interpretations, even when the same methods were used. To return to the method of least squares as an illustration of this, it becomes clear that the object of measurement does indeed have an impact on the kind of data analysis and interpretation available. The method of least squares was developed for the observation of stable patterns, such as planetary orbits or comets, and it originally dealt with errors, in the sense of values that did not correspond with a calculated or predicted value. These could, for example, emerge during the measurement phase, or as a consequence of the natural phenomenon under study. The method of least squares could then be used to compensate for these errors by calculating the best fit for the data.

In meteorology and botany, the method was applied to variations and deviations from a supposedly normal–or mean–value, and errors were not accounted for.[83] Any deviations were the result of natural causes, unknown to the observers. In these cases, the phenomena measured were recurring natural phenomena such as rainfall, and the value considered normal was calculated by finding the mean over a certain period of time. In social statistics, however, the method was applied differently, to compare data on social phenomena such as rates of suicide or murder. The method of least squares helped researchers to find a regular pattern in these phenomena. According to nineteenth-century statisticians, the regularities that they found were the statistical laws that could explain the workings of a society. I will return to this point in more detail in the following section. What is important to note here is that statistical methods could be applied to many different kinds of data, and that the implications of their use could differ.

The process of reinterpreting the methods in different fields played an important role in the development of the methods themselves. As Theodore M. Porter has claimed, "Only through their successful application to the refractory but rich problems of the social and biological sciences did the probabilistic techniques of error

82 Hansen, J.D. (2015) *Mapping the Germans: Statistical Science, Cartography, & the Visualization of the German Nation, 1848-1914*. Oxford University Press, Oxford, p 22.

83 Boumans, M. (2015) *Science Outside the Laboratory: Measurement in Field Science and Economics*. Oxford University Press, Oxford, p 68-69.

analysis grow into the powerful and flexible method of analysis that we know as mathematical statistics."[84] The development of statistical methods thus occurred in many different fields of research, and this multidisciplinary nature is precisely what made these methods so powerful.

What was Statistics in the Nineteenth Century?

In the nineteenth century, the term statistics could be taken to refer to a wider array of methods than the set of mathematical approaches for which it is known today. Etymologically speaking, the modern word statistics derives from the Prussian *Statistik*, which signified the study and collection of descriptions pertaining to the state. The term is thought to have been first used in this context by Gottfried Achenwall (1719-1772), a professor from Göttingen, in 1749.[85]

Nineteenth-century statistics commonly consisted of qualitative theories and descriptions of states and peoples. Statistics promised powerful tools to study otherwise unobservable social and economic phenomena.[86] Indeed, scholars claimed that it would become "the science of the century," a way to understand–and perhaps even control–the rapidly changing world through the discovery of certain "laws of society."[87] In this sense, statistics was both a science in its own right and an instrument for governance, which aimed to increase the influence–and above all the efficiency–of the state.[88] The goal of many nineteenth-century statisticians was to be able to study certain mass phenomena without first having to familiarise themselves with all of the details that constituted the phenomenon.[89] Every handbook on statistics, however, began with a different definition of the term, and there was no common international framework for the organisation of statistical research.[90]

84 Porter (1986), p 4.

85 Idem, p 23-24.

86 Hansen (2015), p 20.

87 Randeraad, N. (2010) *States and statistics in the nineteenth century. Europe by numbers*. Manchester University Press, Manchester, p 2-3 and idem (2011) "The International Statistical Congress (1853-1876): Knowledge Transfers and their Limits" in: *European History Quarterly*, 41(1), pp 50-65, p 54.

88 Randeraad (2010), p 12; Hansen (2015), p 39; Echterhölter, A. (2016) "Data, Diplomacy, and Liberalism: August Ferdinand Lueder's Critique of German Descriptive Statistics (c. 1810)" in: *Bulletin of the German Historical Institute*, 59, pp 83-102, p 86.

89 Porter (1986), p 6.

90 Randeraad (2010), p 12.

2.2 STATISTICAL METHODS AS DATA PRACTICES

Ida Stamhuis has pointed out that "statistics could mean different things to different people in different periods."[91] She has identified three types of nineteenth-century statistical thinking: descriptive (qualitative) state sciences, quantitative state sciences, and probability theory as a means of analysing quantitative statistical information.[92] The latter, mathematical statistics, developed from the biological study of heredity in the last decades of the nineteenth century, and can be considered the methodological field that today forms the basis of many modern disciplines.[93]

Throughout most of the nineteenth century, however, statistics resembled an arm of bureaucracy more than an expression of academic investigation.[94] Most bureaucratic "statists" followed the Prussian *Statistik*, which focused on qualitative and descriptive historical methods to efficiently manage state affairs. These statists attributed value to descriptions and interpretations instead of numbers.[95] Indeed, this form of bureaucratic statistics was much closer to a collection of historical facts, and in this its connection to other historical disciplines, such as geography, becomes clear.[96]

91 Stamhuis, I.H. (2008a) "Introduction: The Statistical Mind in Modern Society. The Netherlands 1850-1940", I.H. Stamhuis, P.M.M. Klep & J.G.S.J. van Maarseveen [eds] *The Statistical Mind in Modern Society. The Netherlands* 1850-1940. *Volume I: Official Statistics, Social Progress and Modern Enterprise.* Aksant, Amsterdam, pp 11-41, p 12.

92 Stamhuis (2008a), p 13-14.

93 Porter (1986), p xi & 3. Mathematical statistics, which emerged around the end of the nineteenth century was quite different from the work of the bureaucratic statisticians, since they no longer centred on averages but on variances and distributions. Heilbron, J. (1995) *The Rise of Social Theory*. Translated by Sheila Gogol from (1990) *Het ontstaan van de sociologie.* Prometheus, Amsterdam, Polity Press, Cambridge.

94 Porter, T.M. (1995) *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*. Princeton University Press, Princeton, p 16.

95 Sepkoski, D. (2018) "Data in Time: Statistics, Natural History, and the Visualisation of Temporal Data" in: *Historical Studies of the Natural Sciences*, 48(5), pp 581-593, p 589; Stamhuis (2008a), p 13; Donnelly (2015), p 114.

96 Echterhölter (2016), p 84. Prussian census officials adhered to statistics as a 'historical science' longer than anywhere else in Europe. Von Oertzen, C. (2018) "Datafication and Spatial Visualization in Nineteenth-Century Census Statistics" in: *Historical Studies of the Natural Sciences*, 48(5), pp 568-580, p 573.

Statistics was seen no more concerned with the analysis of numerical data than were geography or history, and a strong separation was maintained between statistics and mathematical analysis.[97]

On this point, however, the Prussian approach to state sciences, with its emphasis on description, differed from the approach developed in British state sciences. As early as the seventeenth century, the medical doctor William Petty (1623-1687) had used tables with numbers and partial data to estimate the population of London, and this method meant that he did not need to carry out a complete census, which he thought would be highly complicated. His writings on the topic were published posthumously, under the title *Political Arithmetick* (1690).[98] The tradition of political arithmetic exerted a powerful influence on the quantitative science of statistics, which developed from around 1820 to 1850. The mathematics involved in political arithmetic was rather simple, occupied for the most part with counting and averaging.[99] Those influenced by political arithmetic started to be known as statisticians, and theirs was a mission to count everything around them. This was, after all, the "science of the century": statisticians were convinced that they would be able to attain ever greater precision in their estimations and collections of data.[100]

Adolphe Quetelet

The early nineteenth century thus saw two distinct styles of state science emerge: on the one hand, political arithmetic, which involved the use of partial data and mathematical formulae, and on the other, descriptive statistics, based on comprehensive

97 Porter (1986), p 23-24 & Schweber (2006), p 83. There were exceptions, of course. The successor of Achenwall as chairman of the department of statistics at Göttingen, August Ludwig von Schlözer (1735-1809), did recommend the use of precise figures rather than literary terms, though he did not do this himself. Desrosières (1998), p 19; Bödeker, H.E. (2001) "On the Origins of the 'Statistical Gaze': Modes of Perception, Forms of Knowledge and Ways of Writing in the Early Social Sciences", [translated by W. Clark] in: P. Becker & W. Clark [eds] *Little Tools of Knowledge: Historical Essays on Academic and Bureaucratic Practices.* The University of Michigan Press, Michigan, pp 169-195, p 175; Von Oertzen (2018).

98 Petty, W. (1690) *Political Arithmetick*, London, R. Clavel. See also Stamhuis, I.H. (1989) *'Cijfers en Aequaties' en 'Kennis der Staatskrachten' Statistiek in Nederland in de negentiende eeuw.* Dissertation, VU Amsterdam, Rodopi, Amsterdam, p 36.

99 Porter, T.M. (2003) "Statistics and Statistical Methods" in: T.M. Porter & D. Ross [eds] *The Cambridge History of Science, Volume 7: The Modern Social Sciences.* Cambridge University Press, Cambridge, pp 238-250, p 239.

100 Randeraad (2010), p 34; and idem (2011), p 54.

surveys and headcounts to produce reliable data.[101] A pivotal figure in the development of statistical methods according to most of the academic literature on the history of statistics is Adolphe Quetelet. Porter has spoken of a "major transition" that occurred as a result of Quetelet's work: "Quetelet was almost unique in the early nineteenth century in combining the characteristic concerns of the statistical movement with the technical tools of astronomers and probabilists."[102] In fact, and consistent with Porter's claim, Quetelet merged these different kinds of statistical inquiry in such a way as to innovate methodologies that were held in high esteem by nineteenth-century scientists and statesmen, and for which they had high hopes.[103] Quetelet proposed a numerical study of different types of data that would be built up from laws taken from the natural sciences, astronomy in particular.[104] This same approach had in fact already been innovated by Laplace in 1814, but no one took it up quite like Quetelet.

Lambert Adolphe Quetelet was born in 1796 in Ghent, which at that time was part of the French Republic. Ghent was regionally important and a leading European industrial city. Quetelet completed his primary and secondary education in Ghent and started to work as a teacher of mathematics in 1813. In 1815, after Napoleon's defeat at Waterloo, the Belgian provinces became part of the United Kingdom of the Netherlands. Nevertheless, Ghent remained one of the largest cities of the Belgian provinces, and played an important role in the industrialisation of the Netherlands. In 1817, King William I opened the university of Ghent. Here, Quetelet was one of the first students to be enrolled, and he obtained his doctorate in the sciences with a thesis on mathematics in 1819, entitled *De quibusdam locis geometricis, necnon de curva focali* ("Of some new properties of the focal distance and some other curves"). He became a professor at the University of Ghent, and taught mathematics at the Athenaeum of Brussels.

Quetelet was admitted to the Académie Royale des Sciences et des Belles-Lettres de Bruxelles in 1820 and started to lobby for an observatory in Brussels the same year. As part of this undertaking, he visited the Paris observatory in 1823. Here, he met not only the director Alexis Bouvard (1767-1843)–the French astronomer who hypothesised the existence of an eighth planet near Uranus–but also the French mathematicians

101 Schweber (2006), p 4.

102 Porter (1986), p 7.

103 Stamhuis (1989), p 56.

104 Porter (1986), p 41-42.

Laplace and Joseph Fourier (1768-1830).[105] Laplace and Fourier were interested in the use of quantification in the form of probability theory in the sciences, including those which studied moral and political subjects. Quetelet's discussions with these thinkers inspired him to study the uses of probability theory in realms other than mathematics or astronomy.

Quetelet had already worked on the uses of quantitative methods in natural historical research at the very start of his career. His professor at the University of Ghent, Franz-Peter Cassel (1784-1821) a German-born botanist who held the chair of natural history, had published a book entitled *Morphonomia Botanica sive Observationes Circa Propotionem et Evolutionem Partium Plantarum* ("Botanical morphology or Observations concerning the proportions and development of parts of plants", 1820). The book is an attempt to combine mathematical formula with botanical observations, such as the shape and growth of leaves, and contains a number of lithographs which were made by Quetelet.[106]

In 1825, Quetelet set up the journal *Correspondance mathématique et physique* along with the French mathematician Jean-Guillaume Garnier (1776-1840), also a professor at Ghent. The *Correspondance* was meant to inform those scholars interested in mathematics and physics of the latest developments within the disciplines, as well as to publish ongoing research. The journal also published results from observations, as well as instructions on how to use observational instruments, and included sections on meteorology and statistics. Eleven volumes were produced, of which the last appeared in 1839. Quetelet's primary interest within the *Correspondance* was the study of periodical phenomena in nature, such as tides, weather, and seasons, with an emphasis on natural regularities. The *Correspondance* was a success: the journal's members sent in large data sets and this convinced Quetelet of the possibility of international collaboration within his science. It also gave him an audience with whom to share–and from whom to receive–a large amount of new data relating to topics other than astronomical and meteorological research, such as the political and moral sciences.[107]

Quetelet wanted to understand the underlying forces and regularities within society, and the effects that these could have on man. To his surprise, Quetelet found

105 Porter, T.M. (2001) "Adolphe Quetelet, een boegbeeld van de wiskunde" in: A. Despy-Meyer, R. Halleux, J. Vandersmissen, & G. Vanpaemel [eds] *Geschiedenis van de wetenschappen in België. 1815-2000*. Deel 1, Dexia, Brussels, pp 90-98, p 91.

106 Cassel, F. (1820) *Morphonomia Botanica sive Observationes Circa Propotionem et Evolutionem Partium Plantarum*. DuMont-Schauberg, Cologne, p viii.

107 Donnelly (2015), p 109.

such regularities in many different types of data, such as crime or suicide rates and birth ratios, as well as in the average height and weight of men. He used the method of least squares to show that all the data followed a normal distribution, and concluded that this implied the existence of "statistical laws." Quetelet established, for example, that there was a relationship between the number of births and deaths and the time of year: these proved to be statistical generalisations of the form , where is the number of births or deaths, the time of year, normalised, and where and represent empirically determined constants.[108]

Quetelet was an extremely versatile scholar. At the beginning of his career he had published poems and operas.[109] He is probably most known for introducing what we now call the Body Mass Index, or Quetelet's Index: the ratio of height over weight squared. His most important and wide-spread work was published in 1835, entitled *Sur l'Homme et le développement de ses facultés ou Essai de physique sociale*, and translated into English in 1842 under the title *A Treatise on Man and the Development of his Faculties*.[110] Throughout his career, he published on social statistics as well as on climate sciences. Later in his life, Quetelet also published two books on the history of Belgian mathematical and physical sciences, based on his collection of laudations which he had written as secretary of the Belgian Royal Academy.[111] Quetelet is considered influential in such diverse modern scientific disciplines as nutrition, criminology, and ociology.[112] Indeed, his renown in many different fields is coherent with Quetelet's own

108 Porter (1986), p 44.

109 Donnelly (2015), p 62: "Despite the large number of poems, operas, comedies, and essays Quetelet wrote, they take up but a small percentage of his writings collected at the Académie royale: an armful of folders among stacks of boxes."

110 Quetelet himself referred to the book as *Physique Sociale* and in later versions reversed the subtitle as main title. Stigler (1986), p 169.

111 Quetelet, A. (1864) *Histoire des sciences mathématiques et physiques chez les Belges*. Brussels, M. Hayez, and (1866) *Sciences mathématiques et physiques chez les Belges, au commencement du 19e siècle*. Brussels, H. Thiryvan Buggenhoudt.

112 Seifret Weigley, E. (1989) "Adolphe Quetelet (1796-1874): Pioneer Anthropometrist" in: *Nutrition Today*, 24(2), pp 12-16; Beirne, P. (1987) "Adolphe Quetelet and the Origins of Positivist Criminology" in: *American Journal of Sociology*, 92(5), pp 1140-1169; Eknoyan, G. (2008) "Adolphe Quetelet (1796-1874)-the average man and the indices of obesity" in: *Nephrology Dialysis Transplantation*, 23, pp 47-51; Faerstein, E. & Winkelstein, W. Jr. (2012) "Adolphe Quetelet: Statistician and More" in: *Epidemiology*, 23(5), pp 762-763; Mosselmans, B. (2005) "Adolphe Quetelet, the average man, and the development of economic methodology" in: *The European Journal of the History of Economic Thought*, 12(4), pp 565-582.

ambition for his work: his aim was to employ the same method to many types of data so as to create a complete picture of man in nature and society. This encompassed all of the social and natural conditions that had an effect on man, combined into one overarching discipline that he called "social physics."

Sur l'Homme: Quetelet's Social Physics

Quetelet opened A *Treatise on Man* with a quote from Laplace: "We should apply the method based on observation and the calculus to the political and moral sciences, the method that has served us so well in the natural sciences."[113] Not only does this succinctly illustrate Quetelet's main aim for the book–that is, the use of observations and calculus in the political and moral sciences–but it also describes the method that Quetelet deemed appropriate for every science that involves observation.

As discussed above, the production of statistics relating to the state in the nineteenth century was primarily a descriptive science. Statisticians applied descriptive forms of argumentation first and foremost, and some were even opposed to the idea that individuals could be represented by numbers, although they did sometimes employ tables that included numerical data. In *Sur l'Homme*, Quetelet put forward a different approach: his ideal was a reshaping of the political and moral sciences following the model of the natural sciences. He called this new discipline social physics, so as to indicate its dependence on the methods and concepts of the physical sciences.[114]

The chaos of recent political revolutions had convinced the liberal-inclined Quetelet that gradual reforms were the proper expression of responsible social instruments.[115] This proved to be an advantage for Quetelet's programme: his anti-revolutionary stance was popular, and encouraged like-minded people from across Europe with similar political inclinations to contact him and engage with his work.[116]

Quetelet had planned to call his programme "social mechanics" as a reference to Laplace's celestial mechanics, but in the end settled for a term that the French

113 From Laplace, P.S. (1814) *Essai philosophique sur les probabilités*. Bachelier, Imprimeur-Libraire de l'École Polytechnique, Du Bureau des Longitudes, etc., Paris: "Appliquons aux sciences politiques et morales la méthode fondée sur l'observation et sur le calcul, méthode qui nous a si bien servi dans les sciences naturelles" (my translation)

114 Porter (1994), p 346.

115 Wils, K. (2005) *De omweg van de wetenschap. Het positivisme en de Belgische en Nederlandse intellectuele cultuur* 1845-1914. Amsterdam University Press, Amsterdam, p 121.

116 Randeraad (2010), p 25.

philosopher Auguste Comte (1798-1857) had introduced. Although Quetelet claimed to be unfamiliar with Comte's work, there were clear similarities at the heart of the two men's projects: both valued knowledge based on natural phenomena, and considered this a sound basis for a study of humans in society.[117] Comte's ideas for social physics, however, did differ a great deal from those of Quetelet, as Comte did not believe in the relevance of statistics as part of the social sciences.[118] Comte had formalised a hierarchy of the sciences according to their methodologies, and this did not recognise the use of numbers or mathematics in the social disciplines. Quetelet, on the contrary, maintained that statistical methods could be appropriate for every science, and modelled his social physics on astronomy.[119] Social physics was to consider all of man's attributes–moral, intellectual, and physical[120]–and to apply natural scientific methods in analysing them.

It has been said that Quetelet's social physics was "an elaborate metaphor":[121] he encouraged the application of methods borrowed from the natural sciences, and used concepts from physics to describe society. Indeed, *Sur l'Homme* reads like a physics book: Quetelet's expressed aim was to look for the forces that have an influence on people in society, and the laws by which these forces work. He considered society to be under the influence of these forces, and found law-like regularities everywhere. This signalled a moral victory for the social physicist: it was mathematics that would bring order to apparent social disorder.[122]

At the heart of these laws was Quetelet's concept of "the average man," or "*l'homme moyen*,"[123] who could be deduced and described from societal and physical statistics.

117 Wils (2005), p 121.

118 It is claimed that Comte eventually disregarded the term in favour of 'sociology' because of Quetelet's interpretation. Porter (1994), p 346-347.

119 Porter (1986), p 41-42; see also Canales, J. (2001) "Exit the frog, enter the human: physiology and experimental psychology in nineteenth-century astronomy" in: *British Journal for the History of Science*, 34, pp 173-197, on the breaking of Comte's disciplinary hierarchy by linking astronomy to the study of man.

120 Cooper, B.P., & Murphy, M.S. (2000) "The Death of the Author at the Birth of Social Science: The Cases of Harriet Martineau and Adolphe Quetelet" in: *Studies in the History and Philosophy of Science*, 31(1), pp 1-36, p 5.

121 Porter (1986), p 41-42.

122 Porter (1994), p 350.

123 Although Quetelet spoke of an average *man* and continuously used the singular masculine noun, Quetelet's work was meant to describe whole communities of average men and women. Stigler (1986), p 170.

Quetelet did not make ontological claims about the average man,[124] and instead explained in *Sur l'Homme*–where the concept first appeared–that he saw that particular unit as "the centre of gravity of society."[125] In physics, the centre of gravity is an imaginary point within a body of matter that is convenient for calculations. If a body is subjected to certain forces, then it will move as though all of its mass were concentrated at the centre of gravity and as if it were being acted upon by a net force equal to the sum of all forces.[126] It follows that one only needs to consider the net forces working on the centre of gravity in order to understand the effect of the totality of the forces on a certain body. Quetelet's analogy thus meant that to understand the net result of all the forces in society, one only had to look at the effects of the forces that were working on the average man.

Quetelet strongly believed that numbers were self-evident: laws would emerge from systematically collected data.[127] He argued that in order to be able to observe patterns in social phenomena and to deduce a clear image of the average man[128], a large amount of observations and data would need to be collected from a great many people, since at that level the effects of social phenomena would be sufficiently pronounced as to be observable in a way similar to physical phenomena.[129] Moreover, by studying the masses, one could rule out the influence of any particular individual. This should be

124 The interpretation of the average man underwent some slight evolutions during Quetelet's career. Whilst in *Sur l'homme* the concept only posed as the centre that might vary to some extent with other values, a decade later Quetelet shifted his attention to the centre itself. The average man could now be considered to be the "type" for the race and was even elevated to a standard of beauty, at which nature aims. Stigler (1986), p 171-172.

125 Quetelet, A. (1835) *Sur l'homme et le développement de ses facultés ou Essai de physique sociale*. Bachelier, Imprimeur-Libraire, Paris, p 21.

126 Young, H.D. & Freedman, R.A. (2008) *University Physics with Modern Physics*. 12th edition, Addison-Wesley, Boston, p 309. Centre of gravity is, assuming a uniform gravitational field, identical to the centre of mass of a body.

127 Randeraad (2011), p 58.

128 This was contrary to Laplace's original approach: Laplace extrapolated from incomplete sets of data. In his first statistical works, Quetelet also applied this approach. In later work, however, when he had more experience with the unpredictability of social data, Quetelet opposed incomplete data sets and became in favour of large, complete surveys and censuses, aiming to collect as many data as possible. Stigler (1986), p 166.

129 Quetelet (1835), p 12.

done, Quetelet instructed, by applying the calculus of probability.[130] He demonstrated how, using the method of the least squares, data could be displayed as a bell curve, which he called the "binomial law," or "possibility curve."[131] According to Quetelet, one should compare the data on people from different countries just like one compares the temperatures of different places.[132] In this sense, Quetelet's work was a call for observations, in line with his work as editor of the *Correspondance*: to find the regularities in society it was necessary to gather a large amount of data.[133]

Quetelet envisioned an international project to collect data and observations on society, which he called "the observation sciences" (*les sciences d'observation*).[134] In his model, the scientific ideal was not that one should have a detailed knowledge of every individual element within a given body, but that one should find uniformities that were created by the mass, from which general principles could be formulated.[135] For this type of science, two fundamental elements were necessary. The first was a familiarity with probability theory so as to ensure accurate measurements and observations. The second was linked to this, and was the need for forms of training that would equip scientists with the skills needed to acquire more data. In this sense, social physics was not a science of discovery: it was a practical science meant to provide data capable of imputing order to a society.[136]

Quetelet's averages implied the existence of stable patterns within society–yearly crime rates seemed to be stable, for example–and this brought forward the possibility of studying society with the assumed rigour of the natural sciences.

130 Idem, p 13. Quetelet used probability to obtain accurate measurements such as the law of large numbers and the convergence of binomial distribution, but he did not use probabilistic theories even though he had studied them. Stigler (1986), p 180-181; Desrosières (1998), p 80.

131 Desrosières (1998), p 75; Donnelly (2015), p 7.

132 Quetelet (1835), p 31: "Cette manière de procéder est analogue à celle que l'on suit en physique pour déterminer les températures des différens [sic] pays et les comparer entre elles ."

133 Donnelly, K. (2014) "The Other Average Man: Science Workers in Quetelet's Belgium" in: *History of Science*, 52(4), pp 401-428, p 414.

134 Quetelet, A. (1846) *Lettres à S.A.R. le Duc Régnant de Saxe-Coburg et Gotha, sur la théorie des probabilités, appliquée aux sciences morales et politiques*. M. Hayez, Brussels, p 2.

135 Porter (1994), p 355.

136 Donnelly (2015), p 115; and idem (2014), p 416.

This was met with international enthusiasm, which led to a new universal language of statistics, and a desire to unify data practices across various countries.[137] Indeed, Quetelet's followers agreed that uniformity in the collection and organisation of data was essential, and his own opinion was that this approach heralded the replacement of the single observer with "active observers spread out across the globe."[138]

Quetelet's epistemology implied that the same methods could be used on many different kinds of object: the resulting averages would display regularities, and he defined these as laws that were as irrefutable as the laws of mechanics.[139] Whilst Quetelet acknowledged that the laws and forces that impacted society were distinct from those observed in astronomy,[140] his analogies between social physics and celestial mechanics were profound and intentional: Quetelet considered them parts of the same whole,[141] that is, that they were both concerned with the observation and study of what he called "periodical phenomena" (*les phénomènes périodiques*). As he put it: "As the earth travels through its annual orbit, a series of phenomena develop on its surface that are regularly brought back to the same order due to the periodic return of the seasons. These phenomena have individually occupied observers throughout history, but we have generally neglected to study them as a whole, and to try to grasp the laws of dependence and correlation that exist between them."[142]

The relationships between natural and social statistics, however, raised questions concerning the application of statistical methods and their limits. These questions were the main topics in the international statistical congresses, but despite this they remained unanswered.[143]

137 Desrosières (1998), p 10; Wils (2005), p 121; Randeraad (2011), p 58.

138 Quoted in Donnelly (2015), p 163. These active observers were to become "the New Argonauts ... [had the] ... era been more poetic".

139 Heilbron (1995), p 172-173.

140 Wils (2005), p 120-1; and Porter (1986), p 44.

141 This sense of analogy was shared by other 'quantitative natural historians' such as John Herschel. Porter (1986), p 233.

142 Quetelet (1842), p 1: "Pendant que la terre parcourt son orbite annuelle, il se développe à sa surface une série de phénomènes que le retour périodique des saisons ramène régulièrement dans le même ordre. Ces phénomènes , pris individuellement, ont occupé les observateurs de tous les temps ; mais on a généralement négligé de les étudier dans leur ensemble, et de chercher à saisir les lois de dépendance et de corrélation qui existent entre eux." (my translation)

143 Randeraad (2010), p 67.

It was Quetelet who had orchestrated these congresses, and I will return to them later on in the chapter.

As we have seen, Quetelet combined social questions with natural scientific methods to create a new field of social physics. He adopted a particular kind of statistical methodology, one which used averages and averaged deviations to tackle many different types of data. Quetelet hoped to discover statistical laws in these data, but to achieve this he needed to collect a large amount on a wide variety of topics. He collaborated with the international network that his journal *Correspondence* afforded him, and he organised international scientific congresses. Now, in the following section, I will turn to one specific discipline from which Quetelet aimed to collect data, and to which he applied his statistical methods in the analysis of that data: botany.

2.3 Data Practices in Botany

This section examines how statistical methods were used as data practices in the botanical study of the relation between temperature and the growth and life of plants, a dynamic that was of interest for various projects of botanical research. I show how botanical research increasingly came to involve statistical methods for the analysis of certain data. I discuss the case of Quetelet's practices in botany in more detail by considering his observations on plants and temperature.

Botanical Research and Statistical Methods

As discussed in the previous section, Quetelet aimed to collect data from several different fields of research, and to analyse these data using statistical methods. This included data extracted from botanical research. Quetelet was not, however, the first to apply statistical or numerical methods to botanical inquiry. What follows is a brief overview of the history of botany as a discipline.[144]

Botany spans multiple fields of research. The histories of the various botanical fields are of course interconnected, yet they are also seen to be distinct endeavours: they are connected through their object of study–plants–but the methods, approaches, and aims of their data collection differ. Each area has a discrete focus, and therefore requires its own forms of data collection.

144 For more elaborate overviews of the discipline see Morton, A.G. (1981) *History of Botanical Science: an account of the development of botany from ancient times to the present day*. Academic Press Limited, London; and Cittadino, E. (2009) "Chapter 13: Botany" in: P.J. Bowler & J.V. Pickstone [eds] (2009) *The Cambridge History of Science*. Cambridge University Press, Cambridge, pp 225-242.

Nineteenth-century botany underwent a number of profound transformations.[145] The early modern term "botanicus" implied any interest in the plant world, regardless of whether the interested party was a medical professional, a naturalist, or an amateur. The more specialised terms of "botanist" and "botany" developed in the late seventeenth century to indicate a specialist in plant taxonomy and nomenclature.[146] The naming, collecting, and ordering of plants and data about plants fell under the rubric of natural history research, and was taught as such at the earliest European universities.[147] The interest in classificatory systems remained into the nineteenth century; indeed, an internationally accepted code of botanical nomenclature was only fixed in 1867. At this time, observation and observational methods were central to botanical research and led to a rise of quantification in the discipline.

In the late eighteenth and early nineteenth centuries, botany enjoyed immense popularity among amateur naturalists: not only did they collect specimens, correspond with each other, and publish their observations, but these naturalists also organised themselves into local and regional societies and even maintained their own periodical publications within these associations.[148] However, by the end of the nineteenth century, this situation had changed drastically. Botany had become more of a specialised and laboratory-oriented discipline, and this made it less accessible to amateurs. Botanists now were primarily middle class professionals, almost exclusively male, situated in university departments, and with access to botanical gardens or agricultural research stations.[149] Whilst amateur interest in botany and natural history remained strong, a

145 Outram, D. (1996) "New spaces in natural history" in: N. Jardine, J.A. Secord, & E.C. Spray [eds] *Cultures of Natural History*. Cambridge University Press, Cambridge, pp 249-265, p 249.

146 Schiebinger, L. & Swan, C. [eds] (2007) *Colonial Botany. Science, Commerce, and Politics in the Early Modern World*. University of Pennsylvania Press, Philadelphia, p 10.

147 Roche, D. (1996) "Natural history in the academies" in: N. Jardine, J.A. Secord, & E.C. Spray [eds] *Cultures of Natural History*. Cambridge University Press, Cambridge, pp 127-144, p 133; Morton (1981), p 120-121.

148 Cittadino (2009), p 225 and Müller-Wille, S. (2017) "Names and Numbers: 'Data' in Classical Natural History" in: *Osiris*, 32, pp 109-128, 112.

149 Cittadino (2009), p 226.

clear divide was created between botanical science and "botanophiles."[150]

The formation of disciplinary boundaries reflected these changes in botanical research. Fields such as anatomy, morphology, and plant physiology began to dominate the discipline. It was in fact the traditional emphasis on taxonomy that had brought about the proliferation of these new fields within botany, and this included various applications of these specialities in the agricultural sciences.[151] The changes in botany also influenced and were influenced by the relationship with other disciplines, such as chemistry and physics, as well as by the newly established discipline of biology.[152] Moreover, botanists increasingly made use of quantitative methods in their analyses of data.

The relationship between botany and statistics has been well established in the literature on the history of science, including Theodore M. Porter's influential work on the important role of hereditary and botanical research for the maturity of statistical methods in the last decades of the nineteenth and early twentieth centuries.[153] The connection can be traced back still further, however.[154] Indeed, this approach to analysing data from botanical observations is to be found throughout the nineteenth century. Different types of data were important for botanical research: data often came from multiple series of observations, and could be both descriptive and numerical.

The use of statistical methods in botany is especially prevalent in the study of the

150 Shteir, A.B. (1997) "Gender and 'Modern' Botany in Victorian England" in: *Osiris*, 12, pp 29-38, p 30-31. On the popular appeal of natural history and botany: Drouin, J. & Bensaude-Vincent, B. (1996) "Nature for the people" in: N. Jardine, J.A. Secord, & E.C. Spray [eds] *Cultures of Natural History*. Cambridge University Press, Cambridge, pp 408-425.

151 Cittadino (2009), p 235-236.

152 Nickelsen, K. (2007) "From Leaves to Molecules: Botany and the Development of Photosynthesis Research" in: *Annals of the History and Philosophy of Biology*, 12, pp 1-40, p 29.

153 Porter (1986).

154 Janet Browne has shown how Darwin applied statistical methods, or 'botanical arithmetic', to his system of natural selection. Browne, J. (1980) "Darwin's Botanical Arithmetic and the Principle of Divergence, 1854-1858" in: *Journal of the History of Biology*, 13(1), pp 53-89. Other connections between mathematics, statistics, and natural history have been made reaching into the twentieth century as well: Kleinman, K. (2019) "Why Edgar Anderson Visited Math Departments: Natural History, Statistics, and Applied Mathematics" in: *Historical Studies in the Natural Sciences*, 49(1), pp 41-69; Hagen, J. (2003) "The Statistical Frame of Mind in Systematic Biology from 'Quantitative Zoology' to 'Biometry'" in: *Journal of the History of Biology*, 36, pp 353-384.

relationship between temperature and plant development. Interest in this relationship came as a result of the increased economic status of plants: certain plants had become valuable commodities in the spice trade, and as such, factors that might affect their growth became an lucrative topic of research. It has been observed that in the early modern period, botanical knowledge, commerce, and state politics formed a "volatile nexus."[155] Naturalists pursued plants either for their own profit or for their king and country, and opportunities arose for naturalists willing to sell their knowledge to imperialist governments.[156] Some travellers were instructed by naturalists at scientific academies to undertake observations on plants in distant countries.[157] The experts, who did not always travel themselves, were interested in the growth of certain plants at certain temperatures, as well as at particular longitudes, latitudes, and altitudes. Their goal was to cultivate the valuable plants themselves in their home countries, and so they sought to reproduce certain climatic conditions, although they were often unsuccessful. This type of research did however lead to the creation of botanical gardens: by the end of the eighteenth century, European botanists had established around 1,600 botanical gardens, which served as their laboratories across the globe.[158] Studies on the optimal conditions–such as temperature–for certain plants thus led to a better understanding of how plants grow.

There is also a long tradition of measuring temperature in medical and natural historical research. The connection between climate, temperature, and plants attained the status of a research programme in the 1730s at the French Academy of Sciences. This development was due to the naturalist and meteorologist René-Antoine Ferchault de Réaumur (1683-1757), who was a member of the Académie Royale des Sciences. From his position in the academy, he managed a small group of observers scattered

155 Schiebinger & Swan (2007), p 2.

156 Idem, p 2; Bleichmar, D. (2011) "The Geography of Observation: Distance and Visibility in Eighteenth-Century Botanical Travel" in: L. Daston & E. Lunbeck [eds] *Histories of Scientific Observation*. The University of Chicago Press, Chicago, pp 373-395, p 378.

157 The academics depended on the observations of travellers and for this purpose devised guidelines of what to observe and how to take notes. These guidelines included questionnaires, which are the topic of the second part of my dissertation. It should be clear that these travellers often gained knowledge with the help of native inhabitants of the countries that they entered. For more on this aspect of the production of botanical knowledge see the edited volume by Schiebinger & Swan (2007).

158 Idem, p 13.

throughout the French colonies who gathered data on extreme temperatures.[159] Réaumur invented an alcohol thermometer that was calibrated according to an octogesimal temperature scale, which defined the freezing point of water to be 0 degrees, and its boiling point to be 80 degrees. This scale was taken up by various meteorologists and botanists, especially in France, Germany, and Russia, over the course of the nineteenth century.[160]

A Short History of Botany

To give a historical overview of botany, it proves helpful to divide the discipline into four complementary focal points: the study of a plant's external structure, its internal structure, the study of the growth and life of plants, and the study of natural influences on plants.[161] The study of the external structure of plants is also called plant morphology or physiognomy, and the data collected in the context of these studies are mostly descriptions, which can either take the form of text or illustrations. The production and collection of these data have been ongoing for many centuries, always with the goal of identifying certain plants. These identifications may serve a variety of purposes, the medicinal or nutritional importance of certain plants being one example.[162] The main focus throughout the seventeenth and eighteenth centuries, however, was taxonomy: one might characterise the principal strains of botany during these centuries as "a science of naming."[163] Early collections and descriptions were not very systematic, and tended to describe the different parts of a plant, which made comparing descriptions difficult. As such, discussions were held amongst seventeenth-century plant collectors as to what data would be most suitable in distinguishing one kind of plant from

159 Bourguet, M.N. (2007) "Measurable Difference: Botany, Climate, and the Gardener's Thermometer in Eighteenth-Century France" in: L. Schiebinger & C. Swan [eds] *Colonial Botany. Science, Commerce, and Politics in the Early Modern World*. University of Pennsylvania Press, Philadelphia, pp 212-224.

160 Eventually, however, it was proven that the mercury thermometer, invented by the Dutch physicist Daniel Gabriel Fahrenheit (1686-1736), was more reliable.

161 This slightly crude and artificial distinction aids a historical discussion of the wide-ranging field of the plant sciences. I recognise that other divisions can be made and that my overview will never be exhaustive.

162 Cook, H.J. (1996) "Physicians and natural history" in: N. Jardine, J.A. Secord, & E.C. Spray [eds] *Cultures of Natural History*. Cambridge University Press, Cambridge, pp 91-105.

163 Daston, L. (2001) "Scientific Objectivity with and without Words" in: P. Becker & W. Clark [eds] *Little Tools of Knowledge: Historical Essays on Academic and Bureaucratic Practices*. The University of Michigan Press, Michigan, pp 259-284, p 262.

another.[164] As was mentioned previously, an interest in classificatory systems remained well into the nineteenth century, and it was not until 1867 that an accepted international code of botanical nomenclature was established.

Perhaps the most famous figure in classificatory botany is the Swede Carl Linnaeus (1707-1778). Though he began his career in medicine, he was involved in colonial expeditions to explore new species of plants.[165] His system for the classification of plants by number of stamen, the "sexual system," was proposed in his 1753 work *Species Plantarum*,[166] and had the benefit of being transparent and sophisticated, allowing an easy compilation of data on plant species; Linnaean taxonomy made it possible to "turn species and other taxa into objects that could be counted and whose numbers mattered."[167] Using numbers as indices was a long-standing tradition, yet the categories created within Linnaean nomenclature enabled botanists to count the number of specific plants at a given time and place. Hence, the use of numbers, linked to Linnaean categories, gained an additional level of meaning: the ability to accurately count the number of plants belonging to a certain species also meant the ability to share this information with other botanists.

164 Morton (1981), p 125.

165 Koerner, L. (1996) "Carl Linnaeus in his time and place" in: N. Jardine, J.A. Secord, & E.C. Spray [eds] *Cultures of Natural History*. Cambridge University Press, Cambridge, pp 145-162, p 158.

166 Linnaeus, C. (1753) *Species plantarum, exhibentes plantas rite cognitas ad genera relatas, cum differentiis specificis, nominibus trivialibus, synonymis selectis, locis natalibus, secundum systema sexuale digestas*. Laurentius Salvius, Stockholm. For more on (hetero)sexuality assigned to plants see: Schiebinger, L. (1996) "Gender and Natural History" in: N. Jardine, J.A. Secord, and E.C. Spray [eds] *Cultures of Natural History*, Cambridge University Press, pp 163-177.

167 Müller-Wille (2017), p 114-5.

2.3 DATA PRACTICES IN BOTANY

Research into the internal structure of plants consisted of studies of plant anatomy and physiology. This area of research was closely related to advances made in microscopy research. The data collected through microscopy produced textual descriptions of the observations, and illustrations that were mostly rather schematic. Microscopic research into plants also transformed botany into a discipline with a laboratory-focus, a shift that emerged from research taking place in German universities and that gave botany its "greatest status as independent discipline in the last quarter of the nineteenth century."[168] Studying plants through a microscope and in laboratories led to many new insights in the fields of plant anatomy and physiology, not least into theories of plant cells, for example. This investigation into aspects of the internal functioning of plants, then, replaced the traditional focus on classification.[169]

168 Cittadino (2009), p 226.

169 Idem, p 235; Outram (1996), p 249. On plant physiology see: Kutschera, U. & Niklas, K.J. (2018) "Julius Sachs (1868): The father of plant physiology" in: *American Journal of Botany*, 105(4), pp 656-666. Botany's move into the laboratory did more than just shift the focus of research: it implied a process of professionalisation in the discipline. Botanists started to attach less value and authority to observations done by amateurs than by professionals. Gender played an integral role in this process of professionalization. Whereas women had access to botanical research in the eighteenth century and the field of botany was widely gender coded as feminine, the first decades of the nineteenth century saw an inversion of this gendering. Especially in the context of Victorian society, hierarchies of value and authority were created. These hierarchies aimed at distinguishing between "botanist" and "botanophile", creating a "scientific florist" instead of a "general reader". The elite love for flower collections was seen as amusement, particularly for ladies, while botany was meant for men of science. Both audiences were still relevant: women participated in various botanical clubs and societies, holding active roles in the affairs of botanical organisations, and paid dues as members to support botanical activities. While natural history was "one of the favourite topics of popular books and magazines", of many public lectures, exhibitions, and museums, this was not seen as scientific. For more on the role gender and authoritative hierarchies played in the processes of professionalisation see: Shteir (1997); Rudolph, E.D. (1982) "Women in Nineteenth Century American Botany: A Generally Unrecognized Constituency" in: *American Journal of Botany*, 69(8), pp 1346-1355, p 1353-4; Drouin & Bensaude-Vincent (1996).

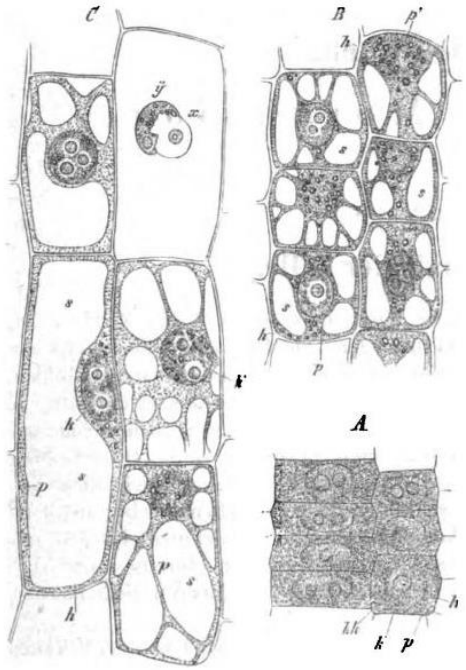


FIGURE 1 With this and similar figures, Julius Sachs illustrated his observations of plant cells. Here he has indicated various parts of the cell, observed at 550 times enlargement. Sachs, J. (1870) Lehrbuch für Botanik nach dem Gegenwärtigen Stand der Wissenschaft, Leipzig, Verlag von Wilhelm Engelmann, p 2.

An influential figure in this development was the German Julius Sachs (1832-1897), whose work is seen as a starting point for plant physiology.[170] Sachs' work is notable particularly for the number of textbooks that he published, which became standard literature for courses on plant physiology (*Handbuch der Experimentalphysiologie der Pflanzen*, 1865) and general botany (*Lehrbuch der Botanik*, first published in 1868). He was an early proponent of a mechanistic view of biological phenomena, as opposed to the then dominant theory of vital forces.[171] Sachs observed the cells of plants, and was one of the first to discuss the activity of chlorophyll bodies in leaves.[172] Figure 1 illustrates the observations with which Sachs explained the various parts of a plant cell in his textbook. This research brought him to test theories of photosynthesis, and this included studying the influence of temperature on plant growth, as Sachs collected data about the impact of different temperatures on sprouting plants.

The study of plants also necessarily involves the study of how plants grow and live, and includes an understanding of plant nutrition and development. This is of particular interest for agricultural research, where the aim is to attain an understanding of the mechanisms of plant growth so as to develop the most efficient practices for

170 Kutschera & Niklas (2018); Nickelsen (2007), p 3.

171 Nickelsen (2007), p 3; Kutschera & Niklas (2018), p 657.

172 Kutschera & Niklas (2018), p 657.

stimulating that growth. To facilitate the collection of this kind of data, agricultural testing stations were established as a counterpart to the botanical gardens in the second half of the nineteenth century,[173] where for example tests on the soil and plant fertilisation could be carried out. This kind of study, then, is closely connected to research into the influence of external factors on the growth and life of plants. Here, systematic numerical observations uncovered relations between plants and their environment.

Linnaeus had already taken an interest in the effect of climatic factors on plants, as can be seen from his 1753 report on an international research project into the budding of leaves of certain trees. This report included the scheme reproduced in Figure 2. Linnaeus noted the observations concerning different moments of budding from certain species of plant taken from 18 sites across Northern Europe. He instructed his observers on all the details of this research: the choice of sites, the phenomenon that was to be recorded, and the method of recording. Linnaeus was interested in data on the moment at which the plant's leaves started to bud; as such, the participants were asked to note the date on which they first observed this. They observed the same tree for three consecutive years.[174] Linnaeus' approach was schematic and does not include a quantitative analysis stage; instead, the numerical data were used as the basis for qualitative descriptions of the observations. This is generally seen as the first systematic international research project into how plant development varies as a result of geographical factors.[175]

Linnaeus' focus was mainly floristic, and prioritised the collection of distributional data for specific plant species. In contrast, similar research into the relationship between temperature and plant growth targeted the distribution of vegetation rather than flora: this was called an ecological focus. Studying the flora of a region takes the level of the individual species of plant as the analytical frame, whereas the study of vegetation requires a focus on the collective phenomenon represented by the

173 Rossiter, M.W. (1975) *The Emergence of Agricultural Science: Justus Liebig and the Americans*. Yale University Press, New Haven; Finlay, M.R. (1988) "The German Agricultural Experiment Stations and the Beginnings of American Agricultural Research" in: *Agricultural History*, 62(2), pp 41-50.

174 Puppi, G. (2007) "Origin and Development of Phenology as a Science" in: *Italian Journal of Agrometeorology*, 3, pp 24-29, p 26.

175 Ibidem.

combination of many species together.[176] A floristic study might give more information about a certain species, while a study of a region's vegetation will provide more insight into how that region and its climate influence plant growth.[177] Both types of study discuss the relationship between temperature and plant growth, and they both collect data on these topics.

FIGURE 2 The scheme from Linnaeus' report on the budding of leaves at different locations throughout Northern Europe. There are three main columns for the three consecutive years of observation (1750–1752). These years are subdivided into the various locations from which Linnaeus received observations. It would appear that not all of the locations sent him regular data over the three years. The rows indicate the specific plants about which the observers collected data, with the month in Roman numerals and the day written underneath. The last three rows contain data on barley (hordei), the moment of sowing (sementis) and harvesting (messis), and the number of days between these two events (aetas). Linnaeus, C. (1753) Vernatio Arborum, Uppsala, Hojer Reg. Acad. Typogr.

176 As explained in Nicolson, M. (1987) "Alexander von Humboldt, Humboldtian Science and the Origins of the Study of Vegetation" in: *History of Science*, 25, pp 167-194, p 289. See also Egler, F.E. (1942) "Vegetation as an Object of Study" in: *Philosophy of Science*, 9(3), pp 245-260.

177 This distinction is also made in Nordenskjöld, E. (1929) *The History of Biology: A Survey*. Routledge, London, p 560-561.

Humboldtian Science

The distinction between studies of floristic and vegetation distribution was introduced by the Prussian Alexander von Humboldt (1769-1859). Humboldt was a proponent of systematically collecting and observing wide-ranging phenomena as a way to understand the "physics of the earth." In his view, all of the various phenomena and processes that affect the earth were to be studied as a coherent whole, and as the historian Susan Faye Cannon has pointed out, many nineteenth-century scientists were actively engaged with this programme, as laid out in Humboldt's work.[178] To describe this trend, Cannon coined the term "Humboldtian science," which she defines as a science that "includes astronomy and the physics of the earth and the biology of the earth all viewed from a geographical standpoint, with the goal of discovering quantitative mathematical connections and interrelationships–'laws', if you prefer, although they may be charts or graphs."[179]

Just such a Humboldtian chart can be found folded into Humboldt's *Essai sur la géographie des plantes*. This essay described research into the landscape of the Andes mountain range, and included a diagram entitled "Tableau physique des Andes et pays voisins" (Figure 3). The diagram–which combines a map and a table of data–condenses a wide variety of physical, meteorological, botanical, and geological data collected by Humboldt, and serves as an elaborate description of the environment. What is produced is a detailed impression of the region, as Humboldt attempted to synthesise a complete diagrammatic description. In the Tableau, a total view of both the mountain and its environment is presented, as is a separation of the mountain into its higher and lower regions. These separations include various types of vegetation, which are grouped using a different classification to the Linnaean taxonomy. Humboldt himself commented on this different approach that "The systematising botanist (...) separates into different groups many plants that the student of the physiognomy of nature is compelled to associate together."[180] According to Humboldt, the traditional botanist only engaged with a small part of their science when they focused on the growth of

178 Cannon, S.F. (1978) *Science in Culture: The Early Victorian Period.* History of Science Publications, New York, p 73-4. See also Achbari, A. (2017) *Rulers of the Winds: How academics came to dominate the science of the weather, 1830-1870.* Dissertation, VU Amsterdam, p 11-13 for a more inclusive approach to the term 'Humboldtian science'. Achbari employs the term to not only incorporate multiple modern disciplines and get rid of anachronistic disciplinary boundaries, but also to include non-academic and non-professional actors in her study of how meteorology became a science.

179 Cannon, (1978), p 77.

180 Quoted in Nicolson (1996), p 292.

specific plants, and a more complete picture was to be had when environmental factors were taken into consideration as well.[181]

In the *Essai sur la géographie des plantes*, Humboldt noted the results of other observers' research on vegetation at certain altitudes, which formed the basis for his plant geography. Humboldt did not, however, attempt to combine multiple observations, or to analyse them together. His eventual conclusions were descriptive and presented the data that he had collected to give a complete image of a certain region. While he did connect multiple aspects–such as altitude, atmospheric pressure, temperature, and vegetation–of the Andean region to others, he did not include mathematical analysis to interpret these relations, instead maintaining a purely descriptive approach. This makes sense when considering what we saw in the previous section concerning Prussian statistics around that time. Humboldt had many followers who continued his line of research, which laid the foundations for the field of plant geography and–around the end of the nineteenth century–for the emerging sub-discipline of ecology.[182]

181 Humboldt, A. (1805) *Essai sur la géographie des plantes accompagné d'un tableau physique des régions équinoxiales*. Levrault, Schoell et Compagnie, Paris, p 13. "Les recherches des botanistes sont généralement dirigées vers des objets qui n'embrassent qu'une très-petite partie de leur science."

182 Nicolson (1996), p 304. A twentieth century study of large-scale, international ecological research can be found in the work of Chunglin Kwa: Kwa, C. (1993) "Modeling the Grasslands" in: *Historical Studies in the Physical and Biological Sciences*, 24(1), pp 125-155.

FIGURE 3 Humboldt's graph containing geographical data on equatorial plants, first published in Essai sur la géographie des plantes accompagné d'un tableau physique des régions équinoxiales (1805).

Throughout the nineteenth century, these researchers sought relations between geographical, meteorological, and botanical data, and increasingly included quantitative and statistical analysis in their observational methods. By and large, nineteenth-century botany saw "the development from rather crude and qualitative accounts of biological phenomena to the use of detailed, quantitative models."[183] This enabled a widespread growth of studies into the relationship between temperature and plants, "making use of data analysis methods and (...) increasingly sophisticated numerical models."[184]

As discussed in the previous section, the expansion of statistical methods to analyse observations was a development that occurred across many fields of research with often broad and interconnected histories, and of which the case of botany and botanical observations is only one part. This interconnectedness is also precisely what Adolphe Quetelet had envisioned for his statistical methods: he wanted to be able to use the same methods to analyse data from many different observations.

183 Nickelsen (2007), p 28.

184 Puppi (2007), p 24.

Quetelet's Botanical Observations

Quetelet's use of statistical methods to study the natural world is not discussed as extensively in the secondary literature as his role in the history of social statistics, though it has often been alluded to.[185] Hence, here I will discuss Quetelet's practice of analysing data from observations in the natural sciences more directly. In 1839, Quetelet began his observations of periodical phenomena in plants at the gardens of the Brussels observatory. He was especially interested in the influence of external factors, such as temperature, on the growth of plants.

In his *Letters on Probability Theory*, Quetelet explained his thinking.[186] This publication consisted of 46 letters which he had written to the brothers Ernest (1818-1893) and Albert (1819-1861) von Sachsen-Coburg und Gotha. Ernest and Albert were nephews of the Belgian King Leopold I, and Albert later married the heir to the British throne, Princess Victoria. They were tutored by Quetelet with whom they developed a friendly relationship.[187] Their correspondence was collected and edited for publication in 1846, and the resulting work gives us a clear overview of Quetelet's statistical programme. He explained his ideas on measuring the relationship between plant development and temperature in letter 32 of the correspondence.

Here, Quetelet put forward his ideas on plant observations, as a case study to illustrate the theory that he had described in earlier letters. As an example of botanical observations, Quetelet made a note of when the lilies started to flower in his garden at the observatory in Brussels, and composed the table found in Figure 4. He remarked that in 1839 the lilies were 12 days late, whereas in 1843 they were eight days early, and in trying to explain this 20-day difference he concluded that no cause other than meteorological circumstances could be possible.[188]

Quetelet combined his observations of the flowering of plants with temperature measurements, and based his work on that of the aforementioned René-Antoine Ferchault de Réaumur. Quetelet cited Réaumur as the first to take a sum of the

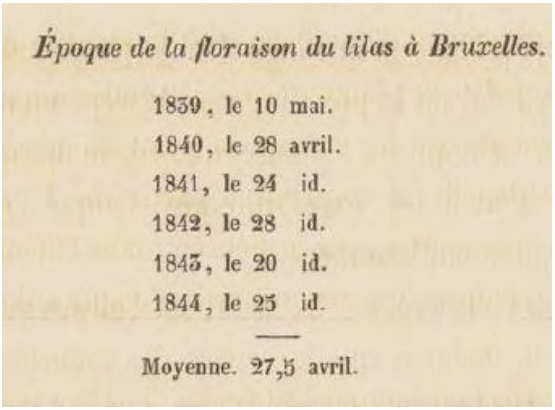
185 Donnelly (2015), p 164.

186 Quetelet, A. (1846) *Lettres à S.A.R. le Duc Régnant de Saxe-Coburg et Gotha, sur la théorie des probabilités, appliquée aux sciences morales et politiques*. M. Hayez, Brussels.

187 Shoen, H.H. (1938) "Prince Albert and the Application of Statistics to Problems of Government" in: *Osiris*, 5, pp 276-318, p 276.

188 Quetelet (1846), p 240.

temperatures measured over a certain period of time and then multiply this sum by a plant-specific constant in order to ascertain the day on which a plant would start to flower.[189] Quetelet, however, was not without objections to this method, feeling for example that Réaumur started his calculation with an arbitrary date. Furthermore, in Réaumur's logic, three days of 8-degree temperatures would be the same as one day of 24 degrees, while in reality the difference between these two scenarios would be hugely consequential for the plants themselves. Quetelet was nevertheless impressed by the formula and decided to test it, though only to conclude that it contained another mistake: the temperatures in the sum should be squared. Quetelet's arrival at this realisation came from viewing temperature as akin to "living forces," whereby the action of such forces follows the sum of their squares.[190]



Époque de la floraison du lilas à Bruxelles.

1839, le 10 mai.
1840, le 28 avril.
1841, le 24 id.
1842, le 28 id.
1843, le 20 id.
1844, le 25 id.

Moyenne. 27,5 avril.

FIGURE 4 Table recording the flowering of lilies in Brussels. Quetelet observed the lilies for six consecutive years (1839-1844) and calculated their average date of flowering: 27,5 April. From Quetelet (1846), p 240.

189 Ibidem.

190 "La force exercée par la température est de la nature des forces vives; c'est par la somme des carrés des degrés, et non par la simple somme des degrés qu 'il faut apprécier son action." Quetelet (1846), p 242-3.

ÉPOQUES.	D'APRÈS LA MÉTHODE DE COTTE.	D'APRÈS LA MÉTHODE DES CARRÉS des TEMPÉRAT.	D'après L'OBSERVAT.
En 1839.	10,5 mai.	9,5 mai.	10 mai.
1840.	4,0 »	2,2 »	28 avril.
1841.	25,5 avril.	25,0 avril.	24 »
1842.	22,5 »	27,3 »	28 »
1843.	19,5 »	19,7 »	20 »
1844.	22,0 »	23.5 »	25 »
MOYENNE. . .	27,0 avril.	27,3 avril.	2,75 avril.

FIGURE 5 With this table, Quetelet proved that his formula, which calculated the date of a plant's flowering with a squared temperature, would give a value closer to that actually observed than Réaumur's method. In the first column are the years for which the dates are calculated and observed. In the second column, Quetelet notes the value that one would expect when using Réaumur's formula (labelled after a follower of Réaumur, the French meteorologist Louis Cotte (1740–1815)), and the third column shows the dates according to Quetelet's formula. In the final column, Quetelet gives the observed date of flowering. The bottom row of the table is the important one: here, Quetelet calculated the average date of flowering according to each method and the observed dates, and concluded that his formula was closer to the observed value. From Quetelet (1846), p 243.

To prove his point, Quetelet had recorded the values from his observations and calculations in a table, shown in Figure 5. In one column, Quetelet listed the dates calculated using Réaumur's method, and next to these are the results as calculated with his version of the formula, where temperatures are squared. Finally, in a third column, Quetelet compared the calculated values with those as they had been observed. He then calculated the averages for each column. Because the average date of the squared method was closer to the average date that Quetelet had found from his actual observations, he concluded that the squared method was more accurate. In this way, Quetelet claimed to have refined Réaumur's formula.

Quetelet's interest did not stop at these simple calculations, however. Indeed, his goal was to observe the relationship between temperature and plant development geographically. He recognised that this meant that he would have to allow for geographical differences, and that there would be more variables to take into account than merely variations in temperature. These difficulties notwithstanding, Quetelet was keen to attempt this project, and here he acknowledged the work of Linnaeus who, as discussed above, had undertaken similar research into the budding of leaves on different trees.[191]

191 Quetelet (1846), p 246.

According to Quetelet, Linnaeus had not been specific enough in his instructions on how one determines the species and variety of plant to be observed, nor on which moment an observer needed to capture: the budding of leaves was not easy to observe and pinpoint to a specific day. As such, Quetelet instructed his observers to record the moment of flowering for a specific list of plants and compared this with his own observations of the same plants in Brussels. He then took the average of the differences between the Brussels observations and those of the observers. With this average, shown in the last column in Figure 6, Quetelet hoped to discern something about the influence of latitude and altitude on plants.[192]

In his *Instructions for the Observation of Periodical Phenomena* which had been published in 1842, Quetelet had given an indication of what he would want to achieve with this kind of research.[193] His desire was to trace synchronous lines around the Earth for the flowering, fruiting, or leafing of plants. For the moment of flowering across different locations, which was the research he had been doing himself, he would draw so-called "isanthesic" lines ("les lignes isanthésiques") across the globe,[194] named accordingly so as to be in tune with Humboldtian isothermal lines–lines that signified the same temperature between different geographical locations. Indeed, Quetelet referred directly to Humboldt's work when discussing his project, and intended to compare his isanthesic lines with the known isotherms.[195]

192 Idem, p 251.

193 Quetelet, A. (1842) *Instructions pour l'observation des phénomènes périodiques*. Académie Royale de Bruxelles, Brussels.

194 Idem, p 2.

195 Idem, p 3.

This, Quetelet hoped, would give new insights into the relationship between temperature and plant growth.[196]

Différence en temps pour la floraison, relativement à Bruxelles.

LOCALITÉS.	Syringa vulgaris.	Sambucus nigra.	Aesculus hippoc.	Philadelphus coronarius.	Digitalis purpurea.	MOYENNE.
Parme	— 9 jours.	— 10 jours.	— 8 jours.	— 11 jours.	— 14 jours.	— 10 jours.
Venise	— 9	— 2	»	— 14	»	— 8
Alais	— 44	— 16	— 16	— 22	»	— 24
Genève	— 2	+ 8	— 5	»	»	0
Paris	— 7	»	»	»	»	— 7
Valognes, Manche.	+ 7	— 4	»	»	— 8	— 2
Liége	+ 1	»	»	+ 3	— 2	0
Gand	+ 3	— 2	+ 1	+ 2	— 5	0
Bruges	+ 6	+ 3	»	»	»	+ 3
Ostende	+ 9	+ 10	+ 9	+ 7	+ 1	+ 7
Envir. de Londres.	+ 8	»	+ 5	»	+ 15	+ 9
Id. de Cambridge.	+ 11	+ 10	+ 11	+ 9	»	+ 10
Vucht, Brab. sept.	»	»	+ 9	— 6	»	+ 2
Utrecht	+ 9	+ 12	+ 8	+ 12	+ 9	+ 10
Lochem, Gueldre	+ 12	»	+ 6	»	»	+ 9
Joppe, Deventer.	+ 10	»	+ 7	»	»	+ 9
Groningue.	+ 14	+ 13	+ 17	+ 19	+ 7	+ 14
Prague	+ 12	+ 11	+ 7	+ 15	»	+ 11
Munich	+ 10	+ 25	+ 15	+ 52	+ 8	+ 18
Jever	+ 26	+ 29	+ 14	»	+ 33	+ 25
Rochester, États-Unis	+ 16	»	+ 17	»	+ 27	+ 20
Époque de la flor. à Bruxelles	28 avril.	22 avril.	1 mai.	19 mai.	4 juin.	

FIGURE 6 This table presents the results from Quetelet's research into the flowering of various plants (given in the columns) at different locations (given in the rows). The entries are the differences in days between the observed flowering at a certain location compared to the "normal" location, which is based on Quetelet's observations in Brussels (the bottom row). Quetelet records the averages of these differences for each location in the final column. Quetelet (1846), p 250.

196 The tables show that Quetelet was predominantly interested in calculating averages. He compared certain observations with what he considered the normal value, namely his observations in Brussels. In the first decades of the nineteenth century, this focus on averages was common among Humboldtian scientists, see Van Lunteren, F. (1998) "De Oprichting van het Koninklijk Nederlands Meteorologisch Instituut: Humboldtiaanse Wetenschap, Internationale Samenwerking en Praktisch Nut" in: *Gewina*, 21, pp 216-243, p 228. A different approach was proposed not long after Quetelet's publications: the Dutch meteorologist Christophorus Henricus Dedericus Buys Ballot (1817-1890) argued for a focus on deviations from a calculated mean. The mean was calculated by looking at observations over a long period of time, up to 10 years of observations. This was possible because Quetelet and his followers had been doing such meticulous observations which could now serve as a foundation for further calculations. The calculated mean was distinct from the 'normal', which Quetelet had chosen to calculate his averages with, namely the observatory in Brussels. Buys Ballot, C. (1850) "On the great importance of deviations from the mean state of the atmosphere for the science of meteorology" in: *Philosophical Magazine Series* 3, 37(247), pp 42-49. Not only did Buys Ballot have epistemological reasons to argue in favour of the collection of deviations instead of averages, a practical reason was that by working with a calculated mean one could cancel out the recurrent error resulting from a particular instrument. Boumans (2015), p 76.

To best study the influence of temperature on plants, Quetelet looked to obtain data from multiple locations. Beginning in 1840, he led an international research project into the collection of data from meteorological and botanical observations.[197] For this, he collected responses from professional observatories as well as from amateurs who had private observatories or appropriate instruments at their disposal. In the next section, I will take a closer look at one of these observers: Quetelet's former student and colleague Charles Morren. By considering Morren's work for Quetelet, I intend to get an idea of how Quetelet's methods were adopted and adapted by and in the work of different scholars.

Moreover, Morren's case shows how this process could lead to friction: Morren inscribed his work firmly within the discipline of botany, which meant that he had ideas about research and methods that differed from Quetelet's. Through this tension, it is possible to examine the disciplinary boundaries of botany, and how certain methods became embedded within it.

2.4 Observing Periodical Phenomena

In the previous two sections I have shown how statistical methods were used as data practices in botanical research, as well as in other disciplines such as astronomy and state sciences. Far from remaining restricted to one specific field, these methods were shared between the different disciplines. Nevertheless, tensions arose within these disciplines between those who advocated this sharing of methods, and others who preferred to define ones of their own. These tensions illustrate the ways in which boundaries between disciplines work to pin down what belongs to a certain discipline, and what does not.

197 Quetelet had taken over this task from the British astronomer John Herschel (1792-1871) who in turn had conducted series of observations on more than sixty locations all over the world. Observers who took part in these observations were instructed to do hourly sets of measurements for 36 hours on the 21st of the months March, June, September, and December. This was, however, too much data for Herschel to handle and the results were disappointing since the observations had been done so far apart. In 1840, Herschel asked Quetelet to become the coordinator of the campaigns and to carry them out on a smaller scale in Belgium and Europe. Locher, F. (2007) "The observatory, the land-based ship and the crusades: earth sciences in European context, 1830-50" in: *British Journal for the History of Science*, 40(4), pp 491-504, p 494; Van Lunteren (1998), p 219. These projects echo Humboldt's projects to create a geomagnetic map of the world. Cawood, J. (1977) "Terrestrial magnetism and the development of international collaboration in the early nineteenth century" in: *Annals of Science*, 34(6), pp 551-587, p 552.

This becomes especially clear when examining the work of Quetelet's former student and later colleague, Charles Morren. Morren began his career as a collector of observations for Quetelet, though he focused on botany and went on to criticise Quetelet's wide-ranging programme, preferring instead more specialised observations. The debate between Morren and Quetelet illustrates the tension between sharing practices and the formation of disciplinary boundaries. More specifically, it also shows how the statistical practices, which were shared between different disciplines such as astronomy and economics, became part of the discipline of botany. Finally, I describe how this case sheds light upon the disciplinary activity that was involved in adapting the methods such as they were embedded within botany.

Quetelet's Observer: Charles Morren as a Follower of Quetelet

Quetelet's programme entailed an international study of periodical phenomena, and produced an array of data that was to be analysed and managed using the same set of methods. This data was collected in different countries by various observers who had received little or no training in how to use the appropriate instruments and record their observations. This opened Quetelet's project to criticism: the observations would never be precise enough to be scientific.[198] Quetelet argued, however, that a large body of observations was more important than exactitude.[199] Averages taken from a large number of observations would be more precise than if one were to work with only a few very specific observations.

One of those supplying Quetelet's data from botanical observations was his former student and later colleague, Charles Morren, who corresponded frequently with Quetelet between 1824 and 1845. During these years, Quetelet was building an international network of observers in order to better understand the nature and

198 Again, a similar point was made against the meteorological observations of Buys Ballot, cf. Van Lunteren (1998), p 231 and Boumans (2015), p 74.

199 Quetelet (1835), p 7.

characteristics of the Belgian climate, and how it compared to others.[200] This culminated in an extensive work entitled *Sur le climat de la Belgique*, published between 1845 and 1857 in seven parts,[201] and mostly comprising tables of data collected from 1833 to 1842. At the very end of the seventh part, Quetelet introduced a number of tables on plants. Indeed, pages 103-113 were on the topic of "Foliage, flowering, fruiting, and falling leaves" and included tables with data for which the observations had been done "in the garden of the Observatory of Brussels, between 1839 and 1852."[202] The plants were listed alphabetically and the data were dates, and from this Quetelet calculated the average dates of a certain plant's flowering, fruiting, or leaf thinning. There are no explanations of or commentaries on these tables, but Quetelet seemed to take for granted that these data should be considered part of the research.

In 1842, Quetelet published the first edition of his *Instructions*, intended to show his correspondents how to carry out observations. It becomes clear from the correspondence between Quetelet and Morren that the *Instructions* had an impact on the work that the latter did for the former. Their correspondence consisted of sharing observations, literature, and research plans. Morren was Quetelet's student while he was at the Athenaeum of Brussels, after which he studied mathematics and natural philosophy at the newly opened University of Ghent. After the Belgian Revolution, Morren was appointed to teach geology, zoology, and anatomy, just before the science faculty at Ghent was closed down. He then became a professor of physics at the industrial

200 These letters are available in the archives of the Royal Academy of Belgium: Archives contemporaines, Papiers Quetelet, Correspondance Générale: lettres reçues et minutes de lettres expédiées, Morren (Charles), further referenced to as *Papiers Quetelet*. More on this episode can also be found in Demarée, G.R. & Chuine, I. (2006) "A Concise History of the Phenological Observations at the Royal Meteorological Institute of Belgium" in: N.R. Dalezios & S. Tzortzios [eds] *HAICTA International Conference on Information Systems in Sustainable Agriculture, Agro-environment and Food Technology (Volos, Greece). Volume 3*. University of Thessaly Press, Volos, pp 815-824; Demarée, G.R. (2009) "The Phenological Observations and Networking of Adolphe Quetelet at the Royal Observatory of Brussels" in: *Italian Journal of Agrometeorology*, 1, pp 22-24; and Demarée, G.R. & Rutishauser, T. (2011) "From 'Periodical Observations' to 'Anthochronology' and 'Phenology': the scientific debate between Adolphe Quetelet and Charles Morren on the origin of the word 'Phenology'" in: *International Journal of Biometeorology*, 55, pp 753-761.

201 The seven parts were: 1) Solar radiation and air and ground temperatures (1845), 2) Direction, intensity, duration and character of the wind (1848), 3) The electricity of the air (1849), 4) Atmospheric pressure and waves (1851), 5) Rains, hails and snow (1852), 6) The hygrometer (1854), 7) The state of the heavens in general (1857).

202 Quetelet, A. (1857) *Sur le Climat de la Belgique. Septième Partie. De l'État du Ciel en Général.* Académie Royale, Brussels, p 103.

school of Ghent, which was an influential institution in an increasingly industrialised Belgium. He returned to a post as professor of botany at the University of Liège in 1835, becoming the chair of agriculture seven years later. At Liège, Morren established a botanical museum and reorganised the botanical garden.

As a follower of Quetelet, Morren can be considered typical. His first observations concerned meteors of which he sent charts to Quetelet in 1826. Some years later, he sent drawings of his microscopy studies of milk, and in 1832 he committed himself to botanical observations. As Figures 7 and 8 show, Morren's observations were mostly descriptive in nature. For the meteors he had a system of symbols to show the object's brightness, and he measured the length of time for which he had observed it. For the direction of the meteor and any other remarks, Morren used textual descriptions.

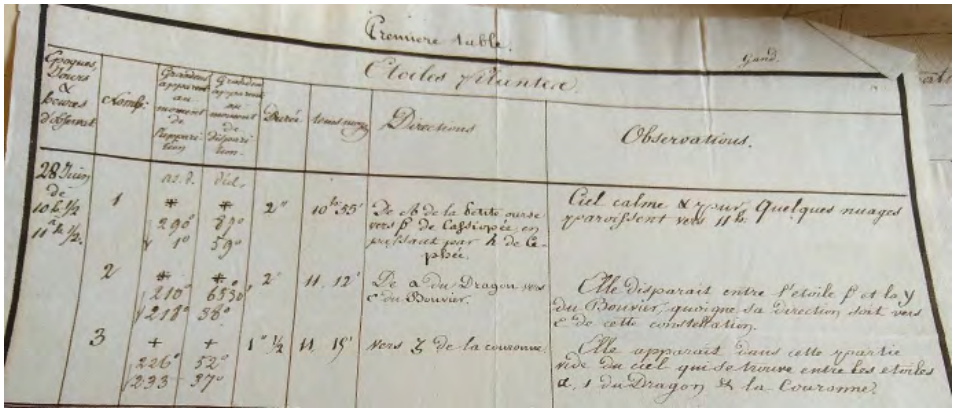


FIGURE 7 Part of the table of observations on meteors sent by Morren to Quetelet on July 17, 1826 (Papiers Quetelet, my photograph). In the columns Morren has noted the date and time of the observation, the meteor's location in the sky when it appeared and disappeared, the duration of its visibility, its direction, and further observations. The last two columns contain descriptive observations where Morren records an impression of the night sky and further specifics.

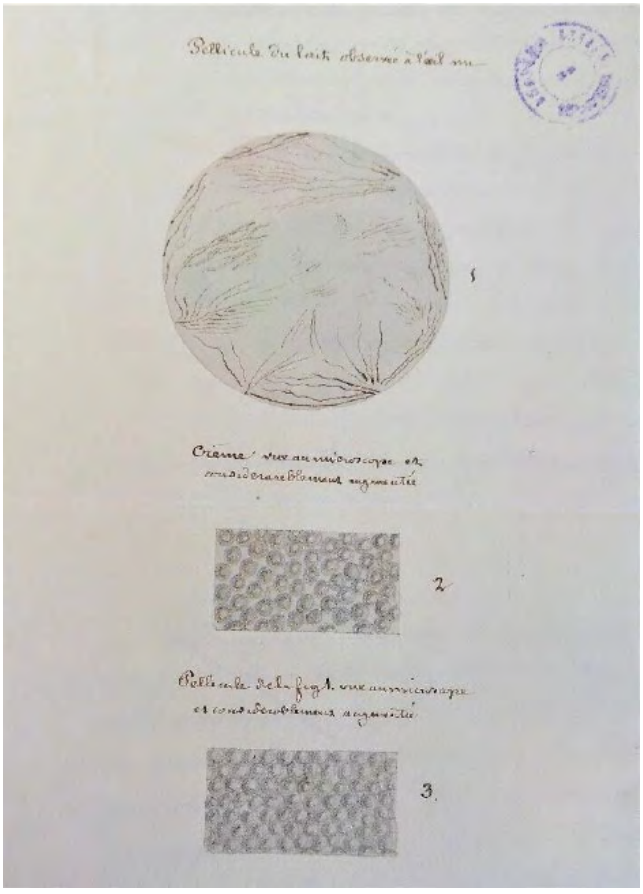
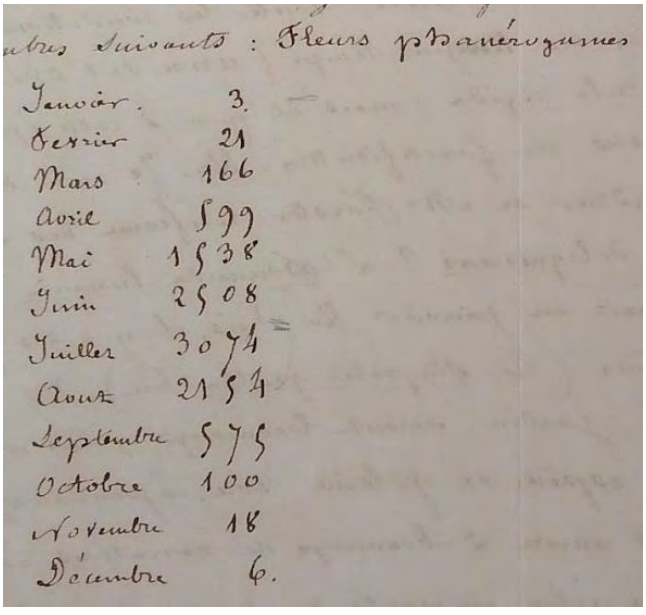


FIGURE 8 Morren's drawings from his microscopy studies of a thin film of boiled milk. He sent these drawings to Quetelet, March 8, 1828 (Papiers Quetelet, my photograph).



Janvier	3.
Février	21
Mars	166
Avril	599
Mai	1538
Juin	2508
Juillet	3074
Août	2154
Septembre	575
Octobre	100
Novembre	18
Décembre	6.

FIGURE 9 In this table, Morren presents the results of his observations of the number of spermatophytes for every month of the year 1841. The results are: January (Janvier) 3; February (Février) 21; March (Mars) 166; April (Avril) 599; May (Mai) 1538; June (Juin) 2508; July (Juillet) 3074; August (Août) 2154; September (Septembre) 575; October (Octobre) 100; November (Novembre) 18; December (Décembre) 6. From Morren to Quetelet, February 10, 1841, Papiers Quetelet (my photograph).

This stands in marked contrast to his observations on plants, which involved much more of his own work and interpretation. For these, he counted the number of plants that were flowering at a particular point in time, and attempted to analyse these numbers. Morren related to Quetelet how he was sent on research trips to other botanical gardens such as those in Florence, London, and Glasgow.[203] He asked Quetelet to share with him certain journals, and wrote articles for Quetelet's journal *Correspondence* himself.

In February 1841, Morren wrote a long letter to Quetelet with which he wanted to add to "all the statistics of our Belgian Flora." Morren had observed "phanerogams," also known as spermatophytes, or plants that produce seeds and hence have visible (φανερός, phanerós) reproductive organs (γαμέω, gameo)[204] as opposed to "cryptogams." Morren ordered his observations into a table that can be found in Figure 9. The data were the numbers of the particular plants that Morren had observed.

Morren then used these data to draw a graph representing the flowering of this type of plant throughout the year. He called this a "continuous flowering curve in temperate Europe," explaining that the curve was produced by calculating the relative proportions of number of flowers for certain months. To complete the curve and make the pattern described there fully legible, Morren applied a best fit to the results (see Figure 10). These interpretative stages demonstrate that Morren shared Quetelet's preference for the application of statistical methods to different types of data.

203 Morren to Quetelet, 20 July 1838, *Papiers Quetelet*.

204 More precisely: 'phanerogams' are plants that marry visibly. See Schiebinger (1996), p 167.

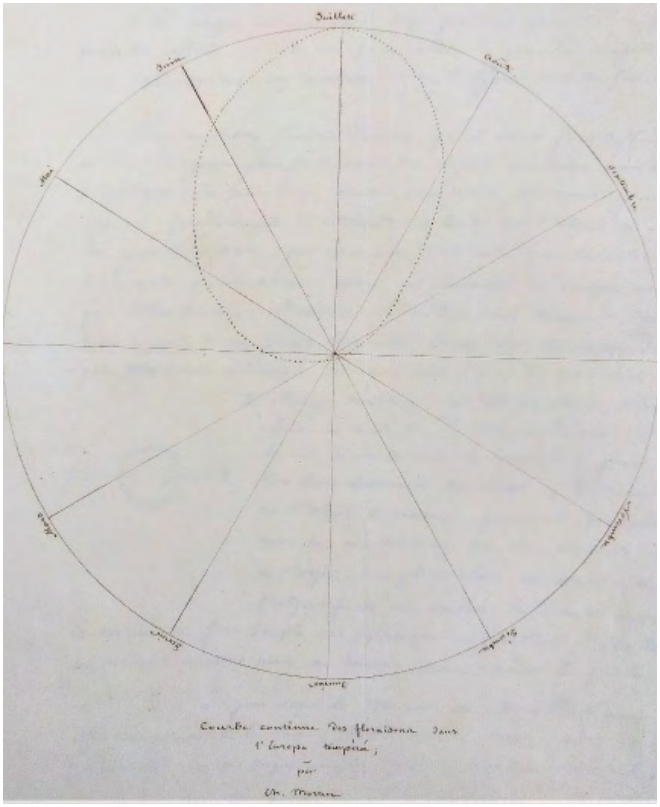


FIGURE 10 Morren produced a diagram from the results presented in Figure 9. He called this a "Courbe continue des floraisons dans l'Europe tempérée." He calculated the proportion of plants observed each month relative to the highest value, which was in June, and equated the circle's radius to the amount of plants observed then. This allowed him to clearly demonstrate the relative proportion of each month as a point reached along the radial lines. This he marked with a dot, which for January gives a dot at 3/3074th of the circle's radius. Finally, all the dots between the months were connected, using a kind of best fit approach. Morren to Quetelet, February 10, 1841, Papiers Quetelet (my photograph).

One final similarity between Morren's work and that of Quetelet is to be found in the book of poems that Morren published. The book was dedicated to the most beautiful part of plants, their flowers, and to the men who study them. Quetelet had also published poems and even operas during the early days of his career, between 1815 and 1823, though these publications only constitute a small part of his total bibliography.[205] Morren's book was called *Fleurs éphémères* (1843), and was divided into five parts: friendship, love, fatherland, science, and God.[206] The fourth part on the theme of science included a poem dedicated to Quetelet's periodical phenomena. It is reproduced below.

205 Donnelly (2015), p 100-101.

206 Morren, C. (1843) *Fleurs éphémères*. Libraire Encyclopédique de Périchon, Brussels.

The Periodical Phenomena[207]

There is in your [Quetelet's] mind a noble and grand system:
The earth and the world and the clear skies,
And the man and the animal and even the flower itself
Must rule their steps on the cycles of the times.

Everything is created, everything is born, everything grows and everything passes;
Nature continues in her revolutions;
And everywhere and always, it is order in space
Who subjects apparitions to his laws.

That the plaintive swallow returns in the spring;
In our cheerful groves where the voices whisper
Of the tender nightingale, the live warbler,
Singers of love, sowing love in the woods;

That in our joyful fields, belt of emerald,
Greens, the meadow or the grass of the trails;
That May blazes the flowers with her warm breath,
And September the fruits that he throws with his hands;

That fly in the scent of the Virgin Mary's [Rosa Mystica],
Mysterious daughters, so full of memories;
That by kissing the flower the butterfly marries
His loving deeds and his ardent desires;

That a flying flame shines on the shoreline,
Towards the bright light of which the child is so afraid!
That a wandering soul is looking for a new Plato
In the midst of the will-o'-the-wisps where the error flies;
That to the stars, which God makes blossom on the earth,
Answer, sisters of azure, the stars of the heaven;
That our globe rotates and its system errs

207 Morren (1843), pp 337-340, my translation.

In the path traced by the radiant sun;

Everywhere, always, your eye sees a huge return,
A vast phenomenon where the order lies entirely;
For you, nothing ends, for you, nothing begins,
Without your hand in time having traced the path.

Interpreter of times, you understand the languages
That the heavens and the suns speak to each other up there.
Say, to us who sail in mute clouds,
Tell us when the day of the great awakenings will sound.

Where do the worlds go? What happens to the men?
What does the calculation say? Does it answer to our wish?
Does he know that down here we are weak humans?
No–the calculation is silent... before the word of God.

And this word is still so rich in hope!
It will in the future provide the balm of happiness.
The science has spoken for a taciturn sky:
But ... that science is that of the Creator.

Your genius bows before its old laws:
Love, science, and faith only make us happy;
And your role is so beautiful, when you give your life
To place on faith the halo of the heavens.

The poem speaks highly of Quetelet and his system. Morren sought Quetelet's permission to publish this version of the poem, and was relieved when permission was granted.[208]

These examples demonstrate that Morren can be considered not only a former student, but a follower and colleague, of Quetelet, whom he kept informed about his research into plants and other observations. Their correspondence came at around the same time as Morren's appointment to the position of professor of botany in Liège in 1835, and that of professor of botany and agricultural studies in 1842, as described above.

During this time, Morren and Quetelet's botanical research was in line with what Quetelet acknowledged to be the Humboldtian tradition: the collection of observations on many different topics that might have an influence upon one another. As seen in the previous section, nineteenth-century botanical research covered a wide variety of topics. Whilst this variety was not as broad as the scope imagined by Quetelet for his sciences of observation, his work did overlap with contemporary botanical research.

From the examples of the correspondence between Charles Morren and Adolphe Quetelet seen thus far, one might deduce that Morren was an avid follower of Quetelet's sciences of observation. After all, Morren did share his observations of plants and other natural phenomena with Quetelet and informed him about his work as a professor of botany. Indeed, it is clear that Morren had a lot of respect for Quetelet's work, visible not least in the poem reproduced above. However, Morren's attitude towards Quetelet's scientific programme was not without a degree of critique. He began to question Quetelet's approach, and the broadness of Quetelet's research. Morren was establishing himself as a botanist, and adhering to the standards of that discipline. Studying the dynamic between the two men will allow me to examine the boundaries of the discipline and how they were formed.

208 Morren to Quetelet, 26 June 1843, *Papiers Quetelet*.

Morren as Botanist

Less than a year after he sent Quetelet his statistics, Morren wrote critically that Quetelet's emphasis on isolated data ran the risk of obscuring a full picture of whatever phenomena were being studied:

As for the reduction of the programme, I am more uneasy than ever. ( ) From the few words you said to me at the Académie, when leaving the meeting, your ideas have changed greatly and I can no longer share your view in this case. By registering the observations as isolated facts, the grand goal is missing, the purpose such as Schübler had conceived it.

Here, Morren refers to the German botanist Gustav Schübler (1787-1834) who had been a professor of botany, natural history, and agricultural chemistry at Tübingen. Though Morren's purpose is unclear,[209] he explains in the next sentence that he had managed in Lyon, Florence, Naples etc. to make the importance of this work visible for physiology by envisaging the phenomenon of periodicity in its general expression. In almost all of my observations of flowering I have also indicated the odours and all of the colours; this has brought me remarkable results. By only observing the flowering of plants and even then, only that of a few flowers that are not precisely determined and that will depend on choices made according to the whim or laziness of the observer, you can be certain that you will have removed from your plan everything that was of use.[210]

Morren's argument is that to observe only a limited set of phenomena would lead to an incomplete understanding of their periodicity. Instead, a more complete view needed to be sought, such as Morren's inclusion in his observations not only of the

209 Perhaps, Morren referred to Schübler because of Morren's chair in agricultural science at Liège. Demarée & Rutishauser (2010), p 758.

210 Morren to Quetelet, 12 January 1842, *Papiers Quetelet*. "Quant à la réduction du programme, je suis plus embarrassé que jamais. J'étais venu à Bruxelles pour vous en parler, mais je n'ai pas pu vous trouver chez vous. D'après le peu de mots que vous m'en avez dit à l'Académie, en sortant de la séance, vos idées sont bien changées et je ne puis plus partager votre manière de voir dans cette affaire. En restreignant les observations à des faits isolés, le grand but est manqué, le but tel que Schübler l'avait conçu. Si j'ai réussi, à Lyon, à Florence, à Naples etc. de faire sentir l'importance de ces travaux pour la physiologie, c'est en envisageant le phénomène de la périodicité dans son expression générale. A presque toute mon observation de floraisons j'avais indiqué les odeurs, à toutes les couleurs ; j'avais là des résultats très remarquables, mais en ne voulant que les floraisons seules et même celles de quelques fleurs que rien de précis ne déterminera et qui seront choisies d'après le caprice ou la paresse de l'observateur, vous pouvez être assuré que vous ôtez de votre conception tout ce qu'elle avait d'utile. Vos chers confrères n'ont pas compris où votre système menait." (my translation)

moment of a plant's flowering but also its scent and colour. Morren had thought that Quetelet was also interested in a complete picture of the phenomena in question, but as we read here, it is evident that he came to doubt this.

Indeed, Quetelet was very specific about which aspects of the periodical phenomena he considered worthy of observation in his *Instructions* of 1842. Having understood Quetelet's *Instructions*, however, Morren claimed that by only observing periodical phenomena, his former teacher was missing important connections between the different phenomena. Quetelet seemed, to Morren at least, to be interested only in collecting as much data as possible on certain specific topics. Moreover, Quetelet was not interested in extending his observations to agricultural plants. Morren, who let us not forget held the position of university chair of agriculture in Liège, hoped for a more complete set of observations of Belgian flora.[211]

To distinguish Quetelet's programme from his own work, Morren coined the term "phenology" in a lecture in 1849. He defined the field as follows: "It is in reality a specific science that has the goal to know the *manifestation of life ruled by time*."[212] Morren had used this phrase in an earlier publication, in which he had written: "The returning phenomena for the plant kingdom constitutes the *manifestation of life ruled by time*. That collection of phenomena has recently been named 'periodical phenomena'. The name seems to us too vague because it is too general."[213] Quetelet, meanwhile, never used Morren's terminology; his programme continued to focus on many different phenomena in multiple fields.

Morren's phenology was adopted as scientific terminology, however, and was not only restricted to plant sciences.[214] The term was briefly taken up by the Meteorological Institute in Vienna, for example, where phenological research was coordinated by Karl Fritsch, mentioned in this chapter's introduction. Fritsch had visited the third International Statistical Congress, which was held in Vienna in 1857, and had presented a report on how meteorological and especially phenological observations

211 Demarée & Rutishauser (2010), p 758.

212 Morren, C. (1849) *Annales de la Société royale d'Agriculture et de Botanique de Gand. Journal d'horticulture et des Sciences accessoires*. Tome V, s.n., Ghent, p 450, quoted by Demarée & Rutishauser (2010), p 758. "C'est en réalité une science particulière, ayant pour but de connaitre la *manifestation de la vie réglée par le temps*" (translated in Demarée & Rutishauser (2010)).

213 Quoted in Demaré & Rutishauser (2010), p 758.

214 Demarée & Rutishauser (2010) list a number of scientists and institutes that took up on the term, p 759.

were connected to developments in human society. This connection was of "statistical importance," and Fritsch argued that "it was now the task of the Congress to establish comparability of these observations."[215]

Some years after the Congress, Fritsch published his own version of Quetelet's *Instructions*: *Instruction für Phänologische Beobachtungen aus dem Pflanzen- und Thierreiche* (1859).[216] In his introduction he made clear that the work was based on Quetelet's research and his own presentation at the Statistical Congress. His hope was for phenological observations done in Austria to be comparable with those performed in other countries. Just like Quetelet's *Instructions* of 1842, the booklet determined which moments of plant development should be observed–flowering and budding first, for example–and included lists of the species of interest to observation. The similarity between Quetelet's approach and Fritsch's was apparent, yet Fritsch called his research "phänologisch." He claimed that "phenology is a science that just as well could belong to meteorology as to botany and zoology."[217]

It seems that Fritsch appropriated both Quetelet's programme and Morren's term, though he was probably unaware of their disagreement. Quetelet's programme was the kind of research that was being called phenological, and not just by Fritsch. In 1884, the German Egon Ihne (1859-1943) published an overview of all the research projects that he considered to be phenological in his *Geschichte der pflanzenphänologis-*

215 Fritsch, K. (1857) "Verhältniss der Statistik zu ihren Hilfswissenschaften aus dem Gebiete der Naturkunde" in: A. Ficker [ed.] *Die Dritte Versammlung des Internationalen Congresses für Statistik zu Wien im September* 1857. Kaiserlich-Königlichen Hof- und Staatsdruckerei, Vienna, pp 129-131, p 130: "Der von Dr. Fritsch über die vorliegende Frage erstattete Bericht erfasste die meteorologischen und speciell die phänologischen Beobachtungen von dem Gesichtspuncte des Zusammenhangs der beobachteten Erscheinungen mit dem Entwicklungsgange der menschlichen Gesellschaft, und vindicirte ihnen nur in diesem Zusammenhange eine statistische Wichtigkeit, der es dann entspreche, dass die Herstellung einer Vergleichbarkeit jener Beobachtungen au den Aufgaben des Congresses gehöre." (my translation)
Fritsch's son, who was also called Karl Fritsch (1864-1934), was a botanist: he was professor of Systematic Botany at the University of Graz from 1900 to his death. Teppner, H., Teppner, E. & Pinter, M. (2015) *Fragmente zur Geschichte der Systematischen Botanik in Graz*. Eigenverlag, Graz, p 54.

216 Fritsch, K. (1859) *Instruction für Phänologische Beobachtungen aus dem Pflanzen- und Thierreiche*. Kaiserlich-Königlichen Hof- und Staatsdruckerei, Vienna.

217 Fritsch (1859), p 11.

chen Beobachtungen in Europa.[218] This overview started with Linnaeus, and contained chapters on many European countries, listing the research programmes that Ihne recognised as phenological. Ihne included Quetelet, and cited Morren as the botanist who coined the term. Ihne explained that although he found the term to be far from perfect philologically speaking, "it soon became generally accepted."[219]

Ihne recognised therefore that whilst the term could give rise to multiple interpretations, phenology had nevertheless been taken up as the term for the programme that Quetelet had advocated. Moreover, it is still practised today: in 2009, a European phenological data platform reported the results of research aimed at making "widespread phenological observations, especially in plants" compatible.[220] The scientists involved with this project argue that phenological data can be used to track climate change. We have seen how Morren was primarily interested in the phenomena of the plant world, while Quetelet was working on an overarching programme. Morren can therefore be seen as a botanist rather than an observer in Quetelet's project of observational sciences. As a former student of Quetelet, Morren started his career with observations that would fit within a "Queteletian" programme, analysing data on various topics related to the natural sciences. We have also seen that Morren's research became more specialised as he focused on botany. While research in phenology could encompass observations from a variety of fields, such as meteorology, Morren considered it to be focused on plants. As someone working within the discipline of botany, Morren joined a body of scholars who agreed that botanical research should be about a wide range of plant phenomena, a specification that goes some way to determining what should and should not be considered relevant to the discipline. This involved the observation of more phenomena in the plant world than Quetelet deemed appropriate, but also excluded things such as social or zoological observations. In this sense, Morren's research was more focused than Quetelet's.

Morren's feeling that Quetelet's "ideas had changed" can now be interpreted in two ways. On the one hand, Quetelet's programme had become more defined and he

218 Ihne, E. (1884) *Geschichte der pflanzenphänologischen Beobachtungen in Europa nebst Verzeichniss der Schriften, in welchen dieselben niedergelegt sind.* Ricker'sche Buchhandlung, Gießen.

219 Idem, p 28: "Obwohl das Wort philologisch nicht sehr richtig gebildet war, bürgerte es sich doch bald allgemein ein." (my translation).

220 Koch, E., Dittmann, E., Lipa, W., Menzel, A., Nekovar, J., Sparks, T.H., & van Vliet, A.J.H. (2009) "COST725: establishing a European phenological data platform for climatological applications: major results" in: *Advances in Science and Research*, 3, pp 119-122, p 119.

had written a clear set of instructions laying out what he envisioned for observational methods. It might well be that Morren had not understood Quetelet's programme in the same way and that he disagreed with these instructions. On the other hand, Morren himself had become more specialised: his research now focused uniquely on plants and he considered it to be inscribed fully within the discipline of botany. In this, it is highly possible that Morren's own ideas about relevant topics and correct methods had changed, leading him to view Quetelet's programme in a different light.

As the previous sections have shown, botanical research covered many different fields and advancements in these fields led to specialised research, moving the discipline into laboratories and institutionalised botanical gardens. In this process, scholars were actively considering which methods and data should be part of their research and which should not. Morren's case illustrates this development: his view was that botanical research required a different focus than what Quetelet had proposed. Morren wanted observations on the development of plants, while Quetelet proposed to include all natural life and even social factors. While Morren still wanted to employ Quetelet's statistical methods, he disagreed on their scope and general nature. His use of the methods was to organise and analyse data on plants and their development, instead of a broad range of natural phenomena.

While Morren's criticism of Quetelet's programme was rather subtle, only amounting to a dissatisfaction with the limited data that Quetelet was collecting on plants, other botanists took a stronger stance. Julius Sachs, for example, argued against Quetelet's approach to the relationship between temperature and plants.[221] Sachs had himself decided to study the relationship between temperature and the sprouting of seedlings. This focus, he claimed, was better for accurate research than the flowering of a plant, for it was unclear exactly when flowering started and ended, and therefore difficult to measure with precision, which he took to mean that the research would have nothing to say about "physiological principles."[222] Such a position illustrates the idea of there being a need to establish certain disciplinary standards for research. Indeed, Sachs referred to Quetelet specifically, saying that the data that he had found could not be explained with Quetelet's theorem of the relationship between temperature and plant growth.[223] Quetelet's research had not been precise enough,

221 Sachs, J. (1860) "Physiologische Untersuchungen über die Abhängigkeit der Keimung von der Temperatur" in: *Jahrbucher für wissenschaftliche Botanik*, 2, pp 338-377.

222 Idem, "so lange warden jene Gesetze keine physiologischen sein", p 375.

223 Idem, p 373.

and therefore his data were not precise either (*ungenauen Daten*).[224] While Sachs did believe that there was a use for research into average temperatures and plant growth, he did not condone Quetelet's less precise data, themselves the result of a more general approach to analysing botanical observations.

Morren and Sachs' criticisms relate to the points made by Planchon at the first International Congress of Horticulture and Botany, as cited at the beginning of this chapter. Planchon argued that whilst taking average temperatures might be of interest for comparative climatology, few would disagree that such studies left many important gaps in the data that could not be filled with simple measurements. "These gaps in the study of the external conditions of plant life are well known and everyone knows that it is almost impossible to fill them," he claimed.[225] The average temperatures, which are used in climatological and meteorological studies, could mask pronounced differences within the actual temperatures which could have highly variable influences on the lives of plants; as Planchon illustrated, a year with an extremely hot summer and an equally cold winter would give the same averages as a year with a mild summer and winter.[226] For the plants, however, the distinction would be enormous, and Planchon argued accordingly for closer observations of the plants themselves–as opposed to using calculations of temperatures–if one wanted to conduct a study into plants. Here, Planchon referred to Quetelet's call to observe periodical phenomena in plants and the relationship with temperature. Such relationships as those found by Quetelet, in which the value of the temperature needed to be squared in order to find the date of a plant's flowering, did not make sense to Planchon and Sachs, who joined Morren in this uncertainty.

Taken together, the cases of Morren, Planchon, and Sachs offer an important illustration of what happened when Quetelet's data practices were adapted to match disciplinary research. The botanists had different opinions about the kind of data to be collected, a choice that depended on the research that they deemed part of their discipline. In this, the botanists' disciplinary activity is distinct from Quetelet's attempt to establish an all-encompassing project of data collection. Even though Quetelet did specify the topics about which he wanted to collect data, the number was large and spread across different fields of research. His aim was to analyse the data collected

224 Idem, p 371.

225 Planchon (1864), p 71. "Ces lacunes dans l'étude des conditions extérieures de la vie des plantes, tout le monde les connaît et tout le monde sait la presque impossibilité de les combler." (my translation)

226 Ibidem.

on these topics with statistical methods, and he hoped that this would lead to the discovery of universal laws and regularities. This approach did not match what the botanists were doing, however, as the latter group prioritised collections of plant data and research into plant-related areas. A combination of the two approaches was possible, as Morren illustrated, yet required an adaptation of what Quetelet considered appropriate.

Quetelet's practices involved analysing data taken from a wide range of natural phenomena, while Morren's interest was limited to the development of plants. Though the methods were comparable, the practices and rules laid out by the former had to be changed in order to be of use to the latter. This example shows how the embedding of certain data practices within the botanical discipline influenced the formation of disciplinary boundaries. Interestingly, this brought about further developments of the methods themselves, while Quetelet's goal–an overarching science of social physics–was eventually disregarded.

2.5 Disciplinary Boundaries: Botany and Statistics

The previous section illustrated how Quetelet's practices were modified in order to be of use to research done in the discipline of botany: scholars such as Morren and Sachs argued that the observation of periodical phenomena was worthwhile as long as it concerned phenomena directly related to plants. Such specialisation resulted in the definition of disciplinary boundaries, as scholars determined what did and did not belong within the discipline. This section takes a closer look at this process, for which I use the concept disciplinary activity. Such activity often took place in discipline-specific journals, but was also openly discussed at scholarly congresses.

In the current section, I look at the formation and enforcement of the disciplinary boundaries of botany, and how statistical methods played a role in this process. I have used the case of Morren to show how statistical methods in botany were met with criticism. Quetelet's methods nevertheless continued to exert a considerable influence in botany, and I examine how research in the discipline still bore traces of his work. This means that I take the liberty of moving forwards in time, towards the end of the nineteenth century. I then return to Quetelet's lifetime to discuss how attempts to create a clearly defined discipline of statistics seemed to fail. This brings me to a more general discussion of the social sciences in the first half of the nineteenth century and how Quetelet's statistical methods spread to many other disciplines at the end of this section.

Statistical Botany

As we have seen, criticisms of the botanical interpretation of Quetelet's observational sciences opposed the use of average temperatures in the study of plants, since this approach led to ambiguity as plant development could not be averaged in the same way: a difference in temperature had a big influence on the development of plants. In his lecture on the use of average temperatures, for instance, Planchon had called on the botanists present to perform more direct observations of plants, and to prioritise these over methods from physics and astronomy. This exhortation allowed Planchon to clearly demarcate disciplinary boundaries, and to offer a definition of the topics and methods that he considered proper for botanists. However, although Quetelet's approach was considered too general and more specific observations were sought to counter this, Quetelet's data practices did continue to play a role in botanical research.

Despite Planchon's critique, Quetelet's science was not universally dismissed, and made a reappearance in the work of Belgian botanist Julius MacLeod (1857-1919). MacLeod had discovered Quetelet's work through his father, Aimé MacLeod, who had not only been in correspondence with Quetelet but had also collected data on periodical phenomena as part of Quetelet's programme.[227] At the first Dutch congress of natural sciences and medicine, held in Amsterdam in 1887, Julius MacLeod gave a lecture on some "statistical reflections" concerning the pollination of flowers by insects.[228] These consisted of a numerical analysis of a set of observations performed by two German botanists who were researching the frequency with which certain insects visited certain flowers. Though the analysis was not of great mathematical interest, MacLeod's claim was that the use of statistical analysis in botany could lead to a "whole new science."[229]

Unsurprisingly, MacLeod credited Quetelet with laying the foundations of this new science, and referred to the latter as a "genius."[230] MacLeod's work was designed to prove that "statistical methods can be trusted," by which he meant that numerical

227 Vanpaemel, G. (1992) " 'Als 't Ware een Nieuwe Wetenschap'. De Toepassing van de Statistische Methode door de Gentse Botanici rond 1900" in: *Gewina*, 15, pp 183-193, p 183.

228 Idem, p 183.

229 MacLeod, J. (1911) "Verslag over de werkzaamheden der Koninklijke Vlaamsche Academie op het gebied der natuur- en geneeskundige wetenschappen" in: *Gedenkboek van de Feestviering van haar 25-jarig Bestaan 1886-1911, Koninklijke Vlaamsche Academie*. A. Siffer, Ghent, pp 177-197, p 191-192, also quoted in Vanpaemel (1992), p 184.

230 Vanpaemel (1992), p 184.

analyses could be appropriate for botanical observations.[231] Indeed, his feeling that he had to defend the use of statistical methods is evident in the following passage:

> One often hears disdain about the statistical sciences. It is very true that in the field of statistics serious errors can be made, and that by statistical conjuring one can give falsehoods the appearance of truth, which has often been done, for example in political matters. This in no way diminishes the fact, however, that statistics, applied with *honesty* and with *the necessary authority*, is a tool for the discovery of truths that cannot be discovered by any other means.[232]

An example of how this should be done was presented by MacLeod's pupil, Caesar De Bruyker (1878-1924), who published a work entitled *De statistische methode in de plantkunde en hare toepassing op de studie van den invloed der levensvoorwaarden* [The statistical method in botany and its application to the study of influence on living conditions] in 1910. As was the case with MacLeod's lecture, De Bruyker's statistical analyses in the work are not particularly profound.[233] The "application" of the book's title consisted rather of verifying whether data taken from observations were distributed according to the expected bell curve, as discussed above. In this sense, one can inscribe De Bruyker's work within the same lineage as Quetelet's programme, presented seven decades earlier.[234]

231 MacLeod, J. (1888) "De bevruchting der bloemen door de insecten (Statistische beschouwingen)" in: *Handelingen van het Nederlandsch natuur- en geneeskundig congres*. De Erven F. Bohn, Haarlem, pp 133-138, p 137.

232 MacLeod, J. (1909) "Bestendige Commissie voor Nieuwere Taal- en Letterkunde. De statistische methode in de plantkunde en hare toepassingen op de studie van den invloed der levensvoorwaarden door Dr. C. de Bruyker, praeparator aan de Gentsche Hoogeschool, als Nr 6 van het Van de Ven-Heremans-Fonds ter uitgave aangeboden. Verslagen" in: *Verslagen en mededelingen van de Koninklijke Vlaamse Academie voor Taal- en Letterkunde* 1909. A. Siffer, Ghent, pp 311-313, p 312. "Zeer waar is het, dat men op het gebied der statistiek erge dwalingen kan begaan, en dat men door statistische goocheltoeren aan onwaarheden den schijn der waarheid geven kan, hetgeen dikwijls werd gedaan, o.a. in politieke zaken. Dit neemt echter geenszins weg dat de statistiek, op *eerlijke wijze* en met de *noodige bevoegdheid* toegepast, een werktuig is tot het ontdekken van waarheden, die door geen ander middel kunnen ontdekt worden." (my translation)

233 Geert Vanpaemel gives an extensive summary of the book in the context of the First World War and the university of Ghent. Vanpaemel (1992), p 185.

234 Idem, p 192.

De Bruyker's book on the statistical method in botany was published following a glowing review written by MacLeod,[235] in which he expressed the hope that De Bruyker's work would show the possibilities of applying statistical methods to the life sciences. In his report, MacLeod asserted that De Bruyker had demonstrated a considerable understanding of the statistical method as it could be applied to "the study of living beings and the phenomena of life."[236] The difficulty with this kind of study was, for MacLeod, the fact that living beings presented practically endless variability: measurements taken of even the most identical of beings could vary to a great extent. MacLeod's conviction was that, thanks to Quetelet and the promise of statistical methods, scholars could now overcome this problem. MacLeod also gave an account of experiments done by the Dutch botanist Hugo de Vries (1848-1935) as being influential for the field of biostatistics.[237]

Due to the First World War, however, MacLeod's research into statistical botany at the University of Ghent never reached maturity. MacLeod was a fervent Flemish nationalist, and was in favour of a Dutch-speaking University of Ghent. This created a rift between him and other Belgian intellectuals, and left him isolated after the First World War.[238] On top of this, De Bruyker was forced to resign and sentenced to five years imprisonment in 1920, as a result of his having collaborated with the Germans during the occupation.[239] Nevertheless, remnants of MacLeod and De Bruyker's scientific ideas did live on within the plant sciences. MacLeod's contemporary Hugo de Vries, for example, dominated the field of botany internationally with his work on heredity and genetics. De Vries was acknowledged as having contributed to the rediscovery of Mendelian population statistics, which he applied to study the reproduction of plants.[240] MacLeod had in fact been in contact with De Vries–who had been the

235 MacLeod (1909).

236 Macleod (1909), p 311.

237 Idem, p 312.

238 Vanpaemel (1992), p 184.

239 Idem, p 193. He was released a year early due to poor health and passed away in 1924.

240 Stamhuis, I.H. (2008b) "The Statistical Mind Moulding Heredity: Hugo de Vries and Mendelian Genetics", I.H. Stamhuis, P.M.M. Klep, J.G.S.J. van Maarseveen [eds] *The statistical mind in modern society. The Netherlands 1850-1940. Volume II: statistics and scientific work*. Aksant, Amsterdam pp 67-90.

vice-chair of the session at the natural sciences and medicine congress where MacLeod delivered his lecture–and a student of MacLeod's, Edward Verschaffelt (1868-1923), became De Vries' assistant at the University of Amsterdam.[241]

De Vries adopted Quetelet's approach to the distribution of errors in data, and in his first publications he referred to the resulting bell curve as "Quetelet's law."[242] De Vries' adaptations of statistical methods–together with the work of other geneticists such as Francis Galton, Ronald Fisher, and Karl Pearson–were fundamental to the advancement of mathematical statistics. Not only did these pioneers of statistics cite the work and celebrate the genius of Quetelet, but they also carried his methods forward and innovated new approaches to them.[243]

MacLeod's claim that Quetelet's statistical methods could be of interest to the plant sciences was shared by other scientists in the field, who were themselves involved in innovating statistical methods. The study of heredity and plant genetics in particular had an important influence on the discipline of botany. Over the course of the previous sections, we have seen how botany transformed during the nineteenth century, away from a primary interest in taxonomy and towards quantitative, laboratory-based, and microscopic research. Kärin Nickelsen has described this transition as a passage "from leaves to molecules."[244] I have observed this transition by following a specific method–Quetelet's statistical approach–as it was picked up by various botanists.

There is a similar development to be identified at a larger scale: the discipline of botany became more institutionalised and professionalised. The shift from the traditional emphasis on taxonomy to a focus on anatomy, morphology, and physiology, which were laboratory-centric fields of research, is one aspect of this larger trend, as were the applications of this new botany in agricultural science, which itself became a speciality.[245] Numbers and quantitative methods began to play an increasingly

241 Vanpaemel (1992), p 184.

242 After having studied the mathematician Carl Friedrich Gauss' work, he called it the "Gaussian curve", which followed "Quetelet's law". Stamhuis (2008b), p 77-8.

243 Porter claims that the work of (bio-)statisticians formed the basis for modern mathematical statistics and its wide-range of applications. While it is readily found that many of the statistical techniques and methods stem from this application of statistics on biological data, the broadening of the field can, as has been done here, be traced back to Quetelet. Porter (1986), p 8-9.

244 Nickelsen (2007).

245 Cittadino (2009) p 225-226, 236.

important role in the discipline too. As we have seen, the regional distribution of plants and the laws that governed this distribution became the main concern, besides the description and cataloguing of plants. As Eugene Cittadino has contended, "by the end of the [nineteenth] century, botany had become the primary occupation of a growing body of middle-class professionals, almost exclusively male, situated in university departments, botanic gardens, and a variety of newer institutions, such as agricultural colleges and research stations."[246]

These transformations were consolidated through the publication of textbooks and standard works within the discipline, whose status as such was granted by the participants of the botanical congresses.[247] As we saw in the case of Planchon and Fritsch discussed above, the congresses were also sites where botanists were able to discuss the methods and rules to which disciplinary research was expected to adhere. Through these discussions, the botanists reached agreements relating to the standardisation of methods in their discipline, which in turn determined that discipline's boundaries.[248]

Agreements on standardisation were also the main goal of the series of International Statistical Congresses that Quetelet initiated. Quetelet was working on government and social statistics at the same time as he was undertaking research in the natural sciences. He saw these as belonging to a single, overarching project: social factors could be influenced by natural phenomena, a claim that was fed by the belief that statistics and statistical regularities could be used to make sense of a rapidly changing world. To achieve this, international statistical research was deemed essential. This posed the problem of how to organise data collections at such a scale, so as to ensure unlimited and uniform statistical data, and given that Quetelet and his followers were well aware of this challenge, it is perhaps not surprising that Quetelet was a major figure in the organisation of several international congresses where such could be discussed.

246 Idem, p 226.

247 On the role of books in discipline formation of botany, see Shteir (1997), p 35. On the nineteenth-century botanical congresses, see Stafleu (1969).

248 As Nickelsen has shown, the attitude towards disciplinary boundaries also altered dramatically, allowing for more cooperation from physics, chemistry, and biology, especially on the research into photosynthesis. Nickelsen (2007), p 29.

A Statistical Discipline?

Quetelet's intention was to inaugurate a series of statistical congresses that would be held in capital cities across Europe. By moving the congress from one city to another, Quetelet hoped to advocate a standardised method for the analysis of statistical data in different countries. This sentiment was picked up and repeated in an article titled "Résumé [*sic*] of the Statistical Congress" by Leone Levi, who explained that the congress' purpose was to introduce "unity in the statistical documents of all countries."[249] Standard statistical results would then be comparable, and it would be possible to deduce general laws from them. It was for these reasons that Quetelet aimed to establish statistical centres in multiple countries to standardise the collection of data.[250]

Between 1853 and 1876, nine statistical conferences were held in nine different cities, the first of which was organised and chaired by Quetelet in Brussels in 1853. The historian Nico Randeraad gives an account of all nine congresses in his 2010 book *States and Statistics in the Nineteenth Century: Europe by Numbers*, offering an analysis of the nine congresses and describing the role of statistics in each of the host nations. Randeraad also emphasises the rise of statistics in the crystallisation of the modern nation state, as the leaders of newly formed or unified nation states began to take an interest in censuses, a practice that in turn involved statisticians.[251]

The first congress illustrates the considerable role that Quetelet played as an organiser and, as such, merits a detailed examination. Quetelet invited statisticians, scientists, policymakers, and other relevant parties to Brussels, which was seen to be the ideal place for an international gathering, due to Belgium's small size and its status as an independent, liberal country.[252] According to Randeraad, the "statistical congresses forged links between the various international scientific interests of the early 1850s."[253] Indeed, "everything could be counted," and this was precisely what the members of the statistical congresses planned on doing. What mattered most however, as we have seen, was for the counting to be done in a way that was standardised and that allowed for comparisons. The congress' main task, therefore, was to agree on how to formalise

249 Levi, L. (1854) "Résumé of the Statistical Congress, held at Brussels, September 11th, 1853, for the Purpose of Introducing Unity in the Statistical Documents of all Countries" in: *Journal of the Statistical Society of London*, 17(1), pp 1-14, p 1.

250 Randeraad (2011), p 59.

251 Randeraad (2010), p 5.

252 Idem, p 33-34.

253 Randeraad (2011), p 54.

a single method for the counting of any and all possible objects of study. This was an enormous project, especially since there were those statisticians who favoured certain topics over others.

At the first congress, chaired by Quetelet, the Belgian organisers decreed amongst other things that the most important topic on the agenda was the implementation and refinement of the census and population registers. Approximately 150 statisticians had gathered in Brussels from every corner of Europe, and among them were official government representatives and academics, along with other interested individuals.[254] Because censuses differed from one European country to another, however, many discussions sprang up about just what the most effective method would be. Other topics included surveys of the working classes, crime statistics, foreign trade, poverty, education, and emigration.[255] As Randeraad explains, "there was a relationship between all these and the social tensions fostered by industrialisation, urbanisation and impoverishment. Statisticians believed they could tackle these problems scientifically and impartially."[256]

The members of the first congress–and, indeed, of the subsequent congresses–had great difficulty in dealing with such highly political issues in a simple, transparent, or readily comparable manner, however. As a result, each congress was given its own topic, which was connected to the specific politics of the host nation: when the members met in Vienna they discussed ethnographical statistics with Karl von Czoernig; in London the hygienic movement with Florence Nightingale; in Germany social insurance; in Italy municipal statistics and the quantification of arts and culture; in the Netherlands colonial statistics; in Russia the census; and in Hungary the domestic industry. As Randeraad explains, these particular and sometimes patriotically inspired topics proved difficult to expand beyond their national borders: "Participants either showed no real interest in these issues or denounced their political background."[257] Therefore, it was sometimes the case that results achieved at one congress would be

254 Randeraad (2010), p 11. A surprising member of the congress was Leopold von Ranke (1795-1886), the famous German historian. By coincidence he was in Brussels in 1853 and even though he did not attend the sessions, he went to the banquet held in honour of the congress participants. He was sceptical about the congress, predicting a clash between Roman and Germanic ideas, with one favouring numerical data and the other using descriptive data, and disagreed with his positivist contemporaries' mechanical faith in progress. Randeraad (2010), p 13-14.

255 Randeraad (2010), p 29-33.

256 Idem, p 33.

257 Randeraad (2011), p 56.

discarded at the next, which meant that the various countries ended up doing their own version of statistics, focusing on topics they deemed important, and attempts to reach centralised agreements were dismissed. Although statisticians did try to establish a permanent international committee in 1873, this had already come apart by 1878.[258]

The diversity of topics addressed at the conferences is a reflection of Quetelet's scientific programme. Because he believed that laws and quantification were to be found everywhere, the programme became too large and had no clear direction. Nevertheless, the members of the first congress were optimistic, so much so that they argued for the addition of another topic to the agenda of the next meeting: "a new category should be inserted into the programme of the next meeting entitled *Physical statistics*, which will examine questions concerning: climatology, orography, botanical geography, both spontaneous and agricultural, and periodical phenomena in the life of plants and animals. This topic relates to the major problems of 'la physique du globe' and has a direct impact on public hygiene, culture, forestry cultivation and the constitution of territorial ownership."[259] The reference to "la physique du globe" shows once more the connection that Quetelet's followers saw between his programme and Humboldtian science.

The diversity of his scientific programme is clearer still in Quetelet's role at the first international meteorological congress. The meteorological congress was officially called the "Maritime Conference held at Brussels for devising a uniform system of meteorological observations at sea" and took place weeks before the statistical congress of 1853. Though Quetelet did not organise this congress, he was asked to chair the 17 days of discussion, at which most of the participants were maritime officers. Only Quetelet and a delegate from the British Royal Engineers were present in a capacity other than representative of their national navies.[260]

258 Idem, p 58.

259 *Compte Rendu des Travaux du Congrès Général de Statistique, réuni à Bruxelles les 19, 20, 21, et 22 Septembre 1853. M. Hayez, publisher of the Central Statistical Committee, Brussels*, p 165: "dans le programme de la prochaine réunion, soit insérée, sous le titre de *Statistique physique*, une nouvelle catégorie de questions à examiner, relatives à la climatologie, à l'orographie, à la géographie végétale, spontanée et agricole, aux phénomènes périodiques de la vie des plantes et des animaux, qui se rattachent aux grands problèmes de la physique du globe, et se trouvent en rapport direct, par leur influence, avec l'hygiène publique, la grande culture, l'exploitation forestière et la constitution de la propriété territoriale." My translation.

260 Achbari, A. (2015) "Building Networks for Science: Conflict and Cooperation in Nineteenth-Century Global Marine Studies" in: *Isis*, 106(2), pp 257-282, p 276.

One of the main topics at this congress was the question of how to devise a set of instructions for meteorological observations, where observers were asked to collect data on phenomena such as currents, winds, temperature, air pressure, and magnetic variations. These instructions were to be presented in the form of a table, which could then be filled in by the observer. Several meetings were held to decide, for example, the columns to be included, the times at which observations should be carried out, and how the observations should be noted in the table.[261]

Quetelet participated in these discussions and voted along with the maritime officers. On the topic of when the observations should be done, for example, Quetelet's opinion was taken seriously: "The president wished that, if meteorological observations be made at sea, those observations should be completed as to conduct to the determination of the diurnal variations, or at least to the annual variations of the temperature, the pressure and the humidity of the air."[262] He remarked that to study diurnal variations, observations would need to be taken at least every three hours. This then led to a discussion about the practicality of such an undertaking at three-hour intervals while at sea, with the conference eventually deciding that four in the morning, noon, and eight in the evening would be the most suitable times for recording observations of temperature, pressure, and humidity.[263]

Quetelet's work was crucial to the earliest developments of statistics and meteorology. The congresses discussed here staged activities and opportunities for the scholars present to discuss the methods and practices deemed necessary for their discipline. In this, the aim was to spread the practices internationally, although agreements in this regard were far from straightforward. The meteorological congress, for example, took 17 days to come up with one standard table for observers, and discussions in the statistical congresses of similar standards did not achieve their intended results either.[264]

So, can we speak of a "discipline of statistics"? Modern statistics can be con-

261 *Maritime Conference held at Brussels for devising an uniform system of meteorological observations at sea. August and September* 1853 / *Conférence Maritime tenué à Bruxelles pour l'adoption d'un système uniforme d'observations météorologiques à la mer. Août et septembre* 1853 (1853), M. Hayez, Brussels.

262 Idem, p 68.

263 Idem, p 70-74.

264 In the 1870s, a permanent commission was established to ensure a sturdier foundation for the statistical projects. This commission met up on several occasions, but in different compositions and with different agendas. Therefore this was not sufficient to consolidate the statistical practices in Europe. Randeraad (2011), p 58.

sidered a sub-discipline or field of research within mathematics, and what statistics stands for is a diffuse collection of methods. Still, universities have departments of statistics, there are statistical journals and conferences, and some scholars call themselves statisticians.[265] These scholars have a set of methods as their object of study, which offers an interesting nuance to our idea of disciplines as object-based. The field of statistics has developed to adapt to many different types of research and forms of data analysis, with close links to disciplines such as mathematics and data science. Parts of this development have been described in this chapter. Moreover, statistical methods have become essential to various disciplines, the social sciences in particular.

Quetelet's approach to statistics–the collection of large amounts of data that are subsequently analysed using one method, looking for averages and attempting to find relationships–has not found its place within modern statistics. However, Quetelet did play a significant role in advancing the use of data practices in the social sciences. During Quetelet's career, social scientific research lacked a disciplinary structure and was practised by a large variety of scholars with different backgrounds, whereas by the end of the nineteenth century, clear frameworks and disciplines had emerged. A commonality between the various strands of social science research was that scholars agreed upon the possible existence of "statistical laws" that could uncover regularities from apparent chaos, and with which they could make sense of various types of data. Accepting this, however, meant having to think in terms of collective reality, something that was distinct from the individual and particular cases that composed it and that could be subjected to forces or even laws.

As the sections of this chapter have shown, statisticians used averages and probability theory to describe such putative collective entities, an example of which might be "society." In order to study such an entity, practices were employed to collect and organise data. Here, I have examined the practices that were developed by Quetelet's research programme, and their incorporation into many different research

265 Northern American universities such as Stanford University, Harvard, and the University of Toronto all have an institutionalised Department of Statistics. On the website of Stanford University's Department of Statistics, statistics is defined as "a uniquely fascinating discipline, poised at the triple conjunction of mathematics, science, and philosophy. (…) What do statisticians do? Everything." Source: https://statistics.stanford.edu/ [Retrieved February 2022]. Journals of statistics include *The American Statistician*, *Significance*, *International Statistical Review*, and *Annals of Statistics*. Many international conferences on statistics exist, often linked to mathematics or data science, such as the International Conference on Statistics and Data Science (ICSDS) or the World Statistics Congress organised by the International Statistical Institute (ISI).

projects and disciplines. Quetelet's practices enabled scholars to analyse concrete data about abstract phenomena, such as developments in human societies. This topic will return in the second case study of this dissertation, in Chapter 3, which further illustrates the institutionalisation of the social sciences.

Further Applications of Quetelet's Methods

Quetelet's influence was not restricted to the domain of social scientific research. I have already examined how some of his methods came to be embedded in the discipline of botany as data practices. This section looks at a number of other ways in which these data practices influenced and were applied in different disciplines, to show not only how widespread the reach of Quetelet's methods was, but also how their epistemology could be applied in different scholarly contexts. This represents an important contribution to my analysis of how similar data practices were shared between and became part of different disciplines.

One of the first, most enthusiastic, and best known proponents of Quetelet's work in Great Britain was a historian: Henry Thomas Buckle (1821-1862). Buckle's magnum opus was the *History of Civilization in England* of which three volumes were published; the first, in 1857, was the literary hit of its season.[266] Buckle's aim was to raise the status of history to that of an exact science resembling social physics, even though he himself had no background in the natural sciences and did not use mathematics in his work.[267] His central thesis was that there existed statistical laws for the development of society, just as there existed natural laws to be studied by the natural sciences, and he used results from statistical analyses–mostly done by Quetelet–to corroborate this, whilst maintaining that the achievements of statistical laws was a crucial lesson for the historian. The examples that Buckle cited to prove his point were those that Quetelet had found the most convincing, namely the constant rates of seemingly irrational human behaviours, such as murder or suicide, in any given society. He took this to indicate that every one of these acts must necessarily be a consequence of some underlying social law.[268]

266 Porter (1994), p 352.

267 The connection Buckle made between the discipline of history and the exact sciences can be placed in a longer, entangled history of physics and history: see Ten Hagen, S.L. (2021) *History and Physics Entangled: Disciplinary Intersections in the Long Nineteenth Century*. Dissertation, University of Amsterdam. For Ten Hagen on Buckle: idem, p 173.

268 Porter (1986), p 60-63.

2.5 DISCIPLINARY BOUNDARIES: BOTANY AND STATISTICS

Quetelet's *Sur l'Homme* was translated into English and German by medical doctors. This was no coincidence: because the use of averages was of real importance to the public health movement, the medical profession played a significant role in the development of statistics.[269] These hygienists employed statistical laws to interpret social data, so as to promote preventive medicine in society.[270] An advocate for the use of statistics on this topic was the British hospital reformer Florence Nightingale (1820-1910), who was profoundly influenced by Quetelet's work. When Quetelet visited the International Statistical Congress in London in 1860, he was invited to meet her, and the two remained in contact until Quetelet's death in 1874.[271] Nightingale was especially interested in the practical value of statistics, and she urged Quetelet to write about this. Her own research focused on hospital statistics, and she shared Quetelet's conviction about the importance of standardising the collection of data, in this case relating to care for the sick. She published forms with which hospitals could collect statistical data on several topics, an approach that was then adopted by the Royal Statistical Society as standard for British hospitals.[272] Through these data, Nightingale hoped to find regularities that could reveal something about the laws at work in the social sphere, following the principle that order in human action was to be best investigated through statistics.[273]

269 Randeraad (2010), p 25; Schweber (2006), p 50.

270 Desrosières (2010), p 85-86. An influential physician in this movement was the French physician Louis-René Villermé (1782-1863) who was a close friend of Quetelet's. Villermé established the journal *Annals d'hygiène publique et de medicine légale* in 1829. In this journal, statistics was considered the tool to understand certain relationships between medical data. His own research was into morality rates and wealth distribution. For more on the French and British public health movement, see Schweber (2006).

271 Nightingale could not attend the Congress because of her health, so she had others read her papers for her during the event and let a number of delegates visit her. In this way, she exerted an influence on the Congress even though she was bedridden. Diamond, M. & Stone, M. (1981) "Nightingale on Quetelet" in: *Journal of the Royal Statistical Society. Series A (General)*, 144(1), pp 66-79, p 71.

272 Nightingale also developed a system of diagrams called "coxcombs," comparable to modern pie charts, to present and popularise her statistical findings. She believed that she would be able to reach a larger audience (including Queen Victoria) if she included "pictures" to her work. Diamond & Stone (1981).

273 Kopf, E.W. (1916) "Florence Nightingale as Statistician" in: *Quarterly Publications of the American Statistical Association*, 15(116), pp 388-404, p 394-398; Diamond & Stone (1981), p 72.

Social statistics also influenced the natural sciences, as can be seen in the work of the physicist James Clerk Maxwell (1831-1879). Maxwell became aware of Quetelet's work in a long essay review written by the astronomer John Herschel (1792-1871). Maxwell often referred to Quetelet's social physics as an analogy for his kinetic gas theory, as he did for example in his famous 1873 lecture at the British Association for the Advancement of Science. More specifically, he adopted Quetelet's analytical tool of the bell curve, or normal distribution.[274] Maxwell used debates from the social sciences to formulate theories for statistical reasoning in physics: in much the same way as a social scientist would not need to be familiar with all the particularities of a certain individual in order to understand the collective whole of society, so a physicist would not need to know all about individual molecules in order to calculate the properties of a gas. Exactly the same analogy was used independently by the Austrian physicist Ludwig Boltzmann (1844-1906), in a landmark paper of his from 1872. Boltzmann presented the laws of social statistics to convince his peers within the discipline of physics that thermodynamic laws, which were based on what he called "population distributions," were by no means merely probabilistic or unreliable. Boltzmann claimed that he had arrived at this view through studying the work of Buckle.[275]

It is important to note, however, that Quetelet's work in social statistics was met critically. His trust in numbers, for example, was disputed by those statisticians who preferred descriptive and qualitative observations, and a primary line of attack against his work accused him of separating off society from the individuals that formed it. Furthermore, Quetelet's observations of statistical regularities in society were considered deterministic, and as posing a challenge to the principle of free will.[276] This debate became particularly heated, not only in England but also in Germany, after the publication and translation of Buckle's history of England, itself stridently deterministic.[277] Quetelet himself, however, was not concerned that his conclusions were, or should appear, deterministic. His logic held that studying social physics meant studying the laws of God, and as such stood diametrically opposed to free will.[278]

274 Porter (1994), p 355-357.

275 Idem, p 356.

276 Porter (1994), p 351; and idem (2003), p 241.

277 Hansen (2015), p 21.

278 Donnelly (2014), p 415.

Despite these criticisms, Quetelet's work was shared widely, and exerted a notable influence in many different fields of research. This section has presented an overview of several cases in which Quetelet's data practices interacted, in one form or another, with a variety of disciplines. Certain individual scholars, of which this section has presented only a few, took it upon themselves to adopt and adapt the statistical methods that Quetelet had put forward for the collection and analysis of data. Though these data were specific to the topic of their discipline, the same practices could nevertheless be applied to analyse and interpret them, regardless of the field they emerged from. In order for data practices to become embedded in a discipline, they required standardisation: rules needed to be defined about how the data practices were to be applied, and this standardisation necessitated discussions about disciplinary boundaries.

2.6 Conclusion

This chapter has discussed the development and spread of Quetelet's statistical methods as data practices. As I have shown, these methods were used to analyse various types of data, in order to enable comparisons between different datasets and identify relationships and regularities that there may be within them. The practices were shared between scholars, and were also adapted to suit an array of research contexts, and though they did develop as a result of these adaptations they nevertheless remained true to their original purpose of systematic data analysis, as governed by Quetelet's statistical methods. This means that it is possible to consider these data practices as cognitive goods that flow between different disciplinary contexts, as I detailed in section 1.3.

To sum up, after an introduction to the case study in section 2.1, section 2.2 examined the development of statistical methods as data practices, from a broader search for regularities, including quantitative and qualitative description, to the methods that Quetelet employed to calculate averages and variations. In section 2.3, I looked at how these methods were further applied in botanical research, specifically concerning the relationship between temperature and plant development. Quetelet's goal was to have a wider application for his methods than botanical research alone, however, and in section 2.4 I discussed Quetelet's programme of observational sciences, in particular through the work of one of Quetelet's observers and former students, Charles Morren. Morren was a professor of botany, and his increasing specialisation within that discipline had a significant impact on his involvement with Quetelet's research programme.

This illustrated the tension that existed between Quetelet's general interest in periodical phenomena on the one hand, and the more specific interest of most botanists in observations of certain plants on the other. Section 2.5 examined this tension further, and looked at how the formation of disciplinary boundaries affected–and was affected by–the spread of Quetelet's methods. The research presented into the botanical and statistical congresses made this particularly evident.

In what follows, I begin to answer my research questions. As stated in section 2.1, I set out to better understand how statistical methods were adopted by different disciplines, especially botany, and how both these data practices and the disciplines involved changed in the process. This offers an important insight into the nature of disciplines and disciplinary boundaries, as well as the transfer of practices between research contexts. I first discuss what this case has shown about the sharing of data practices, and how this influenced their development, to then finish with a look at the conclusions to be drawn about disciplines and the formation of disciplinary boundaries.

Flow of Statistical Methods

Throughout this chapter, I have considered the statistical methods that Quetelet developed in his work on observations of periodical phenomena and social statistics as cognitive goods. Even though the methods were shared between disciplines, they remained recognisable; this is essential to ensuring the autonomy of cognitive goods. Indeed, a study of these statistical methods within their various contexts was only possible because of their being recognisable in each instance, and this was due in no small part to the fact that they were referred to by other scholars precisely as Quetelet's methods, or at least as methods stemming from Quetelet's work. Because this was the case, I was able to examine how the methods were developed and adapted in various contexts, and to systematically observe how the disciplines involved shared certain cognitive goods.

I have analysed the use of Quetelet's statistical methods at both a microscopic level and a mesoscopic level of historical analysis. For a micro-level analysis, I have considered the work of Morren, who applied Quetelet's methods in his own observations. As I have shown, while Morren was in agreement with Quetelet's approach, he adapted the practices as he became more involved in the discipline of botany. Indeed, other botanists shared Morren's criticisms, and this was apparent at the International Botanical Congress.

The congress became a site for debates on how methods could and should be

used. Through my research into the congresses, I have been able to analyse the role of Quetelet's methods in the discipline of botany at a meso-level. I have studied how the discipline transformed to include quantitative analysis, including statistical methods. Moreover, I have sketched the development of statistical methods within botany towards other fields of research, such as genetics.

My analysis has brought me to two conclusions. First, the ways in which statistical methods were sometimes employed in research did not necessarily match Quetelet's intentions. While this did lead to discussions in the discipline of botany, for example, it did not hinder the flow of the methods themselves as cognitive goods.[279] Quetelet had hoped that all the scholars who applied his methods would come together under one umbrella discipline, such as observational sciences. While this may have impacted the spread of the methods, and caused a certain reticence in scholars' use of them, Quetelet's statistical methods nevertheless spread far and wide.

My second conclusion is that the cognitive goods were themselves changed by the different contexts in which they were used. The statistical methods that Quetelet had envisioned as an approach to analysing many types of data in a general way were adapted so as to tackle a range of data on a given topic. In other words, the analysis itself did not change very much–scholars were still calculating averages and variations between averages–but the interpretations of how the methods should be employed, including the conditions governing which data to include or exclude, did. These changes to the data practices were in accordance with the standards and rules that had been agreed upon by botanists.

The same was also true for other disciplines: the approach to and analysis of the statistical methods stayed the same, but the scope and interpretation of the data changed. In fact, Quetelet's statistical methods proved so versatile that these adaptations were possible in many different disciplinary contexts, and in turn this process actually improved and further developed the statistical methods themselves.[280] These observations indicate that cognitive goods are subject to change and development as they are shared between and, of particular importance here, embedded in various disciplines.

Quetelet's statistical methods, therefore, were shared between and adopted by many disciplines, as the widespread use of statistics in modern research testifies. Despite being criticised for their potential to produce inaccuracies–due to their depend-

279 One could even argue that the fact that the methods were discussed already signals a flow.

280 As has been argued by Hansen (2015), p 22; Porter (1986), p 4.

ence on data collected by often untrained observers–as well as for not being specific enough–because they were designed to provide a very general, broad study of phenomena–the methods were adapted to suit different disciplinary standards. To return to my research question of how data practices were changed and embedded in different disciplines, I have shown how this process played out in relation to both statistical methods and the discipline of botany. Viewing statistical methods as cognitive goods meant that it has been possible to study their flow between contexts, as well as how they were embedded in new ones. I have called attention to the ways in which such flows were especially visible during discipline-specific congresses, as well as to the activity of fitting cognitive goods into a given discipline.

Disciplinary Activity

In order to become embedded within a discipline, cognitive goods had to adhere to the standards and rules of that discipline. This process pushed scholars to actively ask and engage with questions about their respective discipline's methods and practices. A proper study of such intra-discipline activity necessitates a move away from disciplinary analyses at a meso-level, and towards a microscopic analysis of scholars' practices. I have therefore examined disciplinary activity and discussed three processes of discipline formation: specialisation, hybridisation, and professionalisation.

Each of these processes contributes a different perspective to the historical analysis of discipline formation, and these are perspectives that the present case study can help us to distinguish. Hybridisation in the formation of a discipline is taken to mean the process of combining various methods, practices, theories, and so on into one research domain. In the case of botany, we have seen how methods from different disciplines, specifically the statistical methods developed primarily by Quetelet, were incorporated into botanical research, which in turn led to new directions of research.

The adaptation of methods and practices to suit the specific scope of botany, and the creation of distinct areas of research, is easy to understand when one considers discipline formation as specialisation. Botanists actively made sure that any practices they might use fit the scope of their discipline's research, and discarded those aspects of the practice that did not. This narrowed down both the topic of study and the practices through which to study it.

This chapter has presented an overview of several cases in which Quetelet's data practices came to be embedded in a variety of disciplines. There is a tension, however, between the disciplinary activity that originally defined Quetelet's idea of social physics–the science of observations that he wanted to create–and the disciplinary activity

of already existing disciplines such as botany, history, and physics. While both cases involved processes of practice standardisation, Quetelet's social physics spanned a wide array of topics, while the latter group of disciplines focused more on specific research and specialisations. This tension is particularly evident when considering the series of International Statistical Congresses that Quetelet had organised, but can also be found in the other cases that are discussed here.

The project of social physics was seen to be contradictory in its desire to span such a breadth of topics by scholars who were starting to train as researchers within specialised disciplines. Moreover, the nineteenth-century statisticians had to accept that national agendas loomed too large to permit the creation of a single, overarching statistical discipline as envisioned by Quetelet. As far as the collection and analysis of natural scientific data–relating for example to plants or the weather–was concerned, the standardisation of practices was a difficult process, and led to debates about disciplinary boundaries. The result of this was that, instead of broadening the focus as Quetelet had suggested, disciplinary boundaries became better defined.

Hence, Quetelet's goal of creating a discipline of social physics, along with his vision of observational sciences, was never realised. As had been the case with the discipline of statistics, Quetelet's activity was seen to be too general. A similarity between all of these projects is that they are based on the application of a certain method, as opposed to relying on specific knowledge of certain objects. In Chapter 1, I discussed the historical sociological analysis of disciplinary classifications, in which a transformation is described from hierarchical epistemic genres based on philosophical, historical, or mathematical methods, to a system of horizontally differentiated disciplines based on specific objects of study. In this sense, both Quetelet's social physics and the discipline of statistics appeared somewhat old-fashioned for their time, reminiscent of eighteenth-century classifications of knowledge production. This brings the tension between object-based and method-based disciplines to the fore once again.

My research into Quetelet's activity thus provides an insight into what was perceived to be important for the creation of a discipline in the middle of the nineteenth century. While a project such as social physics or observational science might have been conceivable in the work of Linnaeus or even Humboldt, Quetelet was met with resistance from colleagues more inclined to conduct research into specific objects. This is not to say that social physics would have succeeded a century earlier, as many other factors would have played a role; discipline formation is, as described in Chapter 1, a multifaceted process. This development is illustrated in this chapter, and most revealingly in the debate between Quetelet and Morren about phenology and the obser-

vation of periodical phenomena. This particular case exemplifies the tension between method-based and object-based disciplines once more.

Nevertheless, Quetelet's project was at odds with the emerging definitions of other nineteenth-century disciplines. Attempts to create general, overarching disciplines such as Quetelet's statistical discipline can be identified throughout the nineteenth and even twentieth century. Some examples are Hermann von Helmholtz (1821-1894) who developed an epistemology of perception, Alexander Potebnja (1835-1891) who attempted a theory of language and consciousness, or Roman Jakobson (1896-1982) who propagated structuralism as an overarching approach.[281] While these attempts did not succeed as the scholars had envisioned them, they did lead to new interactions between different research contexts and instances of sharing of cognitive goods. In the case of Quetelet, his statistical methods were shared far and wide and consequently adapted within different disciplines such as we have seen with botany. The adaptations of these practices meant that only those botanists who adhered to the agreed-upon standards could be considered part of the discipline, which itself became more professionalised, no longer an easily accessible study of plants but a strictly defined science. This process of professionalisation occurred in every area of the discipline, as can be seen in the move from private plant collections to institutions, botanical gardens, and laboratories.

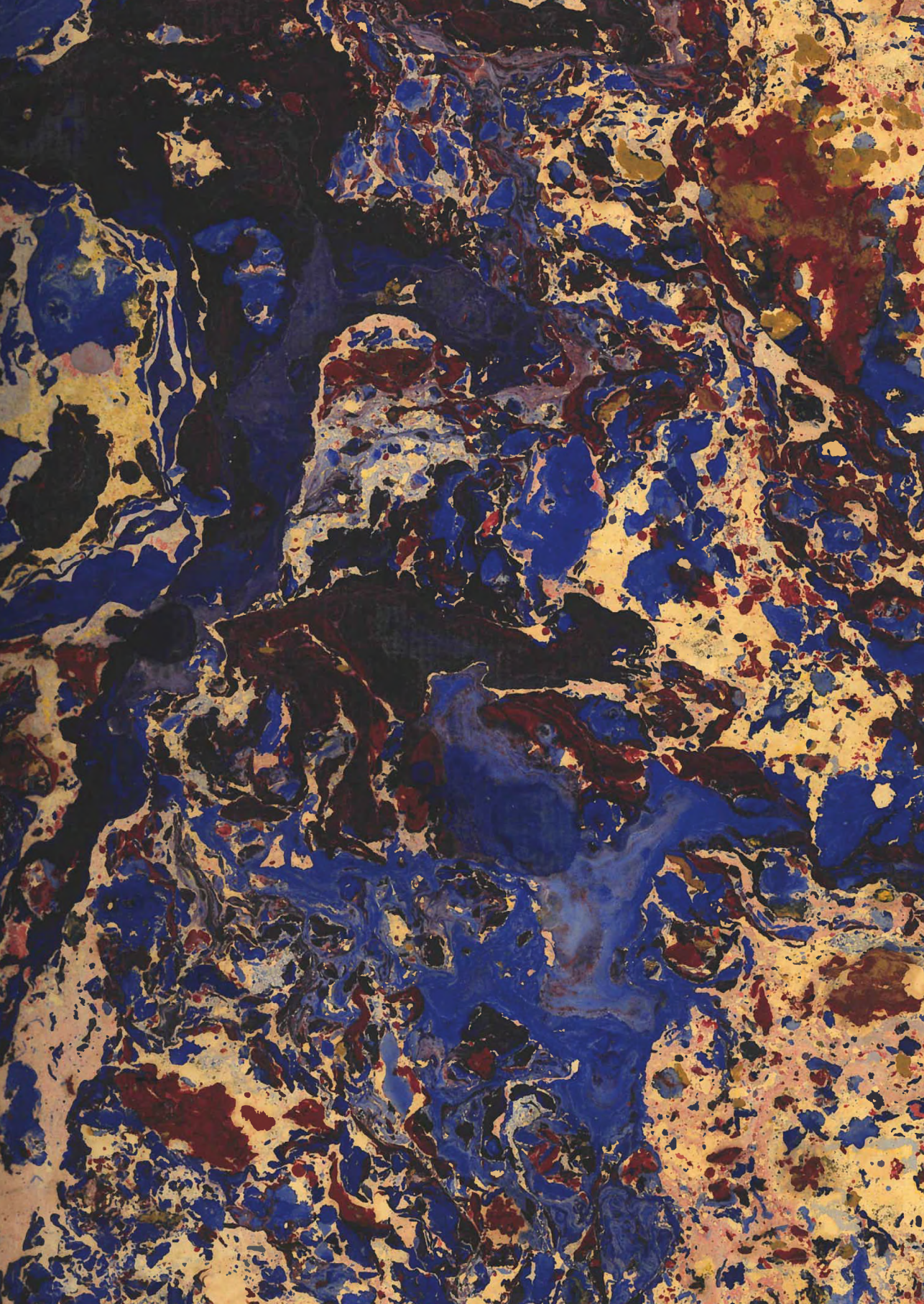
The disciplinary congresses were, in turn, moments for the consolidation of various processes of discipline formation, providing opportunities for discussions and decisions relating to standards for methods and practices, as well as what should count as disciplinary research. Taken together, this resulted in the specialisation of a given discipline: the congresses marked a step in the direction of a discipline's professionalisation, as well as its organisation at an international scale. This was Quetelet's goal in organising the statistical congresses.

As noted above, however, congresses also enabled flows to occur. Fritsch's visit to the statistical congress prior to the botanical congress serves to illustrate this. Participants presented their research, and this could lead to interactions between scholars from different fields. Congresses can therefore be considered sites of both

281 For more on Helmholtz see Kursell, J. (2018) *Epistemologie des Hörens: Helmholtz' physiologische Grundlegung*. Brill/Fink, Leiden, on Potebnja see Kerecuk, N. (2000) "Consciousness in Potebnja's theory of language" in: *Histoire Épistémologie. Language*, vol. XII, fascicule 2, pp 81–95, and on Jakobson see Karstens, B. (2017) " 'The Lonely Form Dies': How Epistemic Virtues Connect Roman Jakobson's New Science of Language and His Personality" in: J. van Dongen & H. Paul [eds] *Epistemic Virtues in the Sciences and the Humanities*. Boston Studies in the Philosophy and History of Science 321, Springer, Cham, pp 149-171.

disciplinary and interdisciplinary activity, where discipline formation and interdisciplinary interactions were facilitated, which can be studied through both meso-level and micro-level analysis. The meso-level of disciplines and disciplinary boundaries emerges at congresses through interactions at the micro-level, debates between individual scholars. As such, they will play a key role in my analysis of the next chapter's historical case study.

This then also begins to answer my research question about developments and changes within disciplines as methods and practices were transferred between them. This chapter has examined various instances of scholarly activity that concerned or engaged with disciplinary boundaries. The clearest example of this was the discussion between Morren and Quetelet, which saw Morren try to understand and uphold the disciplinary boundaries of botany. The reason for this disciplinary activity was the embedding of Quetelet's statistical methods within botanical research, which I have studied here as an example of the flow of cognitive goods. This historiographical approach has enabled me to analyse both the formation and the maintenance of disciplinary boundaries.



Chapter 3

Questionnaires and Linguistics

3.1 Introduction

At the first International Congress of Linguists, held in The Hague in 1928, the French linguist Antoine Meillet argued that "linguists must recognise the necessity of producing linguistic descriptions of the world, just as astronomers do of the sky."[282] Meillet, in a reference to the famous *Carte du Ciel*, thus set the bar high for linguistic endeavour. The *Carte du Ciel* was an international project to map the stars, initiated in 1887 by the French astronomer Ernest Amédée Mouchez (1821-1892), then director of the Paris Observatory. The goal of the *Carte* was not only to produce photographic maps of the sky, but also to establish modes of standard observation upon which future research could be based.

Meillet's hope, therefore, was to achieve something similar in linguistics: the creation of a map of the world's languages, which could be used for further research into changes and variations between and within those languages. Meillet believed that through the creation of such a map, he would be able to preserve certain languages, as well as better understand the differences between them, and in order to collect the necessary data, he proposed a questionnaire. Meillet reasoned that such an approach would be well suited for the collection of data on several different languages, and argued that it was the task of the International Congress of Linguists to produce an appropriately general, standardised questionnaire.

I have chosen the above episode to open this chapter because in it we see linguists, mirroring scholars from other disciplines, undertaking a project of data collection on an international scale, and designing a questionnaire according to a certain set of requirements in order to do so. This chapter, then, examines the use of questionnaires as a data practice in the study of language.

Indeed, the questionnaire, widely used in the modern social sciences, has a history; examples of questionnaires as a research methodology can be found at least as long ago as the sixteenth century. Throughout its history, the questionnaire has been employed systematically to collect and manage data from observations on a given research topic, though its appearance, aims, and specific application frequently vary.

In attending to these historical variations, this chapter discusses the origins of linguistic research via questionnaires, and through this, the origins of the discipline of linguistics more broadly. The development of the linguistic questionnaire cannot

282 *Actes du Premier Congrès de Linguistes. Tenu à la Haye du 10-15 Avril, 1928* (1930). A.W. *Sijthoff, Leiden*, p 28: "les linguistes doivent reconnaître la nécessité de faire une description linguistique du monde de même que les astronomes donnent une carte du ciel." (my translation)

be confined to the single discipline of linguistics, however. On the contrary, linguistics only emerged as a discipline in the late nineteenth and early twentieth centuries, whilst the questionnaire method has been employed to collect data on languages for far longer. Indeed, the origins of the questionnaire are decidedly multidisciplinary.

Just like the data practices developed by Adolphe Quetelet and discussed in the previous chapter, the questionnaire was adopted by various scholars across a number of disciplines. In these different contexts, the questionnaire, as I show in what follows, was adapted and modified to suit the research at hand. Such modifications might pertain to the use of direct or indirect questioning, whether or not to employ a standard or specialised form, or whether to focus on words or sentences. These choices determined what the questionnaire, and thus the wider research project, would look like.

Questionnaires were adapted to ensure the researchers that their research conformed to the particular scientific or scholarly standards of the discipline in which they were deployed, with certain adaptations prioritised as more rigorous and objective. These choices concerning best practice in the questionnaire method relied upon ideas of what constituted research, and shed light on what was considered proper scientific or scholarly work in a given disciplinary context. This becomes particularly clear in discussions of how to standardise the questionnaire within a discipline. Such discussions and agreements about standard methods are then part of the process of discipline formation, as they determine the research conducted in the name of that discipline.

In this chapter, I examine how the questionnaire was used as a data practice in linguistics. I show how this data practice was employed differently for various research projects, and how scholars attempted to standardise it. My aim is to explore how the questionnaire was changed in the process, and how the discipline of linguistics was both influenced by and had an influence on these developments. The standardisation of the questionnaire in linguistics was directly linked to the questionnaire method as it was used in sociology. As such, I also discuss how this particular data practice was shared between these disciplines, and I illustrate the ways in which this connection in fact extended beyond the questionnaire method. The disciplinary boundaries of linguistics and sociology were formed contemporaneously, and influential developments in both disciplines took place around the same time and in the same place, namely Parisian academies and universities of the late nineteenth century. This connection offers new insights into the tension between discipline formation and interdisciplinary interactions.

This chapter also discusses how the questionnaire was used to collect concrete data from observations of an abstract object, language, just as the previous chapter considered statistical practices that collected data on observations of social and natural phenomena. The data collection practices outlined in the previous case studies were based on observations that either measured certain values or observed certain visible phenomena; air temperature and the flowering of plants, for instance. The present case study differs from this. The questionnaires that interest us here were designed to collect text and speech, objects of study which clearly cannot be measured in the same way as temperature or flowering.

Nevertheless, the language scholars and linguists introduced in what follows were keen to collect and analyse data on languages in a manner that closely resembled that of the botanists. In order to do this, they had to develop a data collection practice that was systematic and rigorous, and the data they collected needed to be standardisable, so as to be comparable.

These requirements are, of course, very similar to those that Adolphe Quetelet stipulated in his instructions regarding the observation of natural phenomena. The case discussed here thus offers an interesting point of comparison between similar data collection practices in dissimilar disciplines.

What is a Questionnaire?

Questionnaires are used in various disciplines across the humanities, as well as in the social and natural sciences. The English word "questionnaire" translates as "enquêtes (par questionnaire)" in French, "vragenlijst" in Dutch, and "Fragebogen (-Erhebungen)" in German, and the method functions as an instrument of scientific or scholarly study, facilitating the collection and production of data, and even imposing a certain order on the object of research.[283] In essence, a questionnaire is simply a list of questions with which a researcher systematically collects data about an object of interest. This definition, however, fails to do justice to the complex rules that govern the creation and use of a questionnaire in research. Indeed, the rubrics that ensure rigorous and accurate data collection tend to differ from one discipline to the next, and are often adapted in light of a project's object or goal.

The choices made by a researcher when designing and framing a questionnaire

283 Jacy L. Young has studied the use of questionnaires in psychology. See: Young, J.L. (2014) *When Psychologists were Naturalists: Questionnaires and Collecting Practices in Early American Psychology, 1880-1932*. Dissertation, York University, Toronto; and idem (2017) "Numbering the mind: Questionnaires and the attitudinal public" in: *History of the Human Sciences*, 30(4), pp 32-53.

shed light on the role that the method plays within a given study. As such, no fixed approach or blueprint exists for the use of a questionnaire, and scholars have designed vastly different variants over time and across disciplinary boundaries, with specific choices dictated by the requirements of the research at hand. This chapter presents examples of how the questionnaire has been employed differently in multiple contexts. It is worth noting, however, that there are many other ways in which the questionnaire can be put to use that fall outside the scope of this dissertation, and which, when taken together, demonstrate just how versatile a research tool it is.

It should be pointed out here that a number of research methods share common characteristics with the questionnaire, and are thus closely associated with it. These include the opinion poll, the social survey, the interview, and the census. Like the questionnaire, each of these approaches aims to collect data on a specific topic, often by asking questions, and each is generally ordered systematically. Unlike the questionnaire, however, the data collected via these methods are not necessarily intended for scientific purposes. Opinion polls, social surveys, and censuses are often mobilised in the political or commercial domain, whereas the questionnaires considered here are employed for purely scholarly ends.[284] This is not to say that questionnaires do not have a political valence–science and politics are, after all, often tightly imbricated–yet research via questionnaires is primarily considered an academic practice. Linguistic questionnaires often resemble, or even include, word lists, since both aim to collect data on the pronunciation of certain words. Whilst there is an overlap between the methods, however, the linguistic questionnaire differs from the word list in that the former includes words as they are used in sentences, and seeks to investigate the pronunciation of different combinations, rather than compiling a list of single words.[285]

The questionnaire can broadly be defined as a data collection method that contributes to the systematic study of an object that cannot be seen directly, such as social conditions in a given society, human thoughts, or spoken language. This definition, however, is malleable; a questionnaire is formed most significantly by the research project in which it is used. The specific choices and conditions of the researcher determine the shape that the questionnaire takes, and how it is used. A parallel can be drawn here with the problems faced by historians when studying data histories; as

284 The distinction between questionnaires and opinion polls is made clearly by Young (2014), p 11.

285 Judith Kaplan has studied the use of word lists and basic vocabularies as data collection practices, see Kaplan, J. (2017) "From Lexicostatistics to Lexomics: Basic Vocabulary and the Study of Language Prehistory" in: *Osiris*, 32, pp 202-223.

Elena Aronova, Christine von Oertzen, and David Sepkoski argue, "it is more fruitful to adopt the principle that data is what its makers and users have considered it to be."[286] Given the ubiquity of the questionnaire in multiple disciplines throughout the nineteenth century, many examples could have been presented here for analysis. This chapter adopts a specifically linguistic focus, however, and primarily considers questionnaires that have been used to collect data on spoken aspects of language, such as dialect or slang.

The Case Study

This chapter explores a number of debates that occurred between scholars of language concerning the various approaches to the research method, and which were informed by conflicting ideas of what was considered to be rigorous and objective research. Attempts were made to standardise these choices in order to define the questionnaire method as part of a discipline of linguistics. In doing this, the scholars also determined the boundaries of the discipline, which until the early twentieth century remained open, and the field of language research broad. By following the development of this important data practice within linguistic research, I throw light onto the development of the discipline as a whole. The transition from language studies to linguistics, and even to general linguistics, took place over the course of the nineteenth and early twentieth century, and can be traced by studying the development of the questionnaire as a linguistic data practice.

The focus of linguistic research was initially the search for common linguistic origins, and the changes that languages underwent. This involved a comparative historical approach that looked at languages over time, and that dominated nineteenth-century linguistics.[287] By the late nineteenth century, the emerging social sciences were beginning to have an effect on language study. Sociologists, ethnologists, psychologists, and anthropologists were starting to see language as a distinguishing factor between peoples, whilst linguists were adopting theories from psychology and anthropology to explain the uses of language. The questionnaire enabled the addition of an ethnological–or social–dimension to the study of language.

286 Aronova, E., von Oertzen, C., & Sepkoski, D. (2017) "Introduction: Historicizing Big Data" in: *Osiris*, 32, pp 1-17, p 13.

287 For an overview of nineteenth century linguistics, see Morpurgo Davies, A. (1998) *History of Linguistics: Volume IV: Nineteenth-Century Linguistics*. Series edited by G. Lepschy, Longman, London; Robins, R.H. (1964) *General Linguistics: An Introductory Survey*. Indiana University Press, Bloomington; Dinneen, F.P. (1995) *General Linguistics*. Georgetown University Press, Washington.

3.1 INTRODUCTION

The end of the nineteenth century also saw the emergence of the social sciences as distinct academic disciplines.[288] This chapter argues that by helping researchers to capture and record that which was difficult to grasp and observe–such as social conditions or spoken language–the questionnaire contributed to emergent social scientific research.

Even today, the practice of linguistics is not easily contained within the humanities, nor within the social, human, or natural sciences; linguistic research is often interdisciplinary or multidisciplinary, and self-reflexive discussions about the discipline's boundaries predominate.[289] Nineteenth-century scholars were actively involved in such disciplinary debates, and conversations about a discipline's methodologies and boundaries played an important role here. These methodological debates took place at formalised gatherings such as scientific congresses, which were a growing phenomenon in the nineteenth century.[290]

As we saw in Chapter 2, data practices were shared between disciplines at the same time as disciplinary boundaries were created, and it is precisely this tension between processes of sharing and division as they related to nineteenth-century academic disciplines that this dissertation examines. This chapter looks specifically at how the questionnaire was used as a data practice in linguistics, while also being developed in several other disciplines. I want to understand how the questionnaire was changed in the process, and how the discipline of linguistics was influenced by and had an influence upon these developments.

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288 Heilbron, J. (1995) *The Rise of Social Theory*. Translated by Sheila Gogol from (1990) *Het ontstaan van de sociologie*. Prometheus, Amsterdam, Polity Press, Cambridge.

289 For example, Victor Yngve has published *From Grammar to Science* (1996) in which he has argued for linguistics to be seen as a science. Contemporarily, Francis P. Dinneen has shown how various disciplines from humanities, social sciences, and natural sciences all have an influence on linguistics and that linguistics is therefore inherently interdisciplinary. Yngve, V.H. (1996) *From Grammar to Science. New Foundations for General Linguistics*. John Benjamins Publishing Company, Amsterdam; Dinneen (1995). The discussion is still an active one, as can also be seen from how the discipline is treated in various academic institutions and how scholars have connected the discipline of linguistics with many other disciplines, like in Nefdt, R., Klippi, C. & Karstens, B. [eds] (2020) *The Philosophy and Science of Language: Interdisciplinary Perspectives*. Palgrave MacMillan, London.

290 Fuchs, E. (2002) "The Politics of the Republic of Learning: International Scientific Congresses in Europe, the Pacific Rim, and Latin America", in: E. Fuchs & B. Stuchtey [eds] *Across Cultural Borders: Historiography in Global Perspective*. Rowman & Littlefield, Lanham, pp 205-244.

Section 3.2 begins in the sixteenth century, and then moves to a detailed discussion of the late eighteenth-century Abbé Grégoire (1750-1831). Grégoire conducted research into French dialects, with the intention of eradicating regional variation in order to unite the French people under a standardised language. As a result, the questionnaire that he used in his research had a clear political aim. Section 3.2 also outlines the role of questionnaires in the development of language studies in the eighteenth and nineteenth centuries. This allows a picture to emerge of what constituted early language studies, as well as how this broad field of research transformed into the increasingly institutionalised discipline of linguistics in the nineteenth and early twentieth century.

The development of the questionnaire in these early language studies contexts is then picked up in section 3.3, as the field moves towards linguistics. I analyse national dialectological questionnaires, conducted by Georg Wenker and Jules Gilliéron in the late nineteenth century, which included questions on the social conditions of dialect speakers. Wenker and Gilliéron differed from one another in their approach to the use of questionnaires in their research, and this section juxtaposes their approaches, as well as the conditions within which their choices were made.

The questionnaire became part of the discipline of linguistics, and in section 3.4 I examine how the development of linguistics involved the questionnaire. This section surveys the efforts of Meillet and his student and colleague Marcel Cohen (1884-1974) to establish an international, standard linguistic questionnaire. Meillet brought the topic to the first International Congress of Linguists, an event that was organised in part due to Meillet's own advocacy. Section 3.4 evaluates the ways in which this congress addressed not only the questionnaire, but the discipline of linguistics as a whole.

The section also shows how these developments were intrinsically linked to the formation of the social science disciplines. A direct connection between linguistics and sociology is apparent in the case of Antoine Meillet, who was influenced by the linguist Ferdinand de Saussure (1857-1913) and collaborated with one of the founders of French sociology, Émile Durkheim (1858-1917). Section 3.5 then offers a more in-depth analysis of this connection between linguistics, sociology, and the other social sciences.

As a whole, this chapter examines the development and utilisation of the questionnaire as a data collection method, a tool that enables the precise collection of readily analysable data. Given that the questionnaire plays an important role in multiple fields, tracking its use across disciplinary boundaries offers a rich study of the relationship between disciplines, uncovering interactions within and across the human and social sciences. In this way, this dissertation adds to recent data histories by

highlighting disciplinary boundaries, for framing the questionnaire as a data collection method allows an analysis of a given linguist's disciplinary activity. Focusing on the questionnaire in linguistics therefore enables a *longue durée* history of the discipline, as well as its relationships with others.

3.2 Early Questionnaires and Language Studies

To properly ground the questionnaire as a data practice, this section introduces and contextualises questionnaire research conducted between the sixteenth and nineteenth centuries. Although I pay particular attention to how questionnaires are designed to collect information that pertains to spoken aspects of language, it is important to say that questionnaires have also had many other applications, and affinities with other disciplines. It should also be noted that the fields of research discussed here were not as established or institutionalised as they are today. Disciplines such as anthropology, sociology, or linguistics emerged and were institutionalised over the course of the nineteenth and early twentieth century, and this disciplinary activity invited scholars to reflect upon and discuss the methods that their disciplines were employing. That will be the focus of later sections.

Early Questionnaires

Questionnaires have been part of scholarly efforts to collect linguistic data for many centuries. Perhaps the earliest examples of questionnaires can be found in attempts to chart the Spanish Kingdom in the sixteenth century; the specifics of how these questionnaires were originally constructed remains unclear, but the project was taken up in earnest in 1577 by the cosmographer and historian Juan López de Velasco (ca. 1530-before 1598). Velasco's scholarly ideal was to utilise the same questionnaire to investigate all parts of the Spanish Kingdom, thus uniting it for the first time.[291] The questionnaire consisted of fifty questions on the topics of cosmography, natural history, and ethnography–which included language–and was sent to all Spanish dependencies in the New World. Thanks to the questionnaire's conscientious respondents, the results were compiled to form what is now known as the *Relaciones Geográficas de Indias*.

To ensure that the collection of data relating to people (along with other subjects

291 For more on the colonial investigations in the Spanish Kingdom, see Portuondo, M. M. (2009) *Secret Science: Spanish Cosmography and the New World*. The University of Chicago Press, Chicago. Velasco's questionnaire is discussed on pages 212-3.

such as plants, animals, and places) was carried out in a systematic manner, manuals were published throughout the seventeenth, eighteenth, and nineteenth centuries. A number of these have been collected by Silvia Collini and Antonella Vannoni as *Les Instructions Scientifiques pour les Voyageurs (XVIIe – XIXe siècle)*,[292] in which one reads instructions for travellers on how to systematically collect information, as well as what to observe and measure during an expedition. Some of these included questionnaires for gathering linguistic data, thereby placing the questionnaire firmly in a tradition of natural historical research.

These questionnaires were mostly intended to be used by colonial travellers. However, the practice of collecting languages was not restricted to the study of other territories; questionnaires were also used to collect linguistic data from within the researcher's country of origin. In the aftermath of the French Revolution, for example, a need was felt to survey the newly emerging French society.[293] One aspect of this larger endeavour was the drive to get a clearer understanding of the language that was being spoken. In order to collect information on this and, simultaneously, to poll the citizens on the new laws and political systems, the French clergyman Henri Jean-Baptiste Grégoire–usually referred to as Abbé Grégoire–created and distributed a questionnaire. Grégoire's goal was clear: he wanted to eradicate all of the dialects in France and thereby unify the nation under a single, standardised language. He reported his results in *Rapport sur la Nécessité et les Moyens d'Anéantir les Patois et d'Universaliser l'Usage de la Langue Française* (1794). Grégoire published the questionnaires, which he claimed were a study of "the dialect and manners of the people from the countryside," in newspapers, and received 49 replies from French citizens. Most of the respondents were fellow clergymen, professors, doctors, or individuals with professions related to the judiciary.[294]

292 Collini, S. & Vannoni, A. (2005) *Les Instructions Scientifiques Pour les Voyageurs (XVIIe – XIXe siècle)*. Le Harmattan, Paris.

293 For more on this history, see Bourguet, M. (1988) *Déchiffrer la France. La statistique départementale à l'époque napoléonienne*. Éditions des Archives Contemporaines, Paris.

294 De Certeau, M., Julia, D. & Revel, J. (1975) *Une politique de la langue: La Révolution française et les patois. L'enquête de Grégoire*. Gallimard, Paris, p 30.

The correspondents were distributed widely around France. Grégoire's questionnaire started with the following four questions:[295]

1. Is the use of the French language general in your region? Do you speak one or more dialects?
2. Does the dialect have an ancient and well-known origin?
3. Does it have many radical terms, many compound terms?
4. Are there words derived from Celtic, Greek, Latin, and in general from ancient and modern languages?

Despite Grégoire's objective of amassing a wealth of information on spoken language in France, his questions could only be answered in full if respondents had a certain theoretical grasp of language and linguistics. Towards the end of the questionnaire, the tenor of the questions changed from linguistic to political. The final five were as follows:[296]

1. Over the last twenty years or so, have the people of the countryside become more enlightened? Are their morals more depraved? Have their religious principles weakened?
2. What are the causes and what would the remedies be for these ills?
3. What moral effects does the current revolution have on them?
4. Do they have patriotic feelings, or only the affectations of self-interest?
5. Are not the clergymen and the former noblemen subjected to gross insults, outrages by peasants, and despotism by mayors and municipalities?

295 De Certeau *et al.* (1975), p 12: "(1) L'usage de la langue française est-il universel dans votre contrée. Y parle-t-on un ou plusieurs patois ? (2) Ce patois a-t-il une origine ancienne et connue ? (3) A-t-il beaucoup de termes radicaux, beaucoup de termes composés ? (4) Y trouve-t-on des mots dérivés du celtique, du grec, du latin, et en général des langues anciennes et modernes ?" (my translation)

296 De Certeau *et al.* (1975), p 13-4: "(39) Depuis une vingtaine d'années, sont-ils plus éclairés ? leurs moeurs sont-elles plus dépravées ? leurs principes religieux ne sont-ils pas affaiblis ? (40) Quelles sont les causes et quels seraient les remèdes à ces maux ? (41) Quels effets moraux produit chez eux la révolution actuelle ? (42) Trouve-t-on chez eux du patriotisme ou seulement les affections qu'inspire l'intérêt personnel ? (43) Les ecclésiastiques et les ci-devant nobles ne sont-ils pas en butte aux injures grossières, aux outrages des paysans et au despotisme des maires et des municipalités ?" (my translation)

Here, Grégoire's political intentions come to the fore, and his respondents consisted only of those who felt qualified to reply to this biased call. As a result, the replies were too few and too divergent to be the ground for any action as a result of the report.[297]

Grégoire's questionnaire is a key example of efforts, during the Napoleonic era, to create a system of state sciences. As part of its war effort, the French state went about centralising and expanding the collection and distribution of information about its population and geography, and this attitude towards demographic statistics had a considerable influence on many surrounding nations.[298] This project was underpinned by the idea that descriptive, qualitative observations were a more accurate barometer than numbers, and significant here is that questionnaires were frequently used by statisticians to collect such observations. One example is that, in preparation for the second International Statistical Congress in 1855, attending members were given instructions on how to collect and assess information using a questionnaire which they were sent in advance. At the congress itself, although these questionnaires were not discussed explicitly, some members presented statistics that they had brought with them in order to highlight and discuss certain variations between countries. This was only possible because they had applied the same method of data collection and ordered the resultant information in the same way.[299] Similarly, the first psychological questionnaires collected mostly descriptive data. The questions were open-ended, producing expansive bodies of descriptive responses. A drastic change to this more discursive study came in 1932, when the American psychologist Rensis Likert (1903-1981) published the first numerically-scaled psychological questionnaire, which were consequently employed as standard method in the psychology discipline.[300]

These changes to the questionnaire as data practice illustrate the development of the method in multiple disciplines and research fields. Before discussing the role of the data practice in nineteenth-century linguistics specifically, I will first consider the historical development of the field of linguistics during this period.

297 Grégoire's report is discussed in further detail in De Certeau *et al.* (1975).

298 Hansen, J.D. (2015) *Mapping the Germans: Statistical Science, Cartography, & the Visualization of the German Nation, 1848-1914*. Oxford University Press, Oxford, p 39. This is also discussed in Chapter 2 on nineteenth century statistics.

299 *Compte Rendu de la Deuxième Session du Congrès International de Statistique* (1855). Madame Veuve Bouchard-Huzard, Paris, pp 78-83; 117-120; 303-309.

300 Young (2017), p 32-3.

Early Language Studies

As mentioned above, the field of language studies developed into the discipline of linguistics during the nineteenth century. At the end of the eighteenth century, the English term "linguistics" was first coined.[301] This proto-discipline consisted of many fields of research, and scholars came from various backgrounds, ranging from comparative historical, philological, dialectological, phonetic, and physiological, to anthropological, sociological, psychological, and geographical; linguists accordingly approached the object of language in different ways, given their multifarious backgrounds. This produced a diffuse field of research with little unity, such that there was no discrete discipline to speak of. This changed in the nineteenth century however, just as we have seen in previous chapters, as modern, empirical disciplines began to emerge.

Where linguistics was concerned, the challenge was to unite the various strands into a broader study of language. In the nineteenth century, the primary focus of research was how to study language change. A new approach was developed, mainly in Germany, of which one of the central goals was a general descriptive coverage and comparison between languages at various stages of their development, using a uniform and empirical-scientific method.[302] Comparative historical linguistics in the nineteenth century was mostly a question of problem-solving and concrete results, and included little theoretical discussion, though the work was still embedded in linguistic theory. In this sense, linguistics came increasingly to be seen as an empirical study.

The linguistic work of Wilhelm von Humboldt (1767-1835), for example, demonstrates this empirical approach, then rather radical for the early nineteenth century. Humboldt was less taken with the textual details of languages and linguistic forms, and disdained the study of language as a collection of rules and words. Instead, he worked on explaining intellectual and cultural differences through text, and on identifying an essential unity of language.[303] His *Kawi Sprache* (1836) has been called the "first book on general linguistics," and in it Humboldt describes a theoretical link between language and thought, anticipating the later Sapir-Whorf hypothesis which states that language determines cognitive processes.[304]

301 Joseph, J.E. (2012) *Saussure*. Oxford University Press, Oxford, p 70.

302 Elffers, E. (2012) "The Rise of General Linguistics as an Academic Discipline" in: Bod, R.; Maat, J.; & Weststeijn, T. [eds.] *The Making of the Humanities; Volume II From Early Modern to Modern Disciplines*, Amsterdam University Press, pp 55-70, p 56-57.

303 Joseph (2012) p 80 & 88.

304 Morpurgo Davies (1992) p 103 & 114.

In 1821, Franz Bopp (1791-1867) was appointed the chair of comparative historical linguistics at the University of Berlin. Bopp's research focused on the search for a common origin of all languages, and involved a general perspective on language based on a comparison between many different languages over time. Hence the name of his chair, "Allgemeine Sprachkunde" (General linguistics).[305] Throughout the nineteenth century, the comparative approach was considered by most scholars to be the one best suited to linguistics. Whilst Bopp saw comparative historical linguistics as complementary to philological research, other linguists saw these approaches as distinct and attempted to move away from the more traditional philology.[306]

Two approaches to understanding language change emerged. Following the Hegelian distinction between *Natur* and *Geist*, the German linguist August Schleicher (1821-1868) theorised a division of the discipline into two parts; one that he considered to belong to the *Geisteswissenschaften*–philology–and one that he claimed was studied by the *Naturwissenschaften*–lawful language change. To the latter he gave a natural scientific name, designed to resemble "Botanik" and "Physik": *Glottik*.[307] This distinction became highly influential for scholars of language in the nineteenth century, who either embraced and reinforced the separation or sought to counter it. According to Schleicher, linguistics was a natural science, and language subject to natural laws. One could understand language, and differences between languages, by studying these laws–which were considered stable–and this had nothing to do with stylistics or interpreting texts.

As did Quetelet's social physics, Schleicher used numerous metaphors from the natural sciences, and claimed that languages could be studied like organisms because they could be classified into genera, species, and subspecies. Indeed, he was not the only linguist to employ these metaphors; an organistic view of language was already present, for example, in the work of Friedrich von Schlegel (1772-1829).

305 Karstens, B. (2012) "Bopp the Builder: Discipline Formation as Hybridization: The Case of Comparative Linguistics" in: R. Bod, J. Maat, & T. Weststeijn [eds] *The Making of the Humanities, Vol. 2: From Early Modern to Modern Disciplines*. Amsterdam University Press, pp. 103–127.

306 On the relationship between linguistics and philology before 1850, see Solleveld, F. (2018) *The Transformation of the Humanities: Ideals and Practices of Scholarship between Enlightenment and Romanticism, 1750-1850*. Dissertation, Radboud Universiteit Nijmegen.

307 Yngve (1996), p 25-26; Elffers, E. (2008) "Georg von der Gabelentz and the rise of general linguistics" in: L. Van Driel & T. Janssen [eds] *Ontheven aan de tijd: linguïstisch-historische studies voor Jan Noordegraaf bij zijn zestigste verjaardag*. Uitgaven / Stichting Neerlandistiek VU Amsterdam, Amsterdam, No. 57, pp 191-200, p 8.

The opposition organic-inorganic, as well as organic-mechanic, serves as the basis for organicism: the contrast between organisms with their own motivation or impulse for development, and mechanisms, which are formed by parts that artificially make up a whole.[308] Language, then, was seen as the organic expression of a people or a nation in its totality. For linguists who followed organicist lines of inquiry, the focus was on the organisms as such, their structure, development, and history. Thinking in terms of organisms in such a way stems from biology, and it was due to biology's growing popularity that other disciplines started to do so as well.

As E.F. Konrad Koerner has explained, although Schleicher's ideas were not always original, "it cannot be sufficiently stressed that Schleicher, taking up ideas coming from outside the realm of linguistics, worked out an overall theory of language based on his conviction that linguistics should imitate the natural sciences and therefore adopt a methodology no less rigorous than that of botany—in matters of formal classification—and comparative anatomy—in matters of systematic comparison of languages and, in effect, matters concerning linguistic reconstruction."[309] For these language studies scholars, the organicist approach was a justification for their discipline, and therefore, because linguistics used scientific methods, it could be seen as an autonomous discipline. Other scientific analogies contributed to this framing, themselves also primarily a validation of language studies. Georges Cuvier's (1769-1832) comparative anatomy was used in comparative linguistics, for example, and classifications of language were based on ideas from botany and zoology.[310] These flows, occurring at the start of the nineteenth century, were central to the development of comparative historical linguistics.

At the end of the nineteenth century, however, linguists began to take issue with this separation of a lawlike linguistics from the social and human aspects of language.[311] The emerging social sciences–and in particular, the study of social factors as though they were subject to laws–had an effect on the field of language study. Not only did ethnologists and anthropologists analyse language as a distinguishing factor between

308 Morpurgo Davies (1992) p 86.

309 Koerner, K. (1989) *Practicing Linguistic Historiography. Selected Essays*. John Benjamins Publishing Company, Amsterdam, p 360.

310 Both analogies are mentioned in Morpurgo Davies (1992) p 90-92. She claims that "the organicism shared by both sciences and arts underlines and guarantees the unity of knowledge." (p 91) Morpurgo Davies' statement shows the fundamental claim of this report, development in knowledge through sharing something like an analogy.

311 Yngve (1996), p 28.

peoples, linguists used theories from psychology and anthropology to explain the uses of language. Since all of these disciplines were concerned with understanding humankind and its endeavours, overlaps such as these were inevitable.[312]

During the final quarter of the nineteenth century, the University of Leipzig was a centre for the study of language change.[313] Here, a group of scholars formed a school of linguistics under the name of the *Junggrammatiker*, or Neogrammarians. The Neogrammarians studied language change through changes in the sounds of spoken language, and hypothesised that sound change is a simultaneous process for all appropriate lexical items as a part of language change.[314] They claimed that sound change is phonetically gradual and lexically abrupt, though this thesis has been heavily criticised since, its critics pointing out that there are too many exceptions for such a theory to hold. To this, the Danish Neogrammarian Karl Verner (1846-1896) famously replied "no exception without a rule."[315]

The Neogrammarians also innovated another approach to linguistic study. They claimed that the object should not be the language system, but instead the idiolect, the language as it is localised in the individual.[316] On the one hand, this made spoken language directly observable, and therefore research into that language more accessible and better defined. What is more, it coincided with the trend described above of including the users of a language in the study of it. On the other hand, a focus on the idiolect was seen to be too much of an abstraction and overly superficial, since it did not progress beyond surface phenomena.

As was common in the nineteenth century, the Neogrammarians were interested in describing the historical change of a language.[317] For these scholars, however, it was important that language change be studied in the context of the behaviour and culture of its speakers, and in this sense, their approach differed from Schleicher's definition, for instance. With the Neogrammarians, the search for a historical description, the trust in laws and analogies to explain exceptions, and the focus on the individual speaker were all combined. Still, the Neogrammarians continued to operate within and upheld the historical-comparative frame of studying language.

312 Robins (1964), p 352-358.

313 Joseph (2012) p 98.

314 Robins (1964) p 317.

315 Dinneen (1995) p 222.

316 Idem, p 248.

317 Yngve (1996) p 29.

In sum, the various fields of language studies came gradually to be more organised around research schools and at universities. With the introduction of the term linguistics, scholars had a common field of study and, with the comparative historical approach, the beginnings of a shared methodology. The study of language change went from being an interest in the connections between particular languages over time and in different regions, to a focus on the people and situations in which languages are spoken. This transformation is illustrated in the following section, where I discuss how questionnaires were used to research language change between different regions.

As discussed above in the case of its early ethnological iterations, the questionnaire was used to collect descriptive data about the languages spoken and the cultures in a given country. Questionnaires were either printed in newspapers to facilitate distribution, or given to travellers on their voyages overseas. In both instances, the method was deployed indirectly; the researcher is left to interpret the answers that have been written down by others. The results of such research were presented as reports; in Grégoire's case in particular, a political motivation for the report was evident. His research echoed the view of many other scholars who studied a country through the languages that were spoken there: a country's spoken language was considered a key factor in its unification, and was therefore a useful window onto a study of the peoples of a certain territory. This demonstrates a clear link between ethnological and linguistic research, something that will continue to play an important role in the following sections.

3.3 Adapting the Questionnaire in Dialect Research

In the previous section I discussed how the questionnaire was used across a range of research contexts to gather linguistic data. I also looked at the field of language studies which, once encompassing a wide array of research fields, was increasingly institutionalised over the course of the nineteenth and early twentieth century to become the discipline of linguistics. I will now turn to assess the use of the questionnaire in two foundational linguistic projects: the dialectological research of George Wenker and Jules Gilliéron in Germany and France respectively. Wenker and Gilliéron were both scholars of dialectology whose careers spanned the late nineteenth and early twentieth centuries, and both employed similar data practices. These included questionnaires, although the two scholars approached the method in different ways, according to their respective research aims. This section discusses these variations, in order to evaluate how this particular data practice was shared between and embedded

in different contexts.

As we saw in section 3.2, Abbé Grégoire's report signalled an interest in collecting data on dialects, albeit for the political purpose of unification through a standard language. In the nineteenth century, research into dialects, or dialectology, established itself as a discrete field within the study of languages. A key debate at the time concerned the existence of geographical boundaries between different dialects, with the two opposing groups maintaining either that language differences were divisible into distinct and regular parts, or that language differences were continuous and difficult to pin down to a specific location.[318] A methodological difficulty for linguistic cartographers here was the discrepancy between data collected at the level of sounds or words and the total picture of the map, which illustrated a whole language or dialect. Hence, certain data practices were required to gather those data capable of making sense of the dialect in question. For this purpose, the dialectologists opted for a questionnaire.

In the field of language geography and dialectology, two projects in particular are considered linguistic milestones: the language atlases of the German dialectologist Georg Wenker and his Swiss colleague Jules Gilliéron. These works–Wenker's *Sprachatlas des deutschen Reichs* and Gilliéron's *Atlas Linguistique de la France*–were the outcome of the two scholars' individual attempts to map the dialects of Germany and France respectively. Wenker and Gilliéron both used the questionnaire as a research method, and both made a number of significant, divergent choices in how they used it. Their contrasting approaches illustrate a number of possible adaptations of the method, and the effects that these may have on research. In the following two sections, I juxtapose the two projects, to discuss Wenker and Gilliéron's different choices and their effects on the collection and processing of data.

The tradition of linguistic atlases predates the nineteenth century.[319] Whilst it can be argued that the generic terminology was not as rigorously observed in the nineteenth century as it is now (Balbi's *Atlas Ethnographique du Globe* (1826) contains no cartographic material, for instance), the first work to have *Sprachatlas* in its title was published in 1823, Julius Klaproth's *Asia Polyglotta*.

318 Amsterdamska, O. (1987) *Schools of Thought: The Development of Linguistics from Bopp to Saussure*. D. Reidel Publishing Company, Dordrecht, p 144.

319 Edmond Halley's isogonic map of 1701 is widely considered to be one of the first thematic maps, but his map–depicting magnetic fields–did not concern linguistic data. Lameli, A. (2010) "Linguistic Atlases: Traditional and Modern" in: P. Auer & J.E. Schmidt [eds] *Language and Space: An International Handbook of Linguistic Variation, Volume 1: Theories and Methods*. De Gruyter, Mouton, Berlin, pp 567-591.

Klaproth's *Sprachatlas* gives an ethnological presentation of multilingual relations in Asia: rather than listing the languages, Klaproth focused on the speakers. Following this, Bernardino Biondelli's 1841 *Atlante Linguistico d'Europa* can be considered the first systematic linguistic atlas. These maps were accompanied by texts on regional subgroups, historical facts, and other information that was not directly deducible from the map.[320] Wenker and Gilliéron's projects marked a development in this respect: they were able to convey more data due to their stricter practices of data collection.

Georg Wenker's Sprachatlas

The German linguist Georg Wenker was interested in the geographical distribution of the German dialect, and sent questionnaires to schoolmasters across the German districts in order to study it. Wenker operated according to his belief that language differences were regular.[321] His *Fragebogen-Erhebungen* consisted of 40 sentences which the schoolteachers were asked to translate into their local dialect (see Figure 11). Over the course of the project, Wenker adjusted the instructions in light of his experience. For example, he emphasised his request that respondents write in a clearly legible manner "to protect my eyes (I will have to process more than 50,000 translations!) I ask you for clear writing and good ink."[322] In his letter to the schoolmasters, Wenker made some additional comments about the transcription of certain phonetic elements: "vowels that are spoken through the nose are to be indicated by a – placed below, the open e [...] I ask with è, the closed e [...] with é, for length and brevity the known characters - and ~."[323] From the comment on "known characters," it can be deduced that the schoolteachers already had an idea of how to transcribe certain phonetic characteristics.

It has also become clear from a recent study of Wenker's notes that an important role in this arrangement was played by school inspectors, whom Wenker instructed

320 Lameli (2010), p 570-2.

321 Kehrein, R. (2017) "Languages" in: S.D. Brunn & M. Dodge [eds] *Mapping Across Academia*. Springer, Dordrecht, pp 183-208, p 193.

322 Quoted in Fleischer, J. (2017) *Geschichte, Anlage und Durchführung der Fragebogen-Erhebungen von Georg Wenkers 40 Sätzen. Dokumentation, Entdeckungen und Neubewertungen*. Georg Olms Verlag, Hildesheim, p 192: "Zur Schonung meiner Augen (über 50,000 Übersetzungen werde ich zu verarbeiten haben!) darf ich wohl um klare Schrift und gute Tinte bitten."

323 Quoted in Fleischer (2017), p 192: "Vokale, die durch die Nase gesprochen werden, bitte ich durch ein darunter gesetztes – zu bezeichnen, das offene e (z.B. in sehr) bitte ich mit è, das geschlossene e (z.B. in beste) mit é wiederzugeben, für Länge und Kürze die bekannten Zeichen – und ~ anzuwenden."

to make sure that the questionnaires were being filled in correctly.[324] The inspectors also contributed to the selection of the schools. Wenker referred to "doublets" (*Doubletten*) when a location returned more than one form, and in general doublets were to be avoided–he asked school instructors to be aware of this. Nevertheless, he did not overlook the potential significance of doublets in larger towns and cities: variations within doublets could, for example, indicate differences between social groups, which could in turn lead to so-called intra-local variation; such cases were dealt with specifically. In earlier projects, Wenker had chosen to combine multiple items that he saw as belonging to a certain linguistic relationship, or to a similar regional distribution, in one map. In the larger *Sprachatlas des deutschen Reichs* project, however, the maps show the many details captured by data from over 40,000 locations. This was achieved using sheets of transparent paper which could be superimposed over the base map. Wenker's method thus enabled further linguistic and sociolinguistic analyses.[325]

Wenker's questionnaire had the extraordinarily high response rate of almost 80%. This meant that Wenker had to process over 45,000 forms, making his method extremely labour-intensive, notwithstanding the system of doublets. Parts of these maps were published after Wenker's death in 1911–the first in 1889, and the last in 1923. The project was well received, and widely considered to be the best attempt then completed at determining the nature and specifics of German local speech. The most important characteristic of the *Sprachatlas des deutschen Reichs* however was its comparability: because the data from all regions were based on the same sentences, they could be analysed comparatively.[326]

324 Fleischer (2017).

325 Lameli (2010), p 575-6; Fleischer (2017), p 63.

326 Lameli (2010), p 576.

1. Im Winter fliegen die trocknen Blätter durch die Luft herum.
2. Es hört gleich auf zu schneien, dann wird das Wetter wieder besser.
3. Thu Kohlen in den Ofen, daß die Milch bald an zu kochen fängt.
4. Der gute alte Mann ist mit dem Pferde durch´s Eis gebrochen und in das kalte Wasser ge fallen.
5. Er ist vor vier oder sechs Wochen gestorben.
6. Das Feuer war zu stark/heiß, die Kuchen sind ja unten ganz schwarz gebrannt.
7. Er ißt die Eier immer ohne Salz und Pfeffer.
8. Die Füße thun mir sehr weh, ich glaube, ich habe sie durchgelaufen.
9. Ich bin bei der Frau gewesen und habe es ihr gesagt, und sie sagte, sie wollte es auch ihrer Tochter sagen.
10. Ich will es auch nicht mehr wieder thun!
11. Ich schlage Dich gleich mit dem Kochlöffel um die Ohren, Du Affe!
12. Wo gehst Du hin? Sollen wir mit Dir gehn?
13. Es sind schlechte Zeiten.
14. Mein liebes Kind, bleib hier unten stehn, die bösen Gänse beißen Dich todt.
15. Du hast heute am meisten gelernt und bist artig gewesen, Du darfst früher nach Hause gehn als die Andern.
16. Du bist noch nicht groß genug, um eine Flasche Wein auszutrinken, Du mußt erst noch ein Ende/etwas wachsen und größer werden.
17. Geh, sei so gut und sag Deiner Schwester, sie sollte die Kleider für eure Mutter fertig nähen und mit der Bürste rein machen.
18. Hättest Du ihn gekannt! dann wäre es anders gekommen, und es thäte besser um ihn ste hen.
19. Wer hat mir meinen Korb mit Fleisch gestohlen?
20. Er that so, als hätten sie ihn zum dreschen bestellt; sie haben es aber selbst gethan.
21. Wem hat er die neue Geschichte erzählt?
22. Man muß laut schreien, sonst versteht er uns nicht.
23. Wir sind müde und haben Durst.
24. Als wir gestern Abend zurück kamen, da lagen die Andern schon zu Bett und waren fest am schlafen.
25. Der Schnee ist diese Nacht bei uns liegen geblieben, aber heute Morgen ist er geschmol zen.
26. Hinter unserm Hause stehen drei schöne Apfelbäumchen mit rothen Aepfelchen.
27. Könnt ihr nicht noch ein Augenblickchen auf uns warten, dann gehn wir mit euch.
28. Ihr dürft nicht solche Kindereien treiben!
29. Unsere Berge sind nicht sehr hoch, die euren sind viel höher.
30. Wieviel Pfund Wurst und wieviel Brod wollt ihr haben?
31. Ich verstehe euch nicht, ihr müßt ein bißchen lauter sprechen
32. Habt ihr kein Stückchen weiße Seife für mich auf meinem Tische gefunden?
33. Sein Bruder will sich zwei schöne neue Häuser in eurem Garten bauen.
34. Das Wort kam ihm von Herzen!
35. Das war recht von ihnen!
36. Was sitzen da für Vögelchen oben auf dem Mäuerchen?
37. Die Bauern hatten fünf Ochsen und neun Kühe und zwölf Schäfchen vor das Dorf gebracht, die wollten sie verkaufen.
38. Die Leute sind heute alle draußen auf dem Felde und mähen/hauen.
39. Geh nur, der braune Hund thut Dir nichts.
40. Ich bin mit den Leuten da hinten über die Wiese ins Korn gefahren

FIGURE 11 This figure shows the 40 sentences that Wenker sent to the schoolmasters.[327] They are composed in such a way as to cover multiple pronunciations of vowel and consonant combinations. They also include words that were known to differ in pronunciation for different regions.

327 Wenker, G. (1888–1923) *Sprachatlas des Deutschen Reichs*. Marburg. And idem (2013/2014) *Schriften zum "Sprachatlas des Deutschen Reichs". Gesamtausgabe*. Edited by A. Lameli, J. Heil & C. Wellendorf, Olms, Hildesheim, New York, Zürich. Published as *Digitaler Wenker-Atlas (DiWA)*; URL www.regionalsprache.de.

Jules Gilliéron's Atlas Linguistique de France

At the same time as Wenker's *Sprachatlas* was being compiled, similar research was developing in France. The Swiss-French dialectologist Jules Gilliéron believed that dialects had no fixed boundaries, and that "each commune on the one hand, and each form, each word on the other, should have its own purely descriptive monograph, made first-hand and assembled with all the observational rigour required by the natural sciences."[328] This project of linguistic research was to be both descriptive and natural-scientific in nature, and as such, Gilliéron held that meticulous observational methods should be adopted. In order to achieve this required rigour, he adopted the questionnaire form. By the late nineteenth century, then, the method–from its eighteenth-century origins in natural historical research–was being used in decidedly scientific contexts.

Whilst Wenker sent his questionnaire to approximately 50,000 schoolteachers in Germany, Gilliéron did not adopt this postal approach, instead having a fieldworker use the questionnaire to interview participants directly. The motivating factor for this approach was Gilliéron's assumption that Wenker's postal questionnaire was not sufficiently accurate, because linguistic laypeople were allowed to respond to it.[329] His fieldworker, meanwhile, was trained to listen to phonetics and to carefully record the responses given by his subjects. For this purpose, Gilliéron instructed Edmond Edmont (1849-1926) to cycle around France and interview people in 639 villages over the course of four years. Edmont, originally a grocer, went from village to village and spoke to people face to face. He was a trained phonetician who developed his own notation in order to transcribe the dialects he heard, and once he had the responses he sent them to Paris, where Gilliéron processed them and produced the thirteen-volume *Atlas Linguistique de la France*, published between 1902 and 1910.[330] Gilliéron's method of direct interviews can be seen as a departure from the indirect method of questioning which was then prominent, shown by the examples discussed in the previous section. Edmont visited 639 communes spread across France. As Gilliéron announced, "the *Linguistic Atlas of France* is the result of more than four consecutive years of zigzag-

328 Gilliéron, J. & Edmont, E. (1902) *Atlas linguistique de France: Notice servant à l'intelligence des cartes*. Champion, Paris, p 3: "Il faudrait que chaque commune d'un côté, chaque forme, chaque mot de l'autre, eût sa monographie, purement descriptive, faite de première main, et tracée avec toute la rigueur d'observation qu'exigent les sciences naturelles."

329 Idem; Kehrein (2017), p 195.

330 Chambers, J.K. (1998) "Inferring Dialect from a Postal Questionnaire" in: *Journal of English Linguistics*, *26*(3), pp 222-46, p 223.

ging."[331] In recording the data, Edmont had a great deal of freedom: he selected his subjects, and sat with them as they worked through the long questionnaire. Indeed, it was important to Gilliéron that Edmont was free to choose the conditions of the interviews, though he did tell Edmont to transcribe only the first answer given, and to discount further, multiple responses.[332] This stipulation appears to have been an attempt to ensure the spontaneity of the responses, which Gilliéron believed his approach to the questionnaire would record.

Gilliéron's questionnaire consisted of three parts. The first, designed to establish the phonetic rules of each dialect, included a list of isolated common words.[333] In the second, the participants were asked about a number of isolated words that were known by Gilliéron and his colleagues to vary across multiple regions. Lastly came one hundred simple phrases, composed of words from the first two sections plus a selection of new words. These phrases were constructed in such a way as to give an almost complete overview of the regular verb forms.[334] The questionnaire was lengthy, reflecting Gilliéron's complex linguistic ideas about regional dialects.

Comparability was also the main aim of Gilliéron's project to create a linguistic atlas of France. The questionnaire collected responses that Gilliéron and his assistants compiled into a total of 1,920 maps which were then published alphabetically (see Figure 13). These maps presented the differences in spoken language across France, and allowed linguists to draw conclusions relating to language change and grammatical structure across given regions.[335] In addition to the maps, Gilliéron and Edmont also published a supplement that included demographic data collected by Edmont regarding the respondents' age, sex, and profession (see Figure 12). In this sense, Gilliéron and Edmont succeeded in collecting far more detailed information than Wenker. Indeed, Gilliéron included notes with the maps which made clear the differences between

331 Gilliéron & Edmont (1902), p 3: "L'*Atlas linguistique de la France* est le résultat de plus de quatre années consecutives de voyages en zigzag".

332 Goebl, H. (2018) "Chapter 7 Dialectometry" in: C. Boberg, J. Nerbonne & D. Watt [eds] *The Handbook of Dialectology*. Wiley & Sons, Inc., Hoboken, pp 123-142, p 126.

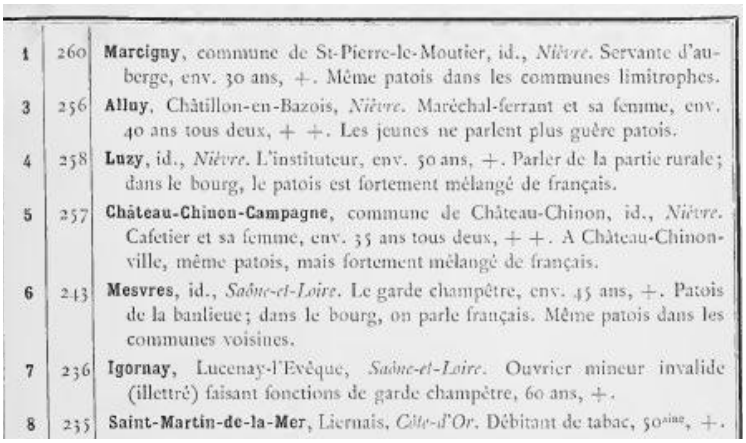
333 Gilliéron & Edmont (1902), p 4.

334 Idem, p 5.

335 Dauzat, A. & Gilliéron, J. (1921) *Essais de Géographie Linguistique: Noms D'Animaux*. H. Champion, Paris, p v; Goebl, H. (2002) "Analyse Dialectométrique des Structures de Profondeur de l'ALF" in: *Revue de linguistique romane*, 66(261-262), pp 5-63, p 5.

social groups, for instance “chez les jeunes,” “chez certains individus,” or “par les vieillards.”[336]

Gilliéron's work made a systematic study of geo-linguistic areas possible; his research delineated zones according not only to linguistic factors, but also social differences and the metalinguistic actions of dialect speakers.[337] One of Gilliéron's most important findings was the confirmation of his hypothesis that there is no such thing as a fixed dialect, since the boundaries of an area inside which a dialect is spoken shifted depending on the feature under study.[338] Notably, Wenker also had to conclude from his own research that dialect boundaries were artificially imposed, although he attempted to work around this by positing the existence of “mixed-dialect-zones.”[339]



1	260	**Marcigny**, commune de St-Pierre-le-Moutier, id., *Nièvre*. Servante d'auberge, env. 30 ans, +. Même patois dans les communes limitrophes.
3	256	**Alluy**, Châtillon-en-Bazois, *Nièvre*. Maréchal-ferrant et sa femme, env. 40 ans tous deux, + +. Les jeunes ne parlent plus guère patois.
4	258	**Luzy**, id., *Nièvre*. L'instituteur, env. 50 ans, +. Parler de la partie rurale; dans le bourg, le patois est fortement mélangé de français.
5	257	**Château-Chinon-Campagne**, commune de Château-Chinon, id., *Nièvre*. Cafetier et sa femme, env. 35 ans tous deux, + +. A Château-Chinon-ville, même patois, mais fortement mélangé de français.
6	243	**Mesvres**, id., *Saône-et-Loire*. Le garde champêtre, env. 45 ans, +. Patois de la banlieue; dans le bourg, on parle français. Même patois dans les communes voisines.
7	236	**Igornay**, Lucenay-l'Evêque, *Saône-et-Loire*. Ouvrier mineur invalide (illettré) faisant fonctions de garde champêtre, 60 ans, +.
8	235	**Saint-Martin-de-la-Mer**, Liernais, *Côte-d'Or*. Débitant de tabac, 50ans, +.

FIGURE 12 Part of Edmont's list of respondents. Each has been numbered and given a code referring to a certain data set. The name of the village is in bold, followed by the name of the commune. The department is italicised. The next pieces of information convey the respondent's occupation and their average age. The +-signs signal whether the informant was originally from the district in which he or she was interviewed. For some cases, Edmont and Gilliéron have added a comment such as "same dialect as neighbouring communes” or “the youth hardly speak the dialect.”[340]

336 Gilliéron & Edmont (1902), p 21; Lameli (2010), p 578.

337 Goebl (2018), p 125.

338 Joseph (2012), p 462.

339 Kehrein (2017), p 193.

340 Gilliéron & Edmont (1902), p 29.

FIGURE 13 A snapshot of the top half of map number 52 of the Atlas Linguistique de la France showing the differences in pronunciation of "les arbres." For the complete map, visit http://lig-tdcge.imag.fr/cartodialect5/#/visualiseur (link 27-05-2020).

Gilliéron was an influential teacher at the *École Pratique des Hautes Études*, where he taught courses on dialectology from 1883 until his death in 1926.[341] Many of his students went on to complete linguistic atlases of their own, following his example of producing a questionnaire and having a fieldworker conduct interviews using it. For example, the Swiss linguists Karl Jaberg (1877-1958) and Jakob Jud (1882-1952) worked on the dialects of spoken Italian in Italy and southern Switzerland, publishing their eight volume *Sprach- und Sachatlas Italiens und der Südschweiz* between 1928 and 1940.[342] Like Gilliéron, Wenker also had many followers, and some of them applied his methods for collecting data on dialects by garnering translations of certain fixed sentences in different countries. Wenker's work has recently been digitalised in the form of the *Digitaler Wenker-Atlas*.[343]

341 Goebl (2018), p 124.

342 Chambers (1998), p 17.

343 Now part of the larger digitalisation project of the Academy of Sciences and Literature in Mainz: https://www.regionalsprache.de/wenkerbogen.aspx (link 27-05-2020).

In conclusion, and as we have seen, Wenker and Gilliéron were contemporaries working on similar projects and aware of each other's research. Their atlases were highly acclaimed for their scholarly rigour, and both exerted a considerable influence on the field of dialectology. Although the pair held different linguistic views on the subject of language change, the methods of both scholars were widely adopted. For both researchers, this involved a questionnaire as the primary research method, but their respective questionnaires had some important differences. Wenker researched the regularities amongst dialects, and to pursue this he designed a questionnaire based around a set of 40 sentences. Gilliéron, on the other hand, was interested in the continuities between dialects, and for this he produced a questionnaire that was detailed and long. These choices had precisely to do with what the scholars thought constituted scientific rigour.

The most significant difference, however, was the method that each chose for the distribution of their questionnaires. Gilliéron believed that only a researcher trained in linguistics would be able to collect precise data, whereas Wenker employed linguistic laypeople and received a far more widespread response–something he thought necessary for accurate results. The consequences of these differences are equally as important, however, for the amount of data that Wenker obtained was so large that the set was almost impossible to work with. Gilliéron's data, meanwhile, despite being the product of fewer responses, was much more detailed than Wenker's.

From their primarily linguistic work, both scholars were able to draw conclusions about social factors, although it should be noted that embedding linguistic data within a social study was the goal of neither Gilliéron's nor Wenker's investigations.[344] As discussed above, this is coherent with the broader developments that took place in the discipline of linguistics during the nineteenth century. An interest in social factors was emerging, but the focus of most linguistic scholars at this time was on the textual aspects of language. Importantly, it was the use of the questionnaire method in particular that enabled the collection of data from both social and linguistic dimensions. In the following section, the link between linguistics and social science becomes even more apparent. I show how a new group of linguists not only built upon the work of Wenker and Gilliéron but how, unlike their predecessors, they explicitly chose to establish and explore the interconnections between linguistics and social science. At the same time however, the discipline of linguistics was becoming increasingly institutionalised and fixed, and this created a tension between the activities of crossing and creating disciplinary boundaries.

344 Lameli (2010), p 583.

3.4 Questionnaires and the Discipline of Linguistics

The previous section illustrated the development of the questionnaire as a practice for collecting data on different languages. I presented the various stages of the method in a number of different research contexts, such as dialectology. Moreover, I discussed certain developments within the discipline of linguistics which, once a relatively broad study of language, was gradually transformed into a more institutionalised linguistic discipline. Linguistics scholars became increasingly interested in the social aspects of language, as opposed to a "pure" study of language itself. Accordingly, the questionnaire enabled the collection of both linguistic and social data.

Following on from this, the current section examines how questionnaire research came to be a standardised part of the discipline of linguistics. This process of standardisation involved agreements between scholars about the proper functioning of the questionnaire within the discipline. This section surveys one example of how such agreements were made, by considering the work of Antoine Meillet and Marcel Cohen to create a standard international questionnaire. The two scholars presented their work at the first International Congress of Linguists, an event which, as I show, played an important role in the formation of the discipline of linguistics. I begin by looking at how Meillet and Cohen's project came to be, placing it in the context of the linguistics discipline at the end of the nineteenth century.

The General Linguistics Discipline

The detailed linguistic atlases of the late nineteenth and early twentieth centuries mostly focused on a particular dialect, language, or nation. Antoine Meillet, however, envisaged an international atlas that would map the languages of the world, with an additional goal being to then preserve these languages. In order to carry out such an undertaking, Meillet needed a standardised questionnaire fit for the collection of data on all languages. This section examines Meillet's attempt to internationalise the discipline of linguistics, and to standardise the linguistic questionnaire.

Towards the end of the nineteenth century, efforts turned towards innovating more overarching approaches to language. Setting off from comparative historical linguistic research, certain scholars attempted to combine the myriad research contexts of language studies, such as dialectological and phonetic, into one general linguistics. Multiple attempts were made to this end, each with a different focus or primary objective. In this section, I discuss some of the most influential approaches, leading up to Meillet's efforts to assemble an international cohort at the first International Congress

of Linguists.

Meillet, himself best described as a comparative historical linguist, took over the lecturing duties of the Swiss linguist Ferdinand de Saussure–to be introduced later–at the *École des Hautes Études* while he was still a student, and an ardent follower of Saussure's. Meillet produced a large bibliography with three main subjects: the first was a system of Indo-European languages (that he drew up using comparative methodologies) and a history of this system; the second was an account of the psychological mechanisms that underpin language change; and the third was an account of the social character of language, as well as its role in language change.[345] In order to fully explain the complex processes involved in language change, Meillet studied these three topics together. This set him apart from the work of other comparative historical linguists on language change: Meillet was keen to get at the causes, not merely describe the process.

According to Meillet, such an approach–involving several different perspectives on language and language change–ought to be central to the discipline of general linguistics, which he attempted to further establish. Meillet was also influenced by and collaborated with the French sociologist Émile Durkheim, and this reinforced Meillet's belief that the questionnaire was an appropriate method for collecting data on language, since it allowed for the incorporation of social factors. I will return to this in section 3.5. In what follows, I examine various approaches to the discipline of general linguistics, leading up to Meillet's work. This will help us to understand not only Meillet's linguistic approach, but also how this led to the creation of a standard and international questionnaire.

I have already mentioned Wilhelm von Humboldt's work *Kawi Sprache*, sometimes referred to as the first book on general linguistics. It is accorded this status due to its broad approach to language as linked to thought, and for envisioning the beginnings of an empirical study of language. Moreover, we have already met Franz Bopp, who was appointed the first chair in *Allgemeine Sprachkund*e and was therefore also a frontrunner in the discipline of general linguistics. His approach, as discussed, used a comparative historical methodology.

The German linguist Georg von der Gabelentz (1840–1893) combined different research styles in the study of language, referring to this as "Die allgemeine Sprachwissenschaft"; he was, in this sense, eclectic in his approach to linguistics, and he wrote

345 Sommerfelt, A. (1966[1936]) "Antoine Meillet, the Scholar and the Man" in: T.A. Sebeok [ed.] *Portraits of Linguists: a biographical source book for the history of western linguistics, 1746-1963*. Indiana University Press, Bloomington, pp. 241-249, p 241.

a textbook on this method that was published in 1891.[346] In it, Gabelentz proposed new ways of measuring, observing, and classifying languages that he combined into a programme called typology, and in 1894, he proposed that a commission be formed to carry out his programme. Part of the typological commission's job was to develop a questionnaire. This questionnaire, consisting of only "yes" or "no" questions, was to record all of the grammatical possibilities within a given language, producing data that would then allow Gabelentz to classify and categorise the languages studied.[347]

The goal for general linguistics, according to Gabelentz, was "to establish the mutually determining relations between a people's character and the structure of the grammar and vocabulary of the language they speak."[348] He referred to the work and ideas of Wilhelm von Humboldt, as Gabelentz also sought to link language with thought, and saw language as a whole.[349] In Gabelentz's work, we see an interpretation of the term "general" that contrasts with that found in Bopp's historical-comparative approach. Gabelentz was concerned with an eclectic study of language that included multiple perspectives; he distinguished his approach from the Neogrammarians which he considered too narrow and too technological.[350] His general linguistics, including his programme of typology, was defined to be a rival in rigour to the historical-comparative school.[351]

Around this time, the general discipline of linguistics started to emerge and gain prominence, engulfing the diffuse field of language studies that it had previously been. Chairs were established at universities in general linguistics, rather than in a specific language, and a remarkable journal specifically for general linguistics was founded: the *Internationale Zeitschrift für allgemeine Sprachwissenschaft* (International Journal for

346 In Gabelentz' work *Die Sprachwissenschaft* (1891) the fourth book is entitled "Die allgemeine Sprachwissenschaft". Here Gabelentz discusses what he sees as general linguistics. Von der Gabelentz, G. (2016 [1891]) *Die Sprachwissenschaft: Ihre Aufgaben, Methoden und bisherigen Ergebnissen*. Edited by M. Ringmacher & J. McElvenny, Classics in Linguistics 4, Language Science Press, Berlin. Els Elffers mentions how Gabelentz used "mixed methodologies" in his linguistic work. Elffers (2008), p 8.

347 Von der Gabelentz, G. (1894) "Hypologie [Typologie] der Sprachen, eine neue Aufgabe der Linguistik" in: *Indo-Germanische Forschungen*, 4(1), pp 1-7, p 6.

348 McElvenny, J. (2017) "Grammar, typology and the Humboldtian tradition in the work of Georg von der Gabelentz" in: *Language & History*, 60(1), pp 1-20, p 7.

349 McElvenny (2017), p 7; Elffers (2008), p 3; Joseph (2012), p 176.

350 McElvenny, J. [ed.] (2019) *Gabelentz and the Science of Language*. Amsterdam University Press, Amsterdam.

351 McElvenny (2017), p 17.

General Linguistics), which ran from 1884 to 1891. This journal was pitched to address diverse linguistic questions, to provide a platform for international scholars from a range of linguistic domains, and to centralise the discipline of linguistics.[352] The journal set out to represent the unity of linguistic science, despite the diverse backgrounds and approaches of its featured scholars.[353] The journal's founder, Friedrich Techmer (1843–1891) was Gabelentz's colleague at Leipzig, and Gabelentz wrote multiple articles for the journal. Significantly, the journal shared Gabelentz's eclectic view on the study of language.[354]

A similar endeavour can be found in the work of the Swiss linguist Ferdinand de Saussure. Saussure is most famous for his *Cours de Linguistique Générale* (1916), published posthumously. The courses that Saussure taught exhibit an assimilation of the different fields of language study within the emerging discipline of general linguistics. Saussure, following Gilliéron, also incorporated linguistic geography into his courses.[355] He was then a professor of Indo-European languages at the University of Geneva, and delivered a course on linguistic geography in 1902 entitled "Geographical linguistics of Europe (ancient and modern), with an introduction to the objects of geographical linguistics in general." This course, though innovative for being the first of Saussure's courses to include "linguistics" in its title, belonged nevertheless to the comparative historical tradition of language study.[356]

Saussure's ideas were published by two of his colleagues, Charles Bally (1865-1947) and Albert Sechehaye (1870-1946), who edited the lecture notes of Saussure's students' to produce the *Cours de Linguistique Générale* (1916). Other than its eclectic, multi-perspective approach that resembled that of Gabelentz, Saussure's theory of language contained some fundamentally new elements which had a considerable impact not only on linguistics, but on academic disciplines in general. For the *Cours* is widely considered to be the foundational text of structuralism, a mode of linguistic analysis that treats language as a system built out of invariant building blocks, in which meaning is added by those who use the language in a particular context. Saussure used

352 Koerner, K. (1973) *The Importance of Techmer's Internationale Zeitschrift für allgemeine Sprachwissenschaft" in the Development of General Linguistics: An Essay*. John Benjamins Publishing, Amsterdam, p 10.

353 Koerner (1973), p 20.

354 Plank, F. (1991) "Hypology, Typology: The Gabelentz Puzzle" in: *Folia Linguistica*, XXV(3-4), pp 421-458, p 435.

355 Joseph (2012), p 571.

356 Idem, p 462.

the internal structure of what he called the "linguistic sign" to get at how languages are built. A sign consists of a signifier, which is the word itself, and the signified, which is the concept that the word implies. According to Saussure, the relation between the signifier and the signified is arbitrary: any word can stand for any concept. In later structuralism however, the relationship between word form and meaning changed.[357] Through this approach, the study of language more closely followed a natural scientific model, becoming a classificatory science, just as we saw in the work of Schleicher.[358]

Saussure emphasised the distinction between diachronic and synchronic studies of language, introducing these terms to linguistics as he did so. He argued that whilst linguists can pursue diachronic analyses, one must study the language as it exists at a single moment in time in order to fully apprehend it. Although Saussure did attach importance to the diachronic perspective, he is primarily known for his interest in the synchronic study of language, famously saying: "Language is a system of signs that express ideas."[359] Saussure envisioned this system of signs as one of communication, and it was this which gave linguistics its autonomy. As such, those who spoke the language were considered part of the object of study, something that had tended to recede to the background in earlier comparative historical approaches.

Saussure's theories, therefore, acknowledged social factors as belonging within the system of language as communication. Saussure distinguished between *langue*, the systematic rules of a linguistic system, and *parole*, the actual use of a language, to argue that all linguistic behaviour (*parole*) can be described through a study of the relationship between different linguistic signs, and between the signifier and signified (*langue*). Language can only function as a system of communication when these relationships are recognisable to the people using the language.[360] Hence, by studying language, one also necessarily touches on the study of people and society, and Saussure maintained that understanding the relationships between people and their use of words brought insights about the language. Through Saussure's linguistics it thus became possible to connect the study of language to the study of society, though merely establishing this connection was not the primary objective of Saussure's work.

357 Karstens, B. (2017) " 'The Lonely Form Dies': How Epistemic Virtues Connect Roman Jakobson's New Science of Language and His Personality" in: J. Van Dongen & H. Paul [eds] *Epistemic Virtues in the Sciences and the Humanities*. Boston Series in the Philosophy and History of Science, Volume 321, Springer, Cham, pp 149-171, p 153

358 Yngve (1996), p 33 & 35.

359 Joseph (2012), p 575.

360 Karstens (2017), p 154.

Saussure's own research was mostly text-based, and there is no record of him using the questionnaire method.[361] His linguistic theories, however, did occupy a prominent place in the new, developing discipline of general linguistics, and prompted diverse new forms of linguistic research, including projects in which scholars did use questionnaires. Saussure's efforts portray a tendency within the discipline to study language in a general, systematic way. The systematic approach is another interpretation of the "general" in general linguistics, an alternative to Bopp's comparative and Gabelentz's eclectic approaches. Furthermore, Saussure's incorporation of social factors within his theories illustrates how research in the last decades of the nineteenth century was increasingly marked by the new social sciences.[362] This influence becomes even more pertinent when one considers the work of Saussure's colleague, Antoine Meillet. Saussure's synchronic turn might therefore be seen as ushering in a social turn in linguistics.

The influence of Saussure's work on Meillet can be seen most clearly in the latter's ideas about the significance of social factors in determining both the uses of and changes within language. Indeed, Meillet's approach to general linguistics was wholly in line with Saussurian theory: not only did Meillet incorporate social factors into his linguistic research, but his analyses also followed the systematic approach of his Swiss colleague. What is more, he saw the need to organise these disciplinary discussions on an international scale and, by uniting those scholars who were interested in such an endeavour at the first International Congress of Linguists, Meillet facilitated a broad discussion about the discipline of general linguistics.

361 Saussure visited Lithuania for field work, but this was not a fruitful visit and he based his further research on Lithuanian accents on published literature. Joseph (2012), p 273.

362 Bouterse, J. & Karstens, B. (2015) "A Diversity of Divisions: Tracing the History of the Demarcation between the Sciences and the Humanities" in: *Isis*, 106(2), pp 341-352.

The International Congress of Linguists

The first International Congress of Linguists was held in The Hague in 1928.[363] The congress brought together an international group of scholars with a range of academic backgrounds and interests. These ranged from philology to anthropology, and from dialectology to psychology, an illustration of the multidisciplinary origins of linguistics. Although the scholars were all working on the study of language, they held a variety of views and objectives concerning research methods which came together and were debated at the congress. Through an examination of the discussions around the data practice of the questionnaire, this section examines how the method was adopted and adapted as part of the discipline of linguistics.

The initial goal of the first International Congress of Linguists was to unite, for the first time, linguists from different parts of the field to discuss a number of issues together. The congress was organised by the professors Jos Schrijnen (1869–1938) and Christianus Uhlenbeck (1866–1951), who were both working at the newly established Catholic University of Nijmegen. The Netherlands had been neutral during the War, and during the interbellum Dutch scholars took it upon themselves to reunite the international community; the organisation of the event can also be seen in this context.[364] The congress was held from the 10th to the 15th of April 1928. In March the previous year, Schrijnen and Uhlenbeck informed a large number of linguists across the world of their plan to organise an international congress, and stated that the goal of the congress would be to bring the group together in order to discuss the interests of their science, and hopefully find solutions to a number of practical questions.[365]

In the invitation letter, Schrijnen and Uhlenbeck stated that a move towards a single, coherent discipline of linguistics was inevitable, "given that the various subdivisions of linguistics, which should be seen as one, indivisible science, cannot be

363 The text in this section has been based on previously distributed work in the following blogpost: Mojet, E. (2018) "Discussing Disciplinary Development: The role of the First International Congress of Linguists (1928) in the formation of the discipline of general linguistics." Blogpost: *History and Philosophy of the Language Sciences.* https://hiphilangsci.net/2018/02/14/first-international-congress-of-linguists/ .

364 This was already explicitly mentioned in the invitation letter for the Congress of Linguists. *Actes* (1930), p vi. Interestingly, this year the Netherlands also hosted the 9th version of the modern Olympic Games in Amsterdam. This indicates the role the Netherlands fulfilled during these years on an international scale.

365 *Actes* (1930), p v: "que les linguistes des différents pays se réunissent afin de discuter ensemble des intérêts de leur science et d'arriver, si possible, à un accord sur un certain nombre de questions pratiques."

FIGURE 14 The participants of the first International Congress of Linguists in front of the Ridderzaal in The Hague, after the opening ceremony. In the front row: the organisers Jos Schrijnen and C.C. Uhlenbeck, together with Paul Kretschmer (1866-1956), Antoine Meillet, and Sigmund Feist (1865-1943). Photo from Leidsch Dagblad, 11 April 1928, vol. 69, no. 20882, p 5.

rigorously separated from one another, and, besides, research in practically every one of these fields is increasingly leading to a general linguistics."[366] The merging of the various domains based on their research practices was already underway, and the congress' organisers saw this as a reason to inaugurate a physical meeting as well.

To structure the congress, Schrijnen and Uhlenbeck sent six practical problems to the participants who were invited to respond and, from their answers, the organisers formulated a series of 42 propositions. The responses and propositions were once again distributed to the participants as preparation for the congress itself. The six problems sent to the linguists were: 1) finding a basis for phonetic notation; 2) establishing and delimiting technical terms; 3) methods of research for linguistic geography; 4) methods for studying a certain grammar; 5) the relationship between past and present cultural domains to specific words and phonetics, as well as morphological and syntactic particularities; 6) research methods when philology is not sufficient. It is clear from these six practical problems that the linguists were discussing research

366 Idem, p vii : "Étant donné que les différents subdivisions de la linguistique, qui est bien une science une et indivisible, ne sauraient être rigoureusement séparées les unes des autres et que, d'ailleurs, pratiquement les recherches dans chacun de ces domaines aboutissent de plus en plus à une linguistique générale."

methods for their discipline.[367] After all, the study of language had undergone a major shift following the publication of Saussure's *Cours de Linguistique Générale*, discussed above. The *Cours* had set out a new theoretical framework that became influential in the discipline of general linguistics, emphasising a focus on the synchronic study of language. The task for the linguists was to innovate methods and approaches through which to adapt these theories to their research; developments at the congress are therefore to be seen within the context of a turn towards a synchronic study of language.

During the congress there were five plenary sessions, and a number of separate sessions,[368] each with a president and a secretary. The plenary sessions determined the groupings for the separate discussions. The discussions held during the separate sessions were subsequently presented again at the corresponding plenary session, and the notes and reports from the congress were then collected and edited by a specially appointed committee. The resulting report was published in 1930 in Leiden as the *Actes du Premier Congrès de Linguistes. Tenu à la Haye du 10-15 Avril 1928*.[369] The role of the questionnaire as a research method in linguistics was raised as part of the congress' third methodological problem, mentioned above.

The solution to the problem as presented by the congress was to create an international standardised questionnaire, fit to collect data on different languages. This led to several points of discussion. As discussed in the previous section, scholars used various types of questionnaire: Wenker had great success with his postal variant,

367 International congresses of other disciplines adhered to a similar trend. The existence of a central methodological topic, namely chemical nomenclature, also governed the first international congress of chemists in Karlsruhe, 1860. At the first international congress of orientalists in 1873, the participants debated the definition of their research topic, the Orient. The first time international scholars met, prompted discussions on methodological topics.

368 The organisers of the congress entertained their guests with a programme of festivities. This included a visit to Amsterdam, a tour through the tulip bulb fields by car, a reception with various politicians, a car trip to Rotterdam where they visited the harbour, and a banquet. This comprised the 'informal' part of the congress.

369 *Actes* (1930), p viii. The *Actes* also included a list of all the 'members' of the Congress: it lists the 309 scholars who expressed their interest. The list is not an attendance list, but a list of 'members': those who supported or were interested in the ICL and wanted to be kept up to date. On the basis of this *Liste des membres*, it can be established that almost all scholars were working in European countries, except for eight scholars in America and one in South Africa. The spread over Europe is not very equal: looking at the top five shows 109 Netherlands based scholars, 47 in Germany, 26 in France, 12 in Italy and 12 in the United Kingdom. The age range at the Congress runs from 18 to 92, where most scholars are in their forties or fifties.

whilst Gilliéron had developed one to be conducted by a fieldworker. Furthermore, the scholars had to select the words, phrases, or sentences about which it would be interesting to collect data, how these data should be collected, and who the representative speakers to question would be. On the latter issue in particular, discussions invoked the centrality of social as well as linguistic factors. This section examines the development of an international standard questionnaire and its role in the discipline of linguistics.

At the first International Congress of Linguists one of Gilliéron's students, the French linguist Oscar Bloch (1877-1937), proposed Gilliéron's approach to the questionnaire–as conducted by a fieldworker–as a method that might function well in linguistic geography.[370] During his presentation, Bloch mentioned a number of specific features that he felt ought to typify a questionnaire: its various elements should be grouped together according to certain themes; all interviews should be undertaken by only one observer (or, at most, by a few observers); only one witness, to be carefully chosen, should be needed for the interview; and the answers collected should reflect as closely as possible the spontaneity of everyday language.[371]

For his part, the French linguist and ethnologist Marcel Cohen, a student of Meillet, further underlined the necessity of gathering the world's languages so as to preserve them as they existed at the time of collection.[372] According to Cohen, it was important not only to compile lists, but also to grasp the contexts of individual words. For this reason, Cohen was interested not only in the words as they were spoken, but also in who was speaking them, and as such Cohen's work took place within the domain of ethnographic studies. He taught at the newly established *Institut d'Ethnologie* from 1925 till 1973, and worked on systematising the questionnaire as a research method.[373] In 1928, the year of the first International Congress of Linguists, Cohen published a booklet on the linguistic questionnaire, his *Instructions d'enquêtes linguistiques*.[374]

370 Idem, p 23.

371 Idem, p 28.

372 Van den Avenne, C. (2016) "Enquête linguistique" in: *À la naissance de l'ethnologie française. Les missions ethnographiques en Afrique subsaharienne (1928-1939)*. URL http://naissanceethnologie.fr/, p 2.

373 Boutet, J. (2009) "Marcel Cohen, l'enquête et les faits linguistiques, de 1908 à 1928" in: *Langage et société*, 2, pp 31-54, p 52.

374 Van den Avenne (2016), p 1.

The book appears in the proceedings of the congress, where it is recorded that Cohen brought the text with him to present to the scholars.[375] In the following section, I investigate the *Instructions*, and examine how Cohen proceeded to compile a standard questionnaire capable of collecting data on many different languages.

The congress resulted in the establishment of various international projects and committees, of which the Committee for the linguistic questionnaire is one example. This increase in international organisation was an important step towards setting up the autonomous and professional discipline of general linguistics. As Schrijnen concluded in his closing speech: "Linguistics had already become an autonomous science, it had created its own bodies, university chairs, and its own societies; but this week, for the first time, it has, in broad daylight and before the forum of the whole world, pleaded its own case, arranged its own affairs, defended its own interests, signalling its life, its spirit, and its mentality."[376]

The 1928 congress initiated a series of others, its twentieth edition being held in Cape Town in July 2018.[377] Critically comparing these congresses testifies to the developments that the discipline of general linguisitcs has undergone, through the crucial stages of its international organisation. Whilst the early years were spent mostly on methodological topics, the focus shifted towards sharing the content of newer research projects. This can be explained within the context of the discipline's increasing professionalisation and institutionalisation on an international scale, moving beyond methodological issues and concentrating on content. Apart from the internationalisation of linguistics, the discipline also saw some content-related changes as a result of the methodological discussions at the congress. Not only did the scholars assembled come from a variety of international backgrounds, but also from different academic fields and subfields. This highlights both the multidisciplinary foundation and the cross-disciplinary interactions that played an important role in the formation of the discipline as a whole.

375 *Actes* (1930), p 82: "M. Marcel Cohen parle des petits carnets d'enquête édités par l'Institute d'Ethnologie de Paris et il en présente un exemplaire au congrès."

376 Idem, p 97: "La linguistique était devenue depuis longtemps une science autonome, elle s'était créé des organes, des chaires d'université, des sociétés propres ; mais cette semaine-ci, pour la première fois, elle a, au grand jour et devant le forum du monde entier, plaidé ses propres causes, arrangé ses propres affaires, défendu ses propres intérêts, fait signe de sa vie, de son esprit, de sa mentalité propre."

377 For more information, see http://icl20capetown.com/ [last visited November 2020].

General linguistics underwent further, significant transformations during the first decades of the twentieth century. One notable influence came from the so-called Prague School of linguistics, credited with introducing a linguistic programme of structuralism.[378] At the second International Congress of Linguists, members of the Prague School were important speakers. Whereas these linguists had only tentatively presented themselves as a group at the first congress in The Hague, now the Prague School confidently took to the stage. At the third International Congress, in Rome in 1933, the salient questions were almost only about linguistic content, far more than at the previous two congresses, where attention had mainly been directed at methodological questions. A significant proportion of the third congress was devoted to phonetic symbolism, a topic that the Prague School linguists predominantly focused on,[379] and this signalled the direction of travel for a large part of the discipline as a whole: having attempted to set some standards at the first congress, linguists from the Prague School gradually took over the role of developing the discipline through structuralism. Not all linguists were on board with the structuralist programme, however, and a number of different approaches to the study of language remained as a result of the many connections between linguistics and other disciplines.

An International Standard Questionnaire in Linguistics

At the first International Congress of Linguists, Marcel Cohen presented his work on a standard questionnaire for linguistic purposes. Cohen's research at the newly established *Institut d'Ethnologie* focused on systematising the questionnaire as a research method.[380] Indeed, in 1928, Cohen published a booklet on the linguistic questionnaire–the *Instructions d'enquêtes linguistiques* introduced above–which comprised a manual for ethnological and linguistic research.[381] It is clear that Cohen (and Meillet for that matter) considered research practices in ethnological and linguistic contexts to be similar. In section 3.5, I explore the connections between linguistics, sociology, and the social sciences further.

378 For more on the Prague circle of linguists, see Toman, J. (1995) *The Magic of a Common Language: Jacobson, Mathesius, Trubetzkoy, and the Prague Linguistic Circle.* MIT Press, Cambridge. On structuralism, see Karstens (2017).

379 *Actes du Troisième Congrès International de Linguistes / Atti del III Congresso internationale dei linguisti. Roma, 19-26 settembre 1933* (1935). F. Le Monnier, Firenze.

380 Boutet (2009), p 52.

381 Van den Avenne (2016), p 1.

3.4 QUESTIONNAIRES AND THE DISCIPLINE OF LINGUISTICS

In Cohen's *Instructions*, he argued that "la linguistique" was affiliated with many other sciences, such as biology, physiology, acoustics, psychology, geography, cartography, history, and palaeontology, as well as (more directly) anthropology, sociology, and ethnology. Linguistics, then, should seek to both systematise the constant characteristics of language, and understand the laws which govern their evolution.[382] Having defined the discipline in this way, Cohen went on to discuss the method of the questionnaire in detail, arguing that it connected the social sciences with linguistics. The questionnaire should be both rapid and methodical, he claimed, to allow a researcher using a standard form of questionnaire to obtain comparable results from different places.[383]

According to Cohen, the linguistic questionnaire's principal object of study was spoken language; the researcher should be able to listen to and accurately note down what has been said. They should therefore be familiar with the languages spoken in an area, as well as who speaks them, and the situations in which they are spoken.[384] Here, Cohen distinguished between two types of questionnaire: those that were designed for the specific area in which they were to be distributed, and those that were more general, to be used anywhere.

For the second, more general style of questionnaire, Cohen suggested an extension of ethnographic questionnaires with linguistic questions,[385] thus making the connection between linguistics and the social sciences entirely explicit, as Cohen carried the ethnological questionnaire directly over into the field of linguistics. The connection between the two disciplines is also evident in Cohen's list of the principal points that a questionnaire might measure. These included differences in speech as a function of generation, sex, class, or caste; one's relationship with the outdoors; communication with strangers; literary, written, and religious language; music, secret, and specialised languages (such as language for special occasions, or within certain professions); and slang, or the languages of specific social groups.

382 Cohen, M. (1950 [1928]) *Instructions d'enquête linguistique. 2e édition revue et augmentée*. Institut d'ethnologie, Paris, p 5-6.

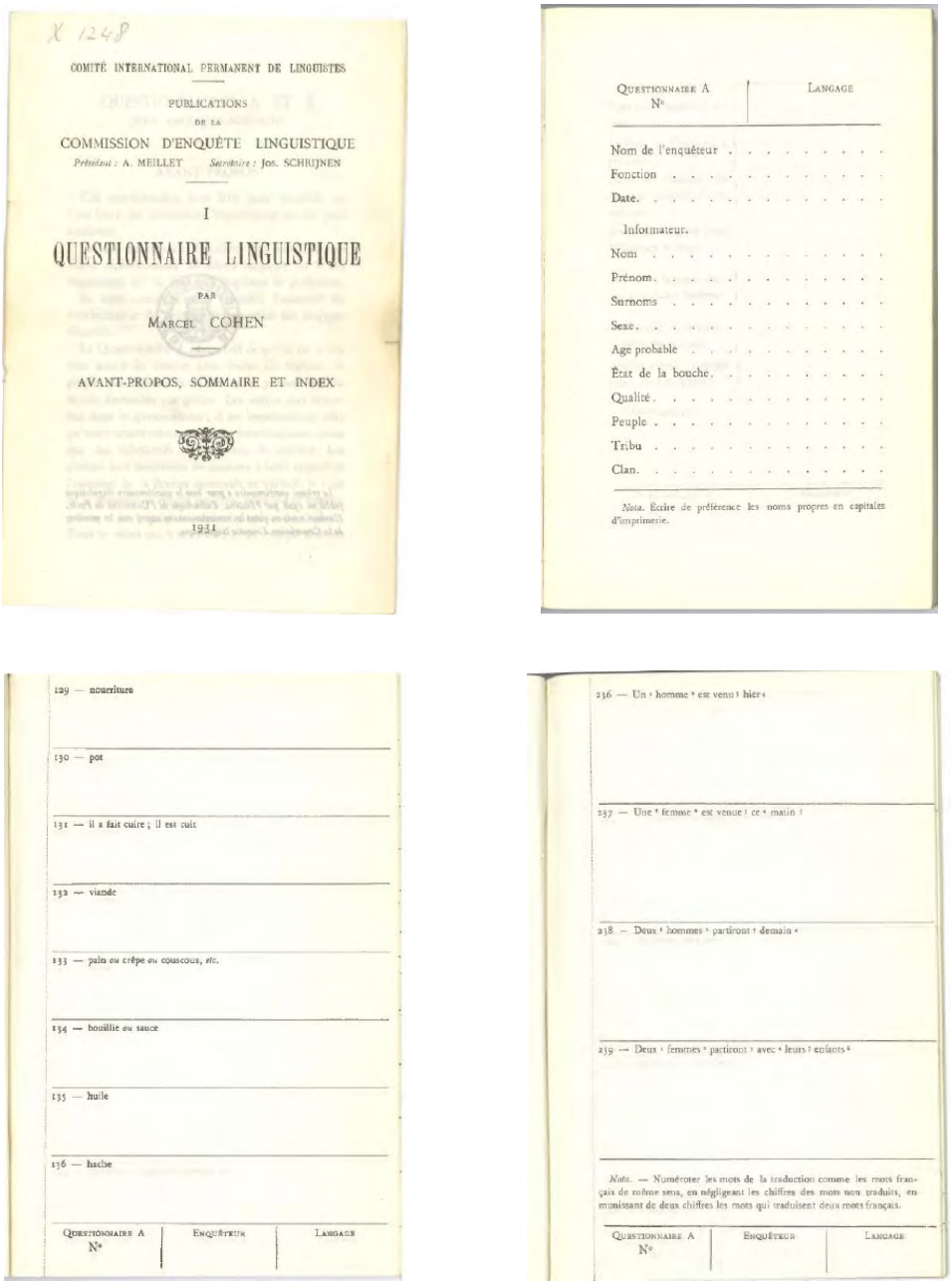
383 Cohen (1950), p 72-3.

384 Idem, p 16.

385 Cohen (1950), p 75.

In addition to this already impressive list of metrics, Cohen also saw the questionnaire method as valuable for examining such phenomena as anatomical influences on the pronunciation of specific groups; the use of signs and gestures (both to talk to strangers and as an integral part of a language); how languages travel long distances; and even how one counts.[386] According to Cohen, each of these elements contributes to differences and changes in languages, and all can be analysed using a questionnaire. Indeed, Cohen's research centred the questionnaire as an important and versatile research method.

386 Idem, p 17-20.



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COMITÉ INTERNATIONAL PERMANENT DE LINGUISTES

PUBLICATIONS DE LA COMMISSION D'ENQUÊTE LINGUISTIQUE

Président : A. MEILLET *Secrétaire :* Jos. SCHRIJNEN

I

QUESTIONNAIRE LINGUISTIQUE

PAR

MARCEL COHEN

AVANT-PROPOS, SOMMAIRE ET INDEX

1931

Questionnaire A N° | Langage

Nom de l'enquêteur . . . . .
Fonction . . . . .
Date. . . . . .

Informateur.

Nom . . . . .
Prénom. . . . . .
Surnoms . . . . . .
Sexe. . . . . .
Age probable . . . . . .
État de la bouche. . . . . .
Qualité. . . . . .
Peuple . . . . . .
Tribu . . . . . .
Clan. . . . . .

Nota. Écrire de préférence les noms propres en capitales d'imprimerie.

129 — nourriture

130 — pot

131 — il a fait cuire ; il est cuit

132 — viande

133 — pain ou crêpe ou couscous, *etc.*

134 — bouillie ou sauce

135 — huile

136 — hache

Questionnaire A N° | Enquêteur | Langage

236 — Un ‹ homme › est venu › hier ‹

237 — Une ‹ femme › est venue › ce ‹ matin ›

238 — Deux ‹ hommes › partiront › demain ‹

239 — Deux ‹ femmes › partiront › avec ‹ leurs › enfants ‹

Nota. — Numéroter les mots de la traduction comme les mots français de même sens, en négligeant les chiffres des mots non traduits, en munissant de deux chiffres les mots qui traduisent deux mots français.

Questionnaire A N° | Enquêteur | Langage

FIGURE 15 Cohen's questionnaire, with a page for personal details and two examples of wordlists to be collected. These were printed on perforated pages which could easily be torn out. Note that the questionnaire can be used for multiple contexts: one of the questions is "pain ou crêpe ou couscous etc." [bread or crêpe or couscous etc.].[387]

387 Cohen, M. (1931) *Questionnaire Linguistique*. Comité International Permanent de Linguistes: Publications de la Commission d'Enquête Linguistique.

Through Cohen's *Instructions*, the questionnaire was standardised across the discipline of linguistics. Upon receiving Cohen's work, the first International Congress of Linguists decided to establish a committee to oversee the standardisation of the questionnaire internationally. At the second congress, held in Geneva in 1931, the questionnaire committee (*Commission d'enquête linguistique*, C.E.L.) reported on their progress, confirming that in their first three years and under the presidency of Meillet, they had achieved several of their goals, not only establishing the committee but obtaining grant money and increasing the number of researchers involved. As a result, with Meillet still in the position of president, the committee was expanded from ten to nineteen members, and this increase in scholars to analyse the data enabled the group's work to cover even more countries. Cohen himself undertook the task of creating a standardised questionnaire, and this was published in the first issue of the *Publications of the Committee for the Linguistic Questionnaire*.[388]

Following this, the committee went about determining which languages to map first. This proved more troublesome than anticipated, in part due to the international tensions that would shortly erupt as the Second World War. Indeed, there is regrettably no later trace of the committee, or any of its results. However, the ambitious project of Meillet and his colleagues had achieved one thing: the questionnaire had been both generalised and standardised as a research method within linguistics, and was becoming particularly prevalent in the field of sociolinguistics. All this serves to confirm that the questionnaire was employed in both linguistics and the social sciences, and attests to the close links between research projects across disciplines. Moreover, Cohen explicitly applied the ethnological questionnaire within linguistics. As a result, Meillet and Cohen's research is often considered to have laid the foundations for the discipline of sociolinguistics; by the end of the 1950s, the questionnaire had become an established part of sociolinguistic research.[389]

This case study illustrates the integral role of the questionnaire, and its development, in the formation of linguistics as a discipline; indeed, the internationalisation of the questionnaire is inextricably linked to the internationalisation, and consolidation, of the discipline as a whole. Around the start of the twentieth century, this turn

388 Cohen (1931); *Actes* (1933), p 39.

389 Koerner, K. (1991) "Toward a History of Modern Sociolinguistics" in: *American Speech*, 66(1), pp 57-70.

towards more global modes of study was widespread across the sciences,[390] and it is in this context that Meillet's project of preserving the world's languages by studying language change worldwide appears. To do this, he created an international organisational body of linguists.

This in turn highlighted the need for standardisation within the discipline, bringing linguists together to debate both what the discipline ought to focus on, and the methods it could most usefully adopt. Cohen published what he hoped would be a single questionnaire designed to facilitate a study of the world's languages, thus extending the method as it had previously been used in ethnology to include linguistic questions. Given its aim of collecting "linguistic documents from all places through a uniform plan," the questionnaire also made possible the collection of "a certain number of ethnographical facts."[391] Here, Cohen and Meillet departed from the work of Gilliéron and Wenker, who had adapted their respective questionnaires according to known regional differences, and who were not explicit when it came to the collection of ethnological data.

3.5 Sociological Influence on the Linguistics Discipline

Meillet and Cohen's international standard questionnaire, discussed above, exemplifies the extent to which linguists were actively thinking about standardisation in their discipline, and was developed as various threads of linguistic research were being consolidated into linguistics as a discipline. This section further investigates the link between linguistics and ethnology, sociology, and the social sciences. The incorporation of social factors within linguistic research–such as, for example, in Saussure's work–went hand in hand with the formation of the social sciences as discrete disciplines. I show how disciplinary boundaries were formed, as well as how disciplines nevertheless maintained their connections through the sharing of data practices, such as the questionnaire. I also examine discipline formation as a multifaceted process, capable of fomenting divisions not only between but also within disciplines and thereby leading to the creation of subdisciplines: a connection can be made, for example, between the

390 This ideal of internationalism and synthesis is argued in: Baneke, D. (2008) *Synthetisch Denken: Natuurwetenschappers over hun rol in een moderne maatschappij, 1900-1940*. Uitgeverij Verloren, Hilversum.

391 Cohen (1931), p iii-iv : "Le Questionnaire (...) complète l'enquête sur les notions usuelles, en permettant de se rendre compte par surcroît d'un certain nombre de faits ethnographiques".

use of questionnaires and the research that led to the subdiscipline of sociolinguistics.

Antoine Meillet and Émile Durkheim

As a scholar, Antoine Meillet was influenced by, and collaborated with, the Swiss linguist Ferdinand de Saussure and the French sociologist Émile Durkheim. In the previous section, I examined the connection between Meillet and Saussure's work on the topic of general linguistics. In this section, I offer a comprehensive discussion of Meillet's relation to one of the foundational scholars of the sociological discipline in France: Émile Durkheim, to show the ways in which the emerging disciplines of linguistics and sociology were indeed linked.

By the end of the nineteenth century, the social sciences were considered proper academic disciplines. Questions pertaining to concepts like society or population had become meaningful, and it was possible to measure them thanks to the social statistical work of Quetelet and others, discussed in Chapter 2. Indeed, the rise of the social sciences has been linked to the transition from monarchies to nation states, bringing with it an increased emphasis on counting and monitoring citizens. However, these methods were adopted across many different academic fields, and not just in the political realm; the social sciences went from being a preserve of political institutions to having their own Academies, and were present in university faculties from the end of the nineteenth century.

From the 1880s up until the outbreak of the First World War, the field of sociology in France was dominated by the debates between three scholars and their followers: Gabriel Tarde (1843-1904), René Worms (1869-1926), and Émile Durkheim. All three published monographs and programmatic texts on sociology, including disciplinary works about methodology and the relationship between sociology and other sciences. Tarde and Worms were both trained primarily in law–Worms also having trained in philosophy–and joined ranks. The organisation led by these two attracted the older generation of sociologists, whereas Durkheim appealed more to younger scholars, and this opposition was so pronounced that university sociology can be said to have essentially been produced by the competition between the networks of Durkheim and Worms.[392] Durkheim was selected to deliver the first university course on sociology in 1887, and his efforts grew to become a vast research enterprise.

392 Heilbron (2015), p 67.

Yet it was Worms who first founded a sociological journal (*Revue international de sociologie*, 1893), an international organisation (*Institut international de sociologie*, 1893) and a book series (*Bibliothèque des sciences sociales*, 1894).[393]

The discipline of sociology thus came under the aegis of the philosophy faculty at French universities. Durkheim, also trained as a philosopher, claimed that sociology should be an autonomous and specific science, based on laws and law-like regularities. It was to be independent from the physical and life sciences, as well as from philosophy, and would focus on the specific, irreducible, and highly complex phenomenon of human societies.[394] Therefore, instead of using psychological foundations or overarching generalist frameworks, Durkheim felt that sociology should establish its own research, concepts, and methods. Since research in sociology connected with many different areas of expertise, it was all the more important for Durkheim to present a clearly defined field of research of his own.

Durkheim thus delineated the field of sociology, separating it from philosophy and law as well as from the natural sciences. If sociology was to be autonomous and independent, however, then it would also need its own methodology, and in 1895 Durkheim published *Les règles de la méthode sociologique*, or *The Rules of Sociological Method*. Here, Durkheim defined the object of sociological inquiry to be the "social fact," a measurable element that could exercise an external constraint over the individual. Through the observation of social facts, various orders or types could be established. Durkheim's first sociological work after defining his *règles* was on suicide rates (*Le suicide*, 1897), in which he proposed that a sociologist should study neither the individual act of, nor moral questions around, suicide, but that the proper object of sociological inquiry was suicide rates.[395] The suicide rate of any given society was a social fact and could, he wrote, be categorised into four types: egoistic, altruistic, anomic, and fatalistic, which were to be found in a causal relationship with two other social facts: group attachment and behaviour regulation. In other words, social facts were caused and contextualised by other social facts. This was how Durkheim felt that sociological research ought to be practised, and to do so, statistical and social data were required.

Durkheim's network was academically heterogeneous, reflecting his prestige but also the dependence on data from neighbouring disciplines. Members of the *Institut français de sociologie* included several jurists and economists, prominent psycholo-

393 Idem, p 70.

394 Idem, p 74.

395 Idem, p 79-80. To come to these rates, Durkheim used statistical data.

gists, historians, ethnologists, political scientists, and linguists, amongst whom was Antoine Meillet.[396] The heterogeneity of this network was an important component of Durkheim's programme, yet he maintained a strict division between scientific and political or moral activity, as well as between academics and amateurs.[397] In his journal, *Année sociologique* (1898), Durkheim made it clear that sociology had to be practised sociologically, that is, by extracting sociological insights from the scholarship of other disciplines.[398]

Here again it can be observed that, on the one hand, Durkheim used social and statistical data from other research fields and disciplines, and on the other hand, employed these data practices to establish disciplinary boundaries through agreed-upon methodologies. This tension between interdisciplinary and disciplinary activity, or sharing and dividing, was also prominent in the previous chapter, where the disciplinary formation of statistics and botany was discussed. Concerning linguistics, the same tension is to be found in cases where the shared data practice of the questionnaire was adapted to fit discipline-specific research.

Durkheim's opponents and colleagues heavily criticised his "social realism," calling it metaphysics. René Worms disagreed with the strict delineation of an empirical discipline, and Tarde preferred an approach to sociology that used theories from psychology. Worms felt that sociology should be a broad, synthetic science, a generalising endeavour rather than a restricted and limited discipline, although here Worms was more involved with organisation than content: he was an academic entrepreneur who designed the international infrastructure for this general scientific enterprise called sociology. However, French universities, redrew sociology's boundaries according to Durkheim's principles, and followers of Durkheim went on to achieve considerable intellectual recognition, promising a scientific study of crucial questions about morality, religion, and other societal issues.[399] Their broad network allowed them to not only use data on many topics, but also encourage various disciplines to gather data in a different way. One example of this influence can be found in Antoine Meillet's linguistic research. Meillet, who collaborated with Durkheim in Paris, began working in 1893 on the journal *Revue Internationale de Sociologie*–establishing its *Linguistique* rubric in 1903–and in 1898 he published an article in Durkheim's *L'Année Sociologique*,

396 Heilbron (2015), p 96.

397 Idem, p 81.

398 Idem, p 84.

399 Idem, p 90.

on changes in the meaning of words over time.[400]

Moreover, Meillet's connection with Durkheim broadens our understanding of the former's use of the questionnaire. Meillet followed the claim that language should be studied as a social fact, drawing on Durkheim's concept as defined in the *Règles*.[401] For Meillet, language was a prime example of a social fact as it was constructed by social groups, and was thus to be studied within its social context; he settled on the questionnaire as the best method for this. Questionnaires had not only been employed in dialectology, as illustrated above, but also in sociological research.[402] Meillet thus adopted the questionnaire as a primary research method, deciding that in addition to shedding light on language itself, it would facilitate an observation of the social context in which language is used and created.

Given his goal of measuring social facts as well as collecting data on language, Meillet encouraged and emphasised the practice of recording social factors when studying variations between languages. In this, he took inspiration from the detailed linguistic atlases of the late nineteenth and early twentieth centuries, which focused primarily on a particular dialect, language, or nation. Meillet, however, envisaged an international atlas to map the languages of the world, with the added ambition of then preserving these languages. In order to carry out such an undertaking, Meillet needed a standardised questionnaire to collect data on all languages, as we have seen above.

Meillet also followed the work of the German linguist Ferdinand Wrede (1863-1934), Wenker's successor at the University of Marburg and responsible for publishing parts of the *Sprachatlas* after Wenker's death. In his own work, Wrede drew parallels between ethnography and dialectology, distinguishing between individual and social instances of language change.[403] Meillet cited Wrede in a 1906 article, in which he combined linguistic and sociological research,[404] and the dual influence of Saussure

400 Meillet (1906).

401 Koerner, K. (1988) "Meillet, Saussure et la linguistique générale" in: *Histoire Épistémologie Langage*, *tome 10*, *fascicule 2. Antoine Meillet et la linguistique de son temps*, pp 57-73, p 59.

402 Brain, R.M. (2001) "The Ontology of the Questionnaire: Max Weber on Measurement and Mass Investigation" in: *Studies in History and Philosophy of Science*, 32(4), pp 647-84, p 672.

403 Koerner (1991), p 60; Wrede, F. (1902) "Ethnographie und Dialektwissenschaft" in: *Historische Zeitschrift*, 88(1), pp 22-43.

404 Meillet, A. (1906) "Comment les mots changent de sens" in: *Année sociologique*, 9, pp 1-38, p 23.

and Durkheim on Meillet's research is particularly evident here: both scholars stressed the importance of the social factors at work in spoken language, and Meillet's text is a firm endorsement of this view.

Meillet realised that if he was to study all of the world's languages, the questionnaire would have to fit an international standard. As I have shown in the previous section, Meillet collaborated with Marcel Cohen in order to produce just such a standardised and general questionnaire. Here, also, the connection between linguistics methodology and the social sciences is evident. Cohen, as mentioned above, worked in the *Institut d'Ethnologie* in Paris. This institute was founded by the Ministry of the Colonies in 1925, with the aim of coordinating, organising, and developing the ethnological studies of the French colonial project.[405] One of the *Institut*'s founding members was Marcel Mauss (1872-1950), whose work was theoretically aligned with Durkheim's and who saw ethnology as a part of the broader discipline of sociology.[406] Like Meillet, Cohen argued that language was a social fact, and that it was therefore part of the science of societies.

Meillet's project of collating and studying the world's languages also required a greater level of organisation from the international community of linguists, and this led to the inauguration of the International Congress of Linguists, discussed above.[407] The organisation of the congress can be seen as a disciplinary activity, effectively bolstering the discipline of general linguistics that it was created to nourish. In fact, René Worms had already been organising international congresses at his *Institut International de Sociologie* since 1894. These were intended to be events at which scholars could share their sociological research and discuss certain problems that the *Institut* had designated as themes.[408] The methodological discussions at these congresses again demonstrate the extent to which the disciplines were further taking shape and demarcating their boundaries at this time.

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405 Marcel, J.-C. (2004) "Mauss au travail autour de 1925" in: *L'Année Sociologique*, 54(1), pp 37-63, p 39.

406 Mauss was not only intellectually related to Durkheim, he was also Durkheim's nephew. Modern ethnology is often associated with cultural and social anthropology and still stands in close relation with sociology.

407 Daalder, S. (2004) "Achter de schermen van een congres: Het eerste Internationale Linguïstencongres (Den Haag, 1928)" in: *Voortgang*, *Jaargang* 22, pp 315-321.

408 Scheurkens, U. (1996) "Les Congrés de l'Institut International de Sociologie de 1894-1930 et l'Internationalisation de la Sociologie" in: *Revue Internationale de Sociologie*, 6(1), pp 7-24.

Sociolinguistic Legacy

One can surmise from the above that Marcel Cohen attributed a great deal of value to the extra-linguistic aspects of the differences between languages–that is, the context in which words were produced and spoken–as his research in ethnology would imply. Cohen and his supervisor, Meillet, were keen to understand the social components that influenced linguistic change, so as to move beyond the merely mechanistic descriptions of linguistic evolution that historical linguists of the late nineteenth century offered.

The historian of linguistics Konrad Koerner has identified this branch of nineteenth-century dialectology as one of the origins of the modern sub-discipline sociolinguistics,[409] arguing that the common view which associates the birth of modern sociolinguistics with William Labov's (born in 1927) work in the 1960s is mistaken. Indeed, other lines of linguistic thought that go back to the nineteenth century can be seen as influential for the early development of sociolinguistics,[410] and Koerner has linked dialectology and linguistic geography to sociolinguistics, for example. To support this view, Koerner has intriguingly mapped out an academic genealogical link that runs from William Dwight Whitney to William Labov. William Whitney (1827-1894) was cited numerous times by Saussure in his *Cours*, and is commonly recognised as having had an important influence on Saussure's work, just as Saussure had on Meillet.[411]

Meillet and his students did not have a particular name for their novel approach to language change. Indeed, the term "sociolinguistics" did not appear before 1952, and it took almost another decade before becoming "the generally accepted name for an important subfield of linguistic research."[412] One of Meillet's students, André Martinet (1908-1999), was an influential lecturer at Columbia University, and is considered a foundational figure in applied linguistics.[413] Martinet used questionnaires to carry out research into local speech and dialects, and employed what he called a phonetic questionnaire on French pronunciation as part of a study in which the respondents were

409 Koerner (1991), p 59.

410 Idem, p 58-9.

411 Idem, p 59.

412 Koerner (1991), p 65.

413 Walter, H. (2009) "André Martinet et la linguistique appliquée" in: *La linguistique*, 45(2), pp 145-152.

French-speaking prisoners in a Second World War camp.[414] The questions in Martinet's questionnaire had a phonetic focus, but the context of the questionnaire made a deep impact on the study and led to the incorporation of social factors in the research.[415]

One of Martinet's students was Uriel Weinreich (1926-1967). Weinreich's most influential work, *Languages in Contact* (1953), was a socio-geographical study of bilingualism, and took its title from a series of lectures given by Martinet.[416] The book included a chapter on research methods, in which Weinreich sketched a historical overview of the ways in which linguists had been interested in "the concrete effects of language contact who endeavoured to account for them by reference to the socio-cultural setting of the contact."[417] In the work, Weinreich describes how some linguists focus on the demographic and social conditions of their subjects, whilst others take a radically different approach and only consider the structural components of language.[418] This division then illustrates how the discipline of linguistics can serve to incubate specialisations. The first group, according to Weinreich, would use data to measure and verify various scales and theorems related to bilingualism.[419] Weinreich considered the second group, meanwhile, to be characterised by their "strong emphasis on structural considerations, while social setting of language contact was left in the background."[420] Weinreich believed a more equal balance should be sought between the two, and claimed that Martinet's work was a good example of a well-balanced study, given its use of a questionnaire.

William Labov was a student of Weinreich, and stated that his research had always focused "on the understanding of linguistic change,"[421] thereby echoing the tradition of which Meillet was a central figure. In the first volume of the journal *Language in Society*, Labov offered a reflection on various linguistic methodologies.

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414 Martinet, A. (1945) *La pronunciation du français contemporain : témoignages recueillis en 1941 dans un camp d'officiers prisonniers*. Libraire Droz, Paris, p 8.

415 Idem, p 16.

416 Koerner (1991), p 61.

417 Weinreich, U. (2010 [1953]) *Languages in Contact: Findings and Problems*. 10th edition, Walter de Guyter, The Hague, p 111.

418 Weinreich (2010), p 111.

419 Idem, p 116-117.

420 Idem, p 112.

421 Koerner (1991), p 63.

He presented the "Observer's Paradox": that "[t]o obtain the data most important for linguistic theory, we have to observe how people speak when they are not being observed."[422] One way to do this, Labov claimed, is to initiate a conversation between the subjects and then place oneself outside of this conversation. This method indicates that the questionnaire had been transformed: Labov referred to the "sociolinguistic interview" as the preferred method of linguistic research,[423] for ensuring spontaneous conversations and providing the researcher with more reliable data than fixed questions can. Labov, often considered the father of sociolinguistics, therefore incorporated a research method that bore a strong resemblance to the questionnaire into his research. The questionnaire, having undergone multiple developments, thus ends up here as Labov's sociolinguistic interview.

By following the history of the questionnaire, I have been able to narrate a prime example of how one particular subdiscipline–sociolinguistics–was formed, in this case as a specific result of scholars orienting their research questions to social factors, and adapting their methods accordingly. Other current examples include psycholinguistics, neurolinguistics, language acquisition, linguistic anthropology, evolutionary linguistics, phonetics, etymology, comparative linguistics, generative linguistics, structural linguistics, cognitive linguistics, and many others. It would be interesting, elsewhere, to study some of these other subdisciplines from the perspective of the sharing and adapting of practices and methodologies to see what this can tell us about how subdisciplines are formed.

Moreover, this historical exercise shows how an adaptation of data practices can have an effect on a discipline as a whole, though of course some scholars were faster or more willing to adapt certain practices than others. The use of shared methods also attracted scholars from different backgrounds to study similar projects, and this resulted in a subgroup of scholars who, though still adhering to most disciplinary standards, also acquired their own standard methodologies and practices. This long-term process is described by Koerner, and illustrated above: a subgroup of scholars eventually goes on to form a subdiscipline, in this case sociolinguistics, and this can be seen within the context of practices of disciplinary sharing and dividing.

The subdisciplines of linguistics also show how multifaceted the study of lan-

422 Labov, W. (1972) "Some Principles of Linguistic Methodology" in: *Language in Society*, 1(1), pp 97-120, p 113.

423 Labov (1972), p 113. See also: Dollinger, S. (2012) "The Written Questionnaire as a Sociolinguistic Data Gathering Tool: Testing its Validity" in: *Journal of English Literature*, 40(1), pp 74-110.

guage is, and that connections between linguistics and other areas of research are readily formed.[424] I have shown that Cohen mentioned this as early as the start of the twentieth century, and it foregrounds Meillet's attempt to create a unified, general discipline of linguistics as well. One could argue that Meillet's project failed: a general discipline was never created, though multiple scholars tried. In some contexts, general linguistics continues to exist, but only as a subdiscipline of linguistics.[425] Indeed, the discipline of linguistics is today interpreted differently, according to the scholar, and it is with this point that I will begin this chapter's conclusion.

3.6 Conclusion

This chapter has presented the questionnaire as a method for systematically collecting data on a phenomenon that is difficult to observe directly: spoken language. This dissertation's primary objective is to study the sharing of data practices between disciplines, and the role this can play in the formation of disciplinary boundaries. For this, my focus is observational data practices in different disciplines, with this chapter looking specifically at the questionnaire and how it became a part of the linguistics discipline. I have examined how both the method and the discipline were changed as a result of this process. In what follows, I present some conclusions of my research, whilst setting the scene for the general findings of the next chapter.

The Data Practice: Flow of the Questionnaire Method

In 1907, the American psychologist Robert H. Gault wrote that "a large proportion of current psychological literature is based upon data obtained by means of the questionnaire [...] by many this is regarded as a reliable, scientific method."[426] Gault illustrates the origins of the questionnaire in the discipline of psychology, and shows how the method has been involved in "various fields of psychological enquiry."[427]

424 For more interdisciplinary connections see Nefdt, Klippi & Karstens [eds] (2020).

425 The Dutch "Algemene Taalwetenschap" is still in use and seen as a particular part of the linguistics discipline owing to yet another interpretation of general namely in a formal sense. See for example "Part 1 Linguistics and the Formal Sciences" in: Nefdt, Klippi & Karstens [eds] (2020), pp 11-140.

426 Gault, R.H. (1907) "A History of the Questionnaire Method of Research in Psychology" in: *The Pedagogical Seminary*, 14(3), pp 366-383, p 366.

427 Idem, p 366.

He also mentions that his investigation will necessarily lead him beyond the boundaries of psychology. The cases studied in this chapter show not only that the same can be said of the discipline of linguistics, that the questionnaire was used in various fields of linguistic inquiry and that to study that we need to look also beyond the boundaries of the linguistic discipline, but also that the questionnaire played a significant role in shaping the discipline itself.

As I have shown, the questionnaire has featured in the methodological repertoires of multiple disciplines, including psychology, statistics, ethnology, anthropology, sociology, and linguistics, and has also frequently been used in natural historical research. In each of these disciplines, and given its versatility as a method, the questionnaire has been adopted to align with the goals and rules of the research in question. It should go without saying that this chapter has only been able to recount a small section of the questionnaire's multifaceted history. The examples presented here demonstrate how the questionnaire became a part of the discipline of linguistics, ensuring a rigour deemed to be both scientific and precise. Jules Gilliéron's and Georg Wenker's applications of the method resulted in highly detailed research, with Gilliéron explicitly referring to his methodology as guaranteeing the same level of observational accuracy as the natural sciences.[428]

My research has considered the data practices involved with questionnaire research as a cognitive good,[429] shared between different research contexts, in line with my understanding of the concept of flow. These flows occur at the mesolevel of historical analysis: for example, when studying the International Congress of Linguists, one might consider decisions being made on a disciplinary scale, involving the use and standards of the questionnaire in linguistics as adapted from ethnology or dialectology. This flow, however, could not be said to merely go from A to B, or to have a clear beginning and destination. Instead, these and other data practices were developed in multiple contexts, at the same time as they were employed in these same contexts. It is therefore necessary to understand that flow, as a historiographical term, describes a sharing process too, addressing not only how a cognitive good enters or originates in

428 Gilliéron & Edmont (1902), p 3.

429 See Chapter 1, section 1.3 on the historiographical tools of the flow of cognitive goods framework.

a certain context, but also how it is shared between multiple contexts.[430] I will discuss reflections on these historiographical tools in the next and final chapter.

Disciplinary Boundaries: Collecting Linguistic and Social Data

Whilst Gilliéron and Wenker also presented conclusions on social and extra-linguistic factors, this was not the initial aim of their research. The opposite can be said of Antoine Meillet and Marcel Cohen, however. Meillet attempted to implement the questionnaire to map the world's languages and, for him, this included social factors. Meillet was well-versed in the emergent field of sociology in France, and Cohen was a member of the *Institut d'Ethnologie* in Paris. It should come as no surprise, then, that their research into language and language change had many ties with these social sciences, and their use of the questionnaire reflected this. The choices that Meillet and Cohen made in the design of their questionnaires demonstrate the significance of these influences on their work, and the method ultimately enabled the two scholars to account for social factors in their linguistic research in a systematic way.

Given the questionnaire's widespread use across a variety of fields, tracing its history necessitates a crossing of disciplinary boundaries. The cases of Meillet and Cohen are concrete examples of how the method might be adapted when embedded within particular contexts. Importantly, the disciplines discussed in this chapter were still being defined in the nineteenth and early twentieth centuries, implying many instances of disciplinary activity, and the questionnaire played a role in this formation; international projects that involved the questionnaire and attempts to standardise research methods had a real impact on this disciplinary process. Scholars used the questionnaire to collect and manage data in a systematic way, and this was understood to make the discipline more scientific and empirical. Rather than continuing to produce historical descriptions of languages, scholars began to ascribe more value to research that looked into the relationship between language use and social factors, and this was based on data collected via questionnaires. Such developments are clearly visible when one studies the history of data practices.[431] What is more, this chapter

430 In his dissertation, Sjang ten Hagen thinks about shared cognitive goods as "entangled histories": Ten Hagen, S.L. (2021) *History and Physics Entangled: Disciplinary Intersections in the Long Nineteenth Century*, Dissertation, University of Amsterdam.

431 I have discussed the historiographical approach of the data historians in Chapter 1 as well. For more on data histories see also: Aronova *et al.* (2017); and De Chadarevian, S. & Porter, T. [eds] (2018) "Special Issue: Histories of Data and the Database" in: *Historical Studies in the Natural Sciences*, 48(5).

has sought to provide another example of how the sharing of data practices and the formation of disciplinary boundaries can lead to tensions between scholars who adopt a method in different ways. Such tensions can come strongly to the fore in the emergence of subdisciplines, as we saw in the case of sociolinguistics.

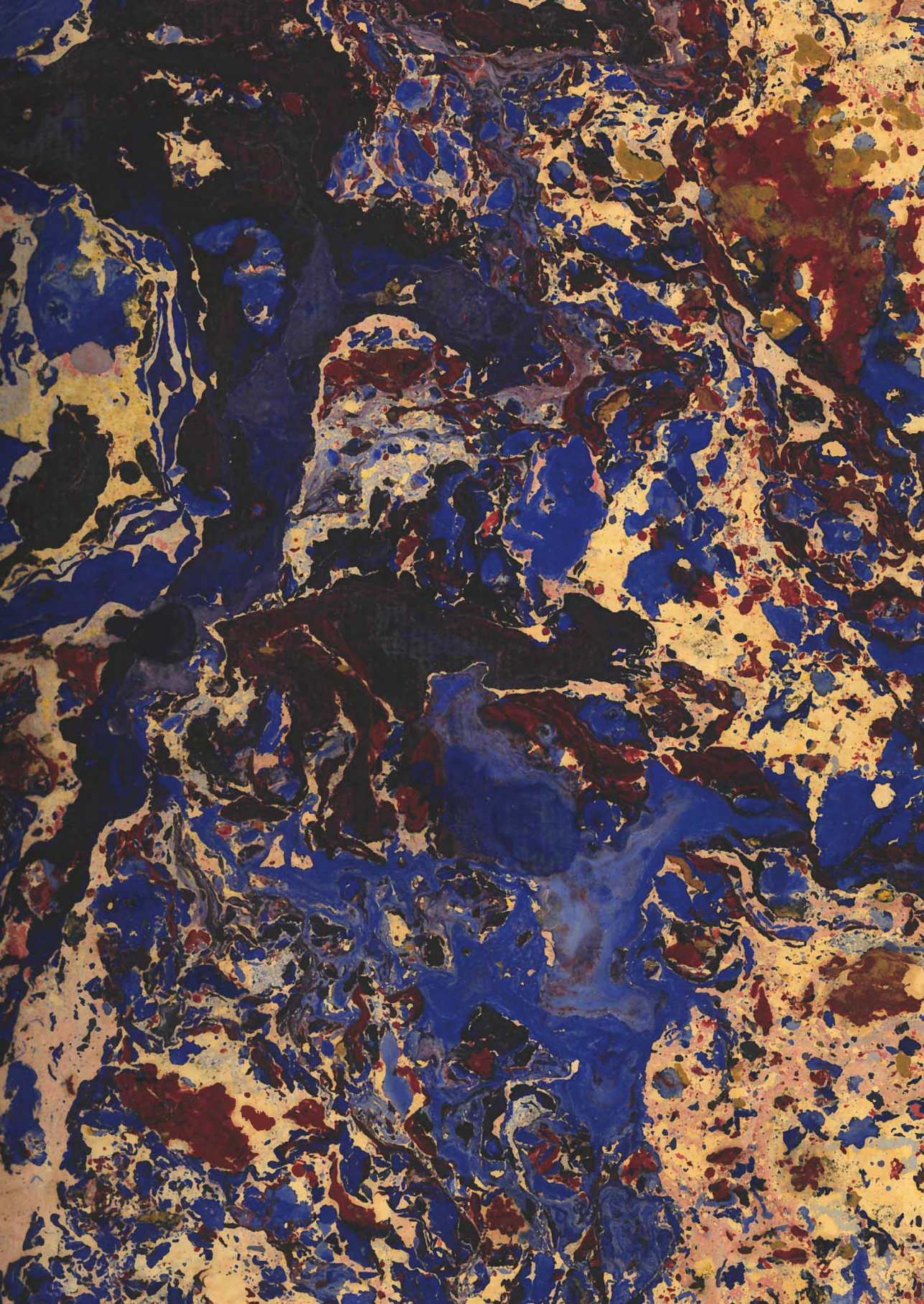
In Sections 3.2 and 3.3, I considered the development of the questionnaire as a data practice for the collection and management of data in linguistics research. I observed how different research projects required different adaptations to the data practices in question: Gilliéron's research into the non-fixity of French dialects required a questionnaire to be conducted by a single fieldworker, whereas Wenker's goal of proving that German dialects were subject to a regular geographic distribution meant that he let his respondents fill in the questionnaire themselves. Such differences offer important examples of the ways in which questionnaires were adapted and embedded within various research contexts.

Section 3.4 illustrated a further development of the method, namely its assimilation within linguistics. The field itself, moreover, was also undergoing a significant development, transforming from a collection of research domains such as dialectology and philology into a general discipline. This required, amongst other things, international agreements on standardised methods: in section 3.4 I recounted scholars' attempts to come to such an agreement at the first International Congress of Linguists. The questionnaire was further adapted as a standard international method for the collection of several different types of language data. This came to include questions on social factors: Marcel Cohen transformed the ethnological questionnaire into the standard linguistic questionnaire by including questions on particular words and sentences. Cohen's questionnaire therefore illustrated Meillet's proposal of what the discipline of general linguistics should look like, by connecting it with sociology. The questionnaire connected language change with social factors and treated language as a social fact which could be collected. Indeed, Cohen's questionnaire illustrated the connection between the proposed discipline of general linguistics and the newly established discipline of sociology. Section 3.5 examined this connection further by focussing on the subdiscipline of sociolinguistics. The emergence of this subdiscipline demonstrated once again the tension between sharing methods on the one hand, and disciplinary demarcation on the other.

The formation of the subdiscipline sociolinguistics also offers another important conclusion: the attempts made by Meillet and other scholars to establish a general discipline of linguistics seem to have failed. Whilst modern linguistics can still be considered general in the sense that it posits abstracts from studies of individual lan-

guages, this study is nevertheless conducted across numerous different groups and fields. When taken with the "failed" discipline of statistics examined in Chapter 2, this offers an interesting comparison. I concluded that statistics was unable to establish a distinct discipline for itself due to the wide variety of topics and objects of study that statisticians aimed to include. However, linguistics does have an object of study, namely language. The distinction that I described in Chapter 1–between eighteenth-century epistemic genres that were based on a certain method and nineteenth-century disciplines that were based on the study of an object–does not seem to hold in this case. But language is such a multifarious phenomenon that it is difficult to fit its study in one discipline only. In fact, that may well be the reason that the linguists seem to be lacking a common method. Meanwhile, those scholars who did arrive at a standard method, such as the questionnaire, computational methods, or textual methods, went on to form subdisciplines, and these are distributed between the humanities, sciences, and social sciences.

All this not only makes the process of discipline formation more complex, but provides insights into the nature of disciplines themselves. In this chapter, I have shown how discipline formation involves the internationalisation and standardisation of methods, and how this is inherently interdisciplinary. The need to standardise methods arises as a result of their being shared between disciplines and research contexts. The organisation of a discipline on an international scale therefore involves communicating and connecting with other disciplines as part of the process of boundary demarcation. These forms of disciplinary activity are especially present at disciplinary congresses. Such congresses provide a forum for scholars to discuss methodological developments within the discipline internationally, as well as to include perspectives from other disciplines. The multiple facets of discipline formation are thus on display at these congresses. In this dissertation's final chapter, I look back at the instances of disciplinary activity that I have studied and come to a comparative analysis.



Chapter 4 General Observations and Conclusion

Chapter 4: General Observations and Conclusion

In this dissertation I have "observed disciplines" by how practices involving the collection and management of data from observations were shared between different academic disciplines and how they became embedded in them. I have shown how the sharing of these practices on the one hand and the standardisation processes of the disciplines on the other hand could lead to tension. This tension between the sharing of practices and the dividing into disciplinary contexts has been central to my dissertation. Studying this tension, my dissertation offers insights into how academic disciplines come into being, how they operate, and how they interact with each other. It also reveals how certain data practices can be seen as part of disciplinary contexts as well as in interdisciplinary interactions.

In this concluding Chapter, I will summarise, analyse, and compare the various instances of activity to create and to cross disciplinary boundaries I have encountered in my historical cases and I ask what this tells us about the nature of disciplines. Through this analysis, I will answer the research questions I had set out in Chapter 1: *How did comparable observation practices become part of different nineteenth and early twentieth-century academic disciplines? How did these practices develop in different disciplinary contexts? How were the different disciplines influenced by the sharing of these practices?* I have concentrated on practices dealing with data from observations by nineteenth and early twentieth-century scholars through two historical cases to operationalise these research questions. The cases focussed on disciplines whose boundaries were unclear or in the process of being defined, namely botany and linguistics, which uncovered multiple instances of tension between disciplinary and interdisciplinary interactions.

I have taken disciplines to be institutionalised social entities, encompassing research and education, with agreed-upon methods, topics, and practices.[432] I have considered the disciplines of botany and linguistics and examined how they developed over time. I argue that both an interdisciplinary and a disciplinary view should be adopted when studying disciplines. The historiographical framework of "flow of cognitive goods" has enabled a coherent overview of how certain data collection practices were shared between disciplines. Still, these interactions are based on activity between individual scholars. In order to combine the abstract level of disciplines

432 In Chapter 1, I examined the definition of an academic discipline and in the research chapters 2 and 3 I used case studies to get a better understanding of disciplinary development.

and the particular level of individuals, and in order to analyse not only the sharing of cognitive goods but also the emergence of disciplinary boundaries, this dissertation has employed the concept of "disciplinary activity". Disciplinary activity can signify the appropriation or embedding of certain practices within an individual scholar's research in order to meet disciplinary criteria. It can also be the debates and discussions between scholars about these disciplinary criteria determining what should belong to their discipline and what should not. Both disciplinary and interdisciplinary perspectives can be achieved by applying the historiographical tools from the flow of cognitive goods framework together with disciplinary activity.

The historiographical framework of flow of cognitive goods enables a systematic study of epistemic transfer between disciplines, by introducing an umbrella term to capture all that is shared between disciplines: "cognitive goods".[433] The cognitive goods in this dissertation were the statistical approach as propagated by Quetelet and the questionnaire research as employed by Gilliéron and Meillet, both of which I have also recognised as data practices. In Chapter 2 I have shown how Quetelet's statistical approach was shared between multiple disciplines, with a focus on how it was implemented in botany. This sharing was sometimes done explicitly, mentioning Quetelet's name and work, as in the cases of Henry Thomas Buckle in the discipline of history or James Clerk Maxwell in physics. Still, this did not necessarily mean that these disciplines adopted Quetelet's approach exactly: the scholars adapted the cognitive goods in order to fit with their own disciplinary work. This shows how cognitive goods are changed when they are shared between disciplines.

Chapter 2 presented cases in which the source and destination of the cognitive good was clear cut: the cognitive goods of statistical approaches developed by Quetelet ended up being shared by multiple disciplines. In Chapter 3, however, the sharing is more intricate. As the cases discussed in Chapter 3 have shown, research which used a questionnaire was spread over many different disciplines, including psychology, linguistics, and ethnology. A clear start or end in these cases is indiscernible, since the questionnaire was developed and altered to have many guises and goals. In the cases of questionnaire research as a cognitive good it is therefore more helpful to think of sharing the cognitive goods than of a certain flow. Perhaps this would have been less trivial had I focused on Gilliéron's questionnaire as cognitive good in Chapter 3, for

433 For a longer description of the methodology of flow of cognitive goods see also Chapter 1, section 1.3, and the programmatic paper on this approach can be found here: Bod, R., Van Dongen, J., Ten Hagen, S.L., Karstens, B., & Mojet, E. (2019) "The Flow of Cognitive Goods: A Historiographical Framework for the Study of Epistemic Transfer", *Isis*, 110(3), pp 483-496

example, similar to Quetelet's statistical methods. This would, however, not have done justice to how questionnaire research was so ubiquitous in the nineteenth century as I have shown. In the following sections I present the results of my research and reflect on the insights I have gained.

4.1 Synopsis: Data Practices as Cognitive Goods

The data practices in my historical cases were part of what can be called observation practices: the scholars applied these data practices to collect, manage, or analyse data from observations. Because the scholars from the different disciplines I have examined had similar ideas about data and observations in their research, it is now possible to discuss the cases collectively. This has resulted in a number of insights into the nature of data practices, of sharing between disciplines, and of disciplinary boundaries which I will reflect upon in this Chapter.

First of all, I have shown how the shared data practices were adapted and developed in different research contexts; what can this tell us about the data practices themselves? Second I have shown how adaptations of data practices led to discussions between scholars concerning the role of these practices in the different research contexts or disciplines and resulted in standardisation processes. These entailed discussions between scholars on how the data practices should be used and incorporated in such a way that the resulting research would meet the agreed-upon standards for scientifically rigorous and objective research. Lastly, and as a consequence of this standardisation process, I have illustrated how these discussions were part of the process of discipline formation.

Statistics and Botany

In Chapter 2 the case under scrutiny was the use of statistical methods as data practices in the discipline of botany. In many different fields, of which Chapter 2 only gave a couple of examples, scholars sought for 'statistical laws' that uncovered regularities from intangible objects. The sections of Chapter 2 demonstrated how statistical and quantitative methods were developed in varying research contexts and introduced the pivotal work of Adolphe Quetelet in social statistics. It displayed how statistical methods were increasingly employed in botany to study the relationship between temperature and plant development. This was illustrated further with in-depth historical research on Quetelet and his former student Charles Morren's botanical observations and discussions. They statistically studied data on the foliage, flowering, fruiting, and

falling leaves for multiple plants over the course of several years. By doing so, they hoped to gain understanding of the Belgian climate and its effect on plants, as well as compare their findings with other observers in different countries. This resulted in discussions on how to standardise their observations in order to make a comparative study of the topic. Here Morren and Quetelet disagreed on what should be observed; Morren took the side of the disciplinary botanists who believed Quetelet's approach was too general, whereas Quetelet aimed at an international network of observers making many general observations.

To Quetelet these general observations did not belong to a particular discipline but to a larger, overarching project.[434] Morren and other botanists, however, required observations of different phenomena to investigate the topics of their discipline, namely those related closer to specific plants and plant development such as the colour or scent of a flower, aspects which Quetelet chose to exclude. Through the lens of disciplinary activity the botanists can be seen determining what should be part of their discipline and what should be left out: they required more specific observations.

The last sections of Chapter 2 discussed the formation of disciplinary boundaries as a result of sharing statistical data practices, especially in the emerging disciplines of the social sciences. This was influenced by Quetelet's international network: scholars adopted and adapted his statistical methods in their own research. While a discipline of social physics as Quetelet had envisioned it was never really established, modern statisticians have created a field of research to study the use of statistical methods and apply them to different contexts. Indeed, throughout the course of the nineteenth century, the statistical methods themselves became more sophisticated and advanced. It became possible to measure and observe intangible objects. An important result of Chapter 2 was that entities such as society became measurable through the use of statistical data collection practices.

Questionnaires and Linguistics

Chapter 3 also centred the observation of an intangible object: spoken language. To collect data on language, scholars worked with questionnaires. In the Chapter, I considered the questionnaire as data collection method, which, based on questions, enabled the systematic study of a certain object which is otherwise difficult observe.

434 In doing so, Quetelet placed himself in the tradition of Alexander von Humboldt, whom Quetelet referenced in trying to create a more complete picture of a certain geography by collecting data on many different phenomena. See section 2.3 for more on Humboldt, Humboldtian science, and Quetelet's adaptation of Humboldt's work.

Questionnaires are best defined, however, by the research project in which they are used. This was done in the first sections of Chapter 3, where several examples of questionnaires to collect data on languages were discussed. A notable development was the introduction of the fieldworker questionnaire instead of postal questionnaires. The postal questionnaire was employed by Georg Wenker in his project to map the language varieties in several German speaking regions. While Wenker obtained a large amount of detailed data, his questionnaires were filled in by many different people and hence contained many uncertainties. To deal with this issue, Jules Gilliéron decided to send one fieldworker to collect data on languages spoken in many different villages in France. This method was seen as more rigorous and therefore was taken up by numerous other linguists.

Throughout the Chapter, I also examined the development of the discipline of linguistics. I have shown how the field of language studies transformed from many separated research fields to one organised linguistic discipline. Different approaches towards a single discipline of linguistics were discussed, including different attempts to generalise the study of language. An important role in this process of discipline formation was played by the International Congress of Linguists, initiated by Antoine Meillet.

Meillet aimed to organise the international collaboration between linguists in order to unify the varying fields into one general linguistics. His main project was to create an international standard questionnaire to collect data on languages from all over the world. I examined this project by looking at the role of the questionnaire at the first International Congress of Linguists. As a result of discussions and debates at the Congress, a standardised questionnaire was developed by Marcel Cohen, a student of Meillet. Cohen was affiliated at the Ethnological Institute in Paris and used ethnological questionnaires as a template for his linguistic version. This shows how closely the social sciences were involved with other disciplines, in this case linguistics.

Moreover, Meillet's work with Ferdinand de Saussure and Émile Durkheim in Paris resulted in a close connection between the upcoming discipline of sociology and the newly proposed discipline of general linguistics. The last sections of Chapter 3 discussed the disciplinary boundaries of linguistics and the upcoming social sciences. Eventually, the discipline of general linguistics was never established, despite the efforts of Meillet and other scholars before and after him, but a direct connection can be made between Cohen and Meillet's linguistic endeavours and the disciplinary specialisation of sociolinguistics. This displayed various instances of disciplinary activity, which I will discuss in more detail later on in this concluding chapter.

Reflecting on Data Practices

By considering both the cases from a focus on data practices and by applying the tools of the same historiographical framework to both of them, it becomes possible to not only synthesise but also compare both research cases. While the data practices and the disciplines in both cases differ just like the historical context and actors considered, the historiographical approach I have chosen allows for a comparison between them.

Throughout this dissertation I have encountered various types of data practices: here I will summarise them and analyse their role in my historical narrative. As I mentioned in Chapter 1, the focus on data practices in histories of knowledge production has been highlighted by a group of historians in the past decade.[435] Their aim has been to be able to connect various historiographies and through a focus on data practices tell a more inclusive and broader historical narrative. In their work, they have included otherwise marginalised historical actors, material aspects, and political influences, which were otherwise neglected. The data historians have also envisioned how a focus on data practices could enable an interdisciplinary perspective on knowledge production. However, this work so far has not included discussions thematising disciplinary boundaries. My research has thus added the perspective of disciplinarity, interdisciplinarity, and discipline formation to the current literature on data histories. This perspective not only fulfils the potential of crossing disciplinary boundaries as the data histories had already promised, but interdisciplinarity and disciplinarity have proven to be inherent to the development of the data practices themselves. As I have shown in my research cases, the data practices were shared interdisciplinarily and adapted according to disciplinary standards.

The data practices I have studied were the statistical methods in Chapter 2 and the questionnaire method in Chapter 3. The statistical methods were used to analyse and systematically organise different types of data from observations. These observations could pertain to many things: stars, plants, or groups of people. I have shown in Chapter 2 how the statistical methods developed to accommodate these different types of data and how this lead to comparable data practices in different disciplines. The questionnaire method considered in Chapter 3 was used to collect and, again, systematically organise linguistic data. Here I have concentrated on linguistic data

435 The main sources which I have focused on for this paragraph are Aronova, E., von Oertzen, C., & Sepkoski, D. [eds] (2017) "Special Issue: Data Histories" in: *Osiris*, 32; and De Chadarevian, S. & Porter, T.M. [eds] (2018) "Special Issue: Histories of Data and the Database" in: *Historical Studies in the Natural Sciences*, 48(5). This has also been applied to cases in the history of humanities disciplines, see Chapter 1.

because observing languages implies the difficulty that spoken language is intangible and requires extra efforts to observe systematically. These practices are found in the development of the linguistic questionnaire. I have studied how scholars had different ideas about the questions and data to be collected and how the questionnaire was adapted to meet these goals.

The two historical cases have illustrated how shared data practices were changed to adapt to a specific research context. The shared data practices enabled scholars to ask new and different questions, through the collection and analysis of different types of data. Examples from my research are how Quetelet was able to make new connections and correlations, or how Meillet could study language change including a social perspective using a questionnaire that was shared between linguistics and sociology. The sharing of data practices affected the specific research questions. Moreover, the data practices needed to adhere to specific ideas of what was scientific, rigorous, and objective depending on the specific context in which they were adopted. As I have shown, Quetelet's methods were criticised by botanists for not adhering to the standards of their observations. Another example of this can be found in Gilliéron's adaptation of the questionnaire method–using one single interviewer or fieldworker–so that the method was considered more rigorous. These adaptations were based on agreements made within the specific research context or discipline. Hence, the data practices not only affected the research contexts, but they were also affected by the standards of these contexts.

The sharing of data practices between disciplines or research contexts thus had a direct effect on the research of the scholars in the new context: the shared data practices enabled different questions and observations. These data practices were debated within their new context and often adapted to fit the discipline's standards. However, another consequence of these debates was the emergence of subgroups of scholars who were extremely in favour of implementing certain methods or who did not agree with meeting certain standards. I have written about MacLeod's statistical botany group, for instance, or the subdiscipline of sociolinguistics. In both cases the scholars were welcoming to data practices which were not always agreed-upon by the overarching discipline of botany or linguistics, respectively. While the adoption of new data practices may only be part of the story, the examples show how connections were made between disciplines through the sharing of data practices and how this led to differentiations and specialisations within the discipline. This also shows the dynamic nature of academic disciplines where boundaries are crossed and rearranged.

Another aspect of data practices which caught my attention was the question

of who was collecting and who was analysing the data. These questions give insights into the workings of disciplines that are not often researched, not focussing on the authoritative figures and their produced work but on the practices and on the collectors. In Chapter 2 I encountered Quetelet's observers, of which Charles Morren was an exceptional case. Kevin Donnelly has called these observers "the real average men", who should have the qualities of industriousness, devotion, and self-sacrifice.[436] They were "largely anonymous administrators" and set with the task to implement Quetelet's scientific programme as explicated in his *Sur l'homme*.[437] Quetelet's observers were not necessarily scientifically trained, yet Quetelet did recognise them as playing an important role in his new science. This led to Quetelet's work being criticised for not being able to uphold a standard of rigour necessary for the sciences. As a response, Quetelet argued for the law of large numbers, being able to average out mistakes if he had collected enough data. A similar discussion can be found in Chapter 3, where Wenker asked school instructors and school inspectors to carry out and fill in his questionnaires, whereas Gilliéron explicitly argued against this. According to Gilliéron, only a linguistically trained field worker would be able to collect precise data, whereas Wenker used linguistic laypeople and received a far higher response rate. Here again, Wenker relied on the law of large numbers: he believed a large amount of data to be necessary for accurate results. On the contrary, Gilliéron reckoned scientific rigour could only be achieved if a single field worker conducted all the questionnaires.

These discussions are contingent to the context of the research and the disciplinary standards that the scholars in question agreed to adhere to: Gilliéron aimed at research goals which differed from Wenker's, and also Quetelet's approach was tailored to meet his own academic aims as explained in the respective research chapters. Yet the comparison shows that the employment of data practices entailed the employment of a new type of helper too. These workers, the data collectors, needed to have certain qualities, which depended on the data practice employed.[438] As Lorraine

436 Donnelly, K. (2014) "The Other Average Man: Science Workers in Quetelet's Belgium" in: *History of Science*, 52(4), pp 401-428, p 410.

437 Donnelly (2014), p 417.

438 Other examples of these scientific persona include Charles Babbage's 'interchangeable workers' or the human computers. For Babbage, see Schaffer, S. (1994) "Babbage's Intelligence: Calculating Engines and the Factory System" in: *Critical Inquiry*, 21, pp 203-227; and on human computers see Croarken, M. (2009) "Human Computers in Eighteenth- and Nineteenth-Century Britain" in: E. Robson & J. Stedall [eds] *The Oxford Handbook of the History of Mathematics*. Oxford University Press, Oxford, pp 375-403.

Daston and Elizabeth Lunbeck have argued, this is in line with how the practice of observation changed in the early decades of the nineteenth century: observation came to be considered as something passive, the mere registration of data that could be left to an untrained assistant and completed at a distance.[439] While observations were still seen as foundational, the observer was expected to passively register the data, out of fear that observation might become contaminated when practiced by scholars or scientists supporting a preferred theory or outcome.[440] The cases of Quetelet and Wenker fit this type of observation practices, while Gilliéron's approach does not. Gilliéron argued, as did critical voices commenting on Quetelet's programme, that a trained observer was necessary to uphold standards of scientific and scholarly rigour. It would be interesting to study these data collectors through the lens of scholarly persona: which epistemic virtues were deemed important for these workers and how did this differ for various research contexts?[441] Writing histories with a focus on data enables the connection between different historiographies, and it is exactly these types of questions which come to the fore by studying data histories and data practices.[442]

Data practices have thus been a valuable basis from which to study the disciplinary and interdisciplinary processes involved in nineteenth-century discipline

439 Daston, L. & Lunbeck, E. (2011) "Introduction. Observation Observed", Daston, L. & Lunbeck, E. [eds] *Histories of Scientific Observation*, The University of Chicago Press, pp 1-9, p 3. In Chapter 1 I discussed the same point as argued in Daston & Galison (2007) on how observations were valued as objective.

440 For more on the role of the scholar during observations, see Canales, J. (2001) "Exit the frog, enter the human: physiology and experimental psychology in nineteenth-century astronomy" in: *British Journal for the History of Science*, 34(2), pp 173-197.

441 An introduction to the concepts of scholarly persona and epistemic virtues can be found here: Paul, H. (2014) "What is a scholarly persona? Ten theses on virtues, skills and desires" in: *History and Theory*, 53, pp 348-371; and for a collection of historical studies applying these concepts, see: Van Dongen, J. & Paul, H. [eds] (2017) *Epistemic Virtues in the Sciences and the Humanities*. Boston Studies in the Philosophy and History of Science, Volume 321, Springer, Cham. Epistemic virtues can be operationalised to connect knowledge production with political, moral, or social virtues, such as in the following research: Tai, C.K. (2021) *Anton Pannekoek, Marxist Philosopher. Photography, epistemic virtues, and political philosophy in early twentieth-century astronomy*. Dissertation, University of Amsterdam.

442 An example which includes a focus on data collectors is Von Oertzen, C. (2019) "Keeping Prussia's House in Order: Census Cards, Housewifery, and the State's Data Compilation" in: C. Bittel, E. Leon, & C. von Oertzen [eds] *Working with Paper: Gendered Practices in the History of Knowledge*. University of Pittsburgh Press, Pittsburgh, pp 108-123.

formation. The fact that comparable data practices could be found in different disciplines enabled me to connect these disciplines and to study the processes within and between them. Yet, relationships between disciplines and the sharing of concepts, theories, and methods are themselves intangible things to study. Just like the data practices that had to be developed to collect data on a concept like society or on a particular dialect, things which are otherwise difficult to observe, I have applied a set of historiographical concepts of flow of cognitive goods and disciplinary activity to be able to do so. In the following paragraph I reflect on what results I have gained from the methodology I have applied.

4.2 Results: Studying the Flows

A result of my approach is that I have found many different instances of sharing between disciplines: I have found a large number of flows. I have not discussed all these instances in detail, focussing on the cognitive goods and flows of my cases, but here I will highlight some of the flows we met along the way. The fact that I encountered so many different instances of epistemic transfer shows the abundance of interdisciplinary exchange and how disciplinary boundaries are crossed. By studying all these instances applying the same historiographical framework, the flow of cognitive goods, it would become possible to create a comprehensive overview of these flows as well as compare and analyse the occurrences of epistemic transfer. In the same way as I have done in this dissertation, such analysis into flows can give us insights into the existence and crossing of disciplinary boundaries from a historical perspective.

In Chapter 2 I researched the history of botany, which transformed to a laboratory-oriented discipline throughout the nineteenth century. Botanical scholars' traditional emphasis on taxonomy started to also include fields like anatomy, morphology, and plant physiology, without losing the descriptive parts of their discipline. This shift was strongly influenced by the relationships between the discipline of botany and other disciplines such as biology, chemistry, and physics. As Kärin Nickelsen has argued, one of the major changes for the discipline of botany was "the attitude to disciplinary boundaries. From a state of mutual disregard–sometimes even contempt–between the fields of physics, chemistry and biology, the climate changed to one of close collaboration."[443] Diving into these historical relationships between disciplines could uncover

443 Nickelsen, K. (2007) "From Leaves to Molecules: Botany and the Development of Photosynthesis Research", *Annals of the History and Philosophy of Biology*, 12, pp 1-40, p 29.

numerous instances of sharing and epistemic transfer between disciplines, as many scholars have already shown.[444]

In Chapter 3 I also encountered interactions between biology and other disciplines, though this time perhaps a more surprising connection than with its natural scientific neighbours. As E.F. Konrad Koerner has emphasised, the German linguist August Schleicher was heavily influenced by concepts "coming from outside the realm of linguistics".[445] Schleicher's influential linguistic theories involved concepts from the natural sciences, particularly a methodology of formal classification from botany and methods of systematic comparison and reconstruction from comparative anatomy, as Koerner has shown.[446] Indeed, the history of linguistics exhibits many crossovers between natural science, social science, and humanities disciplines, as can be witnessed in Chapter 3 of this dissertation and in most historical literature on the discipline.[447]

As well as the discipline of linguistics, I briefly visited the discipline of sociology in Chapter 3, which uncovered more instances of flow between fields of research. Durkheim's sociology, in particular, was based on the principle that, sociology should be practiced sociologically, this was done by extracting sociological insights from research of other disciplines. In Chapter 3 I focused on the connection between Durkheim's sociology and Meillet's linguistic research, but Durkheim's followers also included jurists, economists, psychologists, historians, ethnologists, and political scientists.[448] Not only

444 The following scholars, for example, have researched different aspects of the history of biology or botany to reveal interdisciplinary interactions: Cittadino, E. (2009) "Chapter 13: Botany" in: P.J. Bowler & J.V. Pickstone [eds] (2009) *The Cambridge History of Science*. Cambridge University Press, Cambridge, pp 225-242; Gliboff, S. (1999) "Gregor Mendel and the Laws of Evolution" in: *History of Science*, 37, pp 217-235; Schiebinger, L. & Swan, C. [eds] (2007) *Colonial Botany. Science, Commerce, and Politics in the Early Modern World*. University of Pennsylvania Press, Philadelphia; Kutschera, U. & Niklas, K.J. (2018) "Julius Sachs (1868): The father of plant physiology" in: *American Journal of Botany*, 105(4), pp 656-666; Coen, D.R. (2018) *Climate in Motion: Science, Empire, and the Problem of Scale*. The University of Chicago Press, Chicago; Kwa, C. (1993) "Modeling the Grasslands" in: *Historical Studies in the Physical and Biological Sciences*, 24(1), pp 125-155.

445 Koerner, K. (1989) *Practicing Linguistic Historiography. Selected Essays*. John Benjamins Publishing Company, Amsterdam, p 360.

446 Koerner (1989), p 360.

447 For a collection of such research, see Nefdt, R.M., Klippi, C., & Karstens, B. [eds] (2020) *The Philosophy and Science of Language. Interdisciplinary Perspectives*. Palgrave Macmillan, Springer Nature Switzerland AG, Cham.

448 Heilbron, J. (2015) *French Sociology*. Cornell University Press, Ithaca & London, p 96.

sociology but other social science disciplines too were involved in numerous instances of epistemic transfer. I will return to the emergence of social science disciplines further on in this Chapter.

I can now also reflect on the historiographical framework of flow of cognitive goods, which has only recently been proposed.[449] Since this research project is one of the first to apply this framework, a reflection on the historiography is important. A first observation is that, as indicated by the case of the questionnaires, the principle of flow should also be interpreted to include the sharing of cognitive goods between disciplines. With this perspective, a clearly-defined direction or starting and ending points are unnecessary. Second, it should be stressed that cognitive goods, while autonomous, are constantly subjected to change.[450] This can lead to tensions when defining cognitive goods or signalling their development, yet only by being adaptable can the cognitive goods perspective prevail. Again, this comes to the fore in the case of the questionnaire, where recognising the cognitive good in different disciplines was challenging. My solution was to consider the actor's categories and let the various historical cases define the method. Which brings me to a third and final point: the historiographical framework of flow of cognitive goods does provide a systematic overview of multiple disciplinary cases and a possibility to connect these cases. The framework offers a solution to study the mesolevel of analysis, the level on which disciplines act.

By following the flow of observations and data practices as cognitive goods I have examined how these practices were shared and standardised in two different historical cases. Using the umbrella term of cognitive goods enabled me to study the flow of the data practices. Without it, I would have been able to study the data practices within their research context and I would have seen how there were similarities between different contexts, but I might have missed the sharing and transfer of these practices. Examining data practices offers a useful tool to understand how different contexts are connected through similar practices, but does not provide insight into how these practices are spread and shared. For this, a more abstract analysis is necessary which is provided by employing the umbrella term cognitive goods and by studying their flow.

449 Bod *et al.* (2019), see also Chapter 1, section 1.3 where I introduce the framework and how I have interpreted it for my research.

450 This point is also included in the definition of cognitive goods in Bod *et al.* (2019), but it is pertinent to emphasize.

Sites of Flow: International Congresses

In my research I have found that congresses can be seen as events which on the one hand played an important role in the creation and consolidation of disciplinary boundaries, and on the other hand where interdisciplinary activity, and consequently flows, took place. Questions about the discipline's boundaries were discussed and research methods were explicitly debated. Developments in the discipline—both organisational and content related—come to the fore through the historical study of congresses, particularly the first instances of such an event, which were often organised for foundational purposes. The organisation of an international congress of a discipline marks a significant stage in the development of a discipline.

An example of how international congresses enabled new research projects is the attempt to preserve and map all of the world's languages and dialects as was brought to the fore at the first International Congress of Linguists. The goal of Quetelet's statistical congresses was to establish standardised bureaus for statistical data in many different countries. At the first meteorological congress the collection of meteorological observations while at sea was discussed on an international scale. The botanical congresses enabled the standardisation of new taxonomic rules. Many of these examples can be mentioned for other disciplines as well, and they show how such international events could have a lasting influence on knowledge production.

Even though the congresses played prominent roles in the development of specific disciplines, I have found that studying congresses requires a multidisciplinary point of view to include the influence of cross-disciplinary interactions. At the congress, scholars from different subfields and specialisations met to exchange ideas, research, and methods. Moreover, the scholars attending the congresses got to participate in discussions defining the boundaries of the discipline. They discussed which methods should be used in observations, how data should be collected, and which standards should be upheld. This has consequences for who can participate in the discipline and it is the members of the congresses who define this. The congresses show the authorities in a discipline, the scholars who get to decide. In this way, the congresses played a defining role in the composition of the discipline.

The results of the congresses were often in the form of establishing international committees. These committees had as their aim to create bibliographies for the discipline, for example, or to turn the congress into an annually recurring event. The establishment of permanent, international bodies illustrated the development of the discipline in becoming international and institutionalised entities. Other results, such as the decision for a certain nomenclature or the adaptation of particular methods,

influenced the discipline through the work of the scholars themselves. Scholars adapted their research or educational practices, as they included the newly agreed-upon methods in their textbooks and research projects. This secured the results from the international congresses on a national scale.

At the various disciplinary congresses, scholars from different nationalities would assemble and discuss the status, future course and central problems of their discipline. In this way, the congresses were a means to surpass the national backgrounds of the scholars. Certain theories or practices were validated thanks to the gathering of an international community, something which failed in the separate national contexts. By organising an international congress, decisions made by the assembled scholars would gain international authority and approval, almost functioning as a judge.[451] Nevertheless, national contexts had a strong influence on the scholarly work at international congresses. The organising committee might, for instance, decide upon the topics for the conference based on national preferences. This was the case at the statistical congresses described in the previous chapter: the statistical topics were so closely connected to matters of state that they differed greatly between countries, and due to the lack of continuity between the congresses when they were held elsewhere, this eventually meant the end of the series.[452]

Moreover, the organising committee could use the international congresses as a tool to show off their country and its institutions. Official representatives often honoured the congress with their presence and the hosts organised banquets or excursions to entertain the members of the congress in their country. International congresses could become a political tool, to endorse and to advertise the national scholarship. This had another consequence: the inclusion of politicians and official representatives in the congress generated public attention for the event. The congresses were mentioned in local and national newspapers. This not only brought the event to the attention of a broader group of people but also the discipline itself. The existence of the discipline and the type of research that belonged to it were thus acknowledged by the general public.

The scholars assembling at international congresses came from different backgrounds, both with respect to nationality and disciplinarity. While they shared interest

451 Feuerhahn, W. & Rabault-Feuerhahn, P. (2010) "Présentation: la science à l'échelle internationale" in: *Revue germanique internationale*, 12, pp 5-15, p 10-11.

452 See Chapter 2 and Randeraad, N. (2011) “The International Statistical Congress (1853-1876): Knowledge Transfers and their Limits” in: *European History Quarterly*, 41(1), pp 50-65.

in the topic of the congress, they often worked or were trained in different disciplines. At the congress, scholars from different subfields met and exchanged ideas, research and methods. For example, the botanist Karl Fritsch, mentioned in the previous chapter, had visited an international statistical congress prior to being a participant at an international congress of botany. He had applied certain methods which he had picked up at the statistical congress in his botanical and meteorological work at his home institute and subsequently presented this new research at the botanical congress. The result was that certain statistical methods were discussed at a botanical congress.

This example illustrates how congresses are both disciplinary and interdisciplinary. The results of the discussion concerning Fritsch' case influenced scholars throughout the discipline concerning the application of statistical methods for botanical research. This case can be studied at the microlevel, since it concerns an individual interaction, yet it also signals an interaction at the mesolevel. When applying the framework of cognitive goods, the example illustrates how certain methods flow from one discipline to another by being discussed at the disciplinary congresses. Hence, the congresses enable a connection between microscopic interactions between individual scholars and mesoscopic interactions between disciplines. This connection can be brought to the fore by analysing the congresses using the framework of cognitive goods.

In other words, congresses are sites of interdisciplinary flow as well as sites of disciplinary activity. In this example, the shared methods between statistics and botany became embedded in the discipline of botany at the congress. This did not happen without the botanists discussing how to apply the methods in their research. The methods were adapted in such a way that they fit with what was considered proper research according to their disciplinary standards. The scholars had to discuss how to come to these standards and adaptations. This disciplinary activity of deciding the standards for the discipline was an important part of the various first international disciplinary congresses throughout the nineteenth century. I return to disciplinary activity and discipline formation in the next section.

The congress organisers decided on the topics, methods, and research practices discussed at the congress and how these practices should be conducted in their discipline. Apparently, they had the authority to decide this. Indeed, the books written by the congress participants were presented as standard books or the methods

developed by the newly established committees were seen as standard methods.[453] Only the work published in certain journals or circulated at certain societies were seen as part of the discipline. Of course, important research also happened outside of these circles, but became part of the discipline when it was discussed at the congresses. The congress organisers thus defined the boundaries of the discipline and decided what could and what could not be included. It would be interesting to study in more detail how this was decided, on the basis of what rhetoric, for instance, or how this authority was granted. I would also like to do more research into the identities and backgrounds of the congress participants, and whether this differed greatly between congress in different disciplines. Who were involved in this disciplinary activity? These questions deserve more attention than I can give them in this dissertation.

I have considered international congresses as a site of communication and decision making and I have argued that international congresses can be used to observe and investigate discipline formation. The analysis is both at a microlevel with individual interactions as well as at a mesolevel concerning the discipline and its involvement with other disciplines. To combine these levels of analysis I once again have applied the flow of cognitive goods framework. Congresses can be seen as sites of flow as well as instruments for the embedding of these flows in a particular discipline. They are disciplinary and interdisciplinary phenomena.

Besides, congresses are national and international events. Organised with the ideal of international knowledge production, congresses were seen as neutral territory. However, unsurprisingly for the prevailing nationalistic tendencies of the nineteenth century, nationalities did play a role at the international congresses. This became particularly clear after the First World War when German scholars were not invited to congresses hosted in France or Belgium. Yet also prior to that, the nationalities at the congress played a role in the processes of decision making on including or excluding of research topics, for instance.

All in all, international congresses are influential and multifaceted events and a handful of historical studies, which have been mentioned here, recognise this. A systematic study into the role of congresses in processes of discipline formation is lack-

453 An example here is the questionnaire method that was developed as a result of the first international congress of linguists and seen as standard in linguistic research, as I show in Chapter 3.

ing, however.[454] The flow of cognitive goods framework seems promising to examine the multiple layers of analysis that such a study would require. It would also provide a better understanding of typical actors and interaction patterns between them who were involved in discipline formation. In my dissertation, I have found that the various international congresses discussed can be used to show how practices are shared and become part of particular disciplines and how this influences the disciplines involved.

4.3 Disciplinary Activity and Discipline Formation

This dissertation has studied interdisciplinary interactions through flows of cognitive goods. This enabled an overview of different epistemic transfers which gives insight in the crossing of disciplinary boundaries. However, the creation, upholding, and also the crossing of disciplinary boundaries cannot be described fully without including the practices of scholars involved. These practices have an effect on the analytic mesolevel, the level of disciplines, even though they take place at the level of individual scholars, the microlevel. To be able to describe the creation of disciplinary boundaries and the active role of the scholars involved, I have used the concept of disciplinary activity.

In Chapter 1, I have introduced disciplinary activity, which is defined by Libby Schweber to consist of the work of scholars to create a space for a their discipline.[455] Schweber's disciplinary activity concerns the creation of disciplinary boundaries, yet I have shown that disciplinary activity does not always die out once a discipline has been formed. Indeed, the cases indicate that discipline formation itself is an ongoing process. Through interdisciplinary activity boundaries are constantly challenged and thus disciplines never become static entities. Studying historical instances of disciplinary activity can show this dynamic as well, just as the introduction of new disciplinary categories in Schweber's research. In my research I have used this to illustrate how scholars made agreements about the data practices they intended to use in their disciplines.

454 The HERA project 'The Scientific Conference: A Social, Cultural, and Political History', which started in May 2019, aims to indeed shift historians' focus to congresses. This international, collaborative project examines conferences in science and medicine, held in the twentieth century, so a different scope from the international congresses mentioned here. Research into the disciplinary and interdisciplinary roles of congresses in the natural and social sciences as well as humanities would complement the research being done by the HERA project.

455 Schweber, L. (2006) *Disciplining Statistics: Demography and Vital Statistics in France and England, 1830-1885*. Duke University Press, Durham.

These agreements shaped the boundaries of their disciplines, since they determined the research methods and research questions which belonged to the disciplines. This perspective on discipline formation is practice-based and discusses processes of specialisation, hybridisation, or professionalisation in an active way.

From my research cases I can now determine various instances of disciplinary activity. As mentioned above, the discussions about Quetelet's statistical methods in the discipline of botany point towards disciplinary activity in which scholars determine what is and should be part of their disciplinary research. These scholars argued that observations in botany should be specific and meet their standards, and hence not as general as Quetelet had suggested. This instance of disciplinary activity illustrates the process of specialisation involved to form the standards and rules of a discipline through which the boundaries of the newly defined discipline were consolidated.
Another example of disciplinary activity can be found in Marcel Cohen's work to actively change the questionnaire as used in ethnology to a version that could be used in linguistics. In doing so, Cohen had to decide on how the method that would fit in linguistics and be aware of the differences between the disciplines. The piecing together of these questionnaires to create a standardised version for the discipline of general linguistics reveals an example of the hybridisation process in discipline formation, where building blocks from different contexts are brought together.[456] Hybridisation shows the existence of connections between the different research contexts, and by considering it as disciplinary activity, I can also show the practice of the scholars involved to make this connection.

While it was not the main focus, throughout the case studies we have encountered various instances of textbooks and handbooks being published in order to document the standards and rules of the discipline. The books by Durkheim and Saussure are examples of this in the disciplines of sociology and linguistics respectively. This disciplinary activity is twofold: first these scholars actively made decisions on what they included in their books, and a second activity can be analysed in the process of making these books the authoritative textbooks of the discipline. This latter process was not studied in my research; I only mentioned that the books had been given authority. It would be an important addition to also get a better understanding of how these particular scholars and books gained their authority.

456 Karstens, B. (2012) "Bopp the Builder: Discipline Formation as Hybridization: The Case of Comparative Linguistics" in: R. Bod, J. Maat, & T. Weststeijn [eds] *The Making of the Humanities, Vol. 2: From Early Modern to Modern Disciplines*. Amsterdam University Press, Amsterdam, pp. 103–127.

The publication of textbooks and standardised works can be seen as part of the professionalisation process in forming a discipline. This is also illustrated by the developments in botany and linguistics which I have described in my two research chapters. Botany developed from a broad field which included many amateur and untrained participants to a specific, laboratory-oriented discipline. Similarly, the discipline of linguistics transformed from many language sciences to an internationally institutionalised discipline. These transformations were brought about actively by the scholars we met in the research chapters.

We have also seen multiple instances of the creation of networks between scholars of the same discipline. Meillet initiated the Congress of Linguists precisely to this end: all scholars working on general linguistics should be brought together. This disciplinary activity had as a result that choices were made about who would participate in the discipline and whose contributions were deemed interesting. Moreover, the assembled scholars discussed how to unify within their discipline towards a common research topic and shared research methods. For linguistics this process was relatively successful, but the same cannot be said about statistics. As we have seen, statistics was named the "science of the century" by the statisticians themselves.[457] After nine very different congresses on very different topics based on the different countries they were held in, it became clear that to determine unified research topics was a utopic endeavour. Nevertheless, modern scholars of statistics have created a field of research to study statistical methods and discuss their research in university departments and at international congresses. Modern statistics is closely linked to data science and mathematics, and considers the statistical methods themselves as object of study. While this endeavour is different from Quetelet's project to collect and connect data on many different topics, the field of statistics still provides interesting disciplinary activity to study.

Actually, Quetelet's case shows many aspects of disciplinary activity: he managed to create international networks of observers through the organisation of series of congresses and with his own correspondence with scholars. His work spoke of creating the new discipline of 'social physics' and he clearly defined the methods and practices that should belong to this discipline. Besides, during his congresses, he asked for the establishment of national observatory following his standards of observation. All this activity could be called disciplinary activity, yet Quetelet's aim was not to create one discipline. Instead, his project was to collect many observations on different topics

457 Randeraad, N. (2010) *States and statistics in the nineteenth century. Europe by numbers*. Manchester University Press, Manchester, p 2-3, and idem (2011), p 54.

and organise them systematically. Quetelet's methods influenced many other disciplines and therefore gave rise to interesting disciplinary activity in that way.

In sum, I have encountered instances of disciplinary activity that aimed at standardisation of methods and at creating networks of scholars. In these instances the scholars were explicitly discussing the boundaries of their disciplines, delineating their field. I have found examples of the discipline formation processes of specialisation, hybridisation, and professionalisation. Focussing on disciplinary activity of the scholars, I have given a practical perspective to the often theoretical discussion of discipline formation.

Disciplinary activity is found on the microlevel of historiographical analysis since it pertains to individual interactions between scholars. Nevertheless, a connection exists between these individual interactions and events at a disciplinary level: scholars judged data practices according to rules and standards which have an effect on the whole discipline. Disciplinary activity can therefore function as a bridge between micro and mesolevel analysis. Analysis at the mesoscopic level, the analysis of disciplines, can highlight the interdisciplinary interactions which are, as I mentioned, part of disciplinary activity as well. Disciplinary activity shows these interactions from the microlevel. To study interdisciplinary interactions from a mesoscopic perspective, I have used the historiographical framework of flows of cognitive goods as discussed above.

So what have we learnt about disciplinary activity and discipline formation? Though it might sound like an oxymoron, they involve interdisciplinarity. Both disciplinarity and interdisciplinarity were necessary when studying the development of disciplines. The disciplinary boundaries were discussed after they had been crossed and were defined in relation to other disciplines. The cases have shown how observational and data collection practices were standardised and embedded within a certain discipline after they were shared between disciplines. The embedding and standardisation of these practices involved disciplinary activity, and sharing the practices resulted from interdisciplinary interactions.

General Disciplines

Another insight into the nature of disciplines comes to the fore when disciplinary activity is seen to fail. I have argued how Quetelet's efforts towards an overarching discipline of observation sciences—also called social physics—did not become an established discipline. While statistics and statistical methods are part of many disciplines, from mathematics and biology to most social sciences and some branches of linguistics, the discipline how Quetelet envisioned it did not emerge. The topics were too

broad, the object of study was too undefined, which made it impossible for scholars to agree on the boundaries of the disciplines, as I have shown in Chapter 2. Nevertheless, modern statisticians study the statistical methods and the different ways they can be employed at university departments, international conferences, and in their own academic journals. The topic of study for these statisticians is the methods themselves.

This sheds new light on the differentiation we had made in Chapter 1 between method-based hierarchical epistemic genres prior to 1800 and object-based disciplines after 1800.[458] I also discussed this point in Chapter 2. In a sense, Quetelet's project to create a discipline based on statistical methodology is old-fashioned, since it centred around a methodology and did not clearly define an object. Quetelet's method, in this case, was rather specific and he published a great deal of books to explain how it should be employed. His object of study on which he applied his method, however, was very general and this led to critiques from other scholars in certain disciplines. In Chapter 2 I have shown how Morren argued against Quetelet's "vague" project and opted for a–in his eyes–more specific approach with his introduction of phenology.[459] Yet still, a modern statistics based on the research of statistical methodology survives.

Similar discussions to form a general discipline can be found in my research into the discipline of general linguistics in Chapter 3. In this case the scholars had agreed on the topic of study, namely language, albeit with some differences in focus. The methods to be used in the discipline, however, varied greatly between the different groups of scholars. Hence, a distinction can be made between a discipline with a general object of study or a general method to be applied. The conclusion on the various methods in general linguistics was already drawn by scholars like Gabelentz, Saussure, and Meillet in the final decades of the nineteenth century. Their approach to a general discipline of linguistics were rather distinct, as I analysed in Chapter 3. Different attempts were made to unite the various domains of linguistics into one discipline of general linguistics. It can be argued that they did not succeed as such, even though

458 Stichweh, R. (1984) *Zur Entstehung des modernen Systems wissenschaftlicher Disziplinen. Physik in Deutschland 1740-1890*. Surhkamp Verlag, Berlin; and idem (1992), "The Sociology of Scientific Disciplines: On the Genesis and Stability of the Disciplinary Structure of Modern Science" in: *Science in Context*, 5(1), pp 3-15.

459 Morren, C. (1849) *Annales de la Société royale d'Agriculture et de Botanique de Gand. Journal d'horticulture et des Sciences accessoires*, Tome V, Ghent, s.n., p 450, quoted by D Demarée, G.R. & Rutishauser, T. (2011) "From 'Periodical Observations' to 'Anthochronology' and 'Phenology': the scientific debate between Adolphe Quetelet and Charles Morren on the origin of the word 'Phenology'" in: *International Journal of Biometeorology*, 55, pp 753-761, p 758: "C'est en réalité une science particulière, ayant pour but de connaitre la *manifestation de la vie réglée par le temps*".

our analysis of modern disciplines being object-based might suggest that they would. Nevertheless, the research fields such as sociolinguistics or psycholinguistics are often considered as subdisciplines of linguistics, signalling the existence of an overarching discipline based on language as an object of study after all. Indeed, none of the linguists decided to call themselves *questionnairists*, creating a discipline based on the method they were using, while we do see scholars calling themselves *statisticians*.

The differentiation between epistemic genres and disciplines, and consequently what we call a discipline, needs to be nuanced. Apparently, some objects, like language, and perhaps in extension culture, can be approached by such varying methods that this changes the field of study too drastically to be able to be unified under one discipline. From my research it seems that disciplines should have an object of study that is clearly defined but that object also needs to be subjected to a certain, agreed-upon methodology. This is still rather erratic, yet what has become clear, is the important role of agreements, debates, and discussions between a certain group of scholars to form a standardised foundation for the discipline. To be able to observe and analyse these historical processes, I have used a combination of historiographical tools, which enabled me to study the cases on microscopic and mesoscopic levels.

Formation of Social Science Disciplines

This dissertation narrated the nineteenth and early twentieth century development of multiple disciplines and especially the social science disciplines: from a mix of moral and political sciences to institutionalised social science disciplines such as sociology. The social sciences were originally considered by the liberal elites as measures to control and condition state populations. Methods supplied by social statisticians like Quetelet enabled the statesmen to gather data on their country's citizens. Especially in France, this development of the social sciences was closely related to revolutionary transformations. By the end of the eighteenth century the social sciences had found a place at the post-Revolutionary *Institut de France*. During the Napoleonic era, this institute went through several reorganisations and its members were relocated. In the 1830s, at the end of the Restoration, the social science disciplines found a new and more permanent home: the *Académie des sciences morales et politiques* was established in 1832.

My Chapter 2 illustrated how Quetelet and other scholars attempted to used methods from astronomy on social scientific research. Quetelet was trained as an astronomer and his intention was to use concepts and theories from physics to study laws and regulations in society. Moreover, he was a corresponding member of the

Académie and organised congresses on the use of statistical methods in wide-ranging research questions, including many social scientific research projects. However, since the members often also formed lobby groups for laissez-faire politics and free trade, this *Académie* was seen as leaning more towards the political realm than academia.

After 1870, the research university was developed in France which transformed the intellectual field. This included a space for the social sciences, and the centre of the social science research shifted from the *Académie* to the university faculties. In its new form, research in the social sciences was practiced in a relatively stable tripartite structure: either as political science, economics, or human science. A constellation of disciplines replaced the moral and political sciences, marked by structural differences.[460] For the political sciences, the strong connection with the political realm still existed through the newly established *École libre des sciences politiques* (1871), a private and relatively expensive professional school, separated from the university faculties. It was seen as an eclectic subfield, located at the margins of the intellectual field.[461] The human sciences or *sciences humaines*, however, were accommodated by the Faculty of Letters. These consisted of the classical humanities but also of new disciplines such as psychology, sociology, and ethnology. Lastly, economics was studied at the Faculty of Law, together with statistics.[462] The following decades saw the establishment of a great number of journals for the new disciplines.[463] In Chapter 3 I discussed how the discipline of sociology emerged at the Faculty of Philosophy, led by a new generation of academics including Émile Durkheim. This disciplinary activity gave shape to the emerging field of sociology, a markedly different arrangement than the mix of moral and political science from the beginning of the century.

I have also shown how the social sciences related to the natural sciences and the humanities. Chapter 2 illustrated the wide-spread methods developed by Quetelet from astronomy. While Quetelet is often seen as a founding scholar in many social scientific fields such as sociology or psychology, his statistical approach to data

460 Heilbron, J. (2015) *French Sociology*. Cornell University Press, London, p 32.

461 Heilbron (2015), p 32-33.

462 Idem, p 33-34.

463 Examples include *Revue historique* (1876), *Revue philosophique* (1876), *Revue pédagogique* (1878), *Revue d'économie politique* (1887), *Revue internationale de sociologie* (1893), *Année psychologique* (1895), and *Année sociologique* (1898). Heilbron (2015), p 60.

collection also found its way back into natural scientific disciplines such as botany.[464] Chapter 2 can thus also be seen as a case study into the relationship between social science and natural science.

In Chapter 3 the case of the linguistic questionnaire has shown how social science also related to the humanities. The study of language varieties and language change benefitted enormously from data collected by questionnaires such as Gilliéron's and Wenker's projects. These questionnaires became part of many different disciplines in the social sciences and also in the discipline of linguistics. Chapter 3 has demonstrated how the social sciences influenced linguistic research by considering this questionnaire research. The case of Meillet's work, who collaborated with early Durkheimian sociologists and was foundational for the discipline of linguistics, has uncovered a direct link between sociology and linguistics, and in extension between social science and the humanities.

Indeed, more often than not, knowledge production is a multidisciplinary endeavour and hence those who study it must adopt a multidisciplinary perspective. This is especially the case in the realm of the social sciences, where ties between the disciplines are extremely tight. Even today, social science disciplines are categorised differently according to different institutions. Fields such as philosophy, linguistics, or anthropology are considered humanities disciplines by some universities and social sciences by others, while departments of law or economics are sometimes organised completely separately to the faculties of social sciences.[465] It is therefore perhaps not very surprising that studying the history of social science seems to be more difficult to pin down than the discipline of history of science. The history of science discipline been established and institutionalised over the past century, while the same cannot be

464 Indeed, as Chapter 3 shows, his influence spread even further towards both the natural sciences, like physics, and the humanities, for instance history.

465 At the University of Amsterdam, for example, linguistics is accommodated by both the Faculty of Humanities and the Faculty of Science, respectively at the Amsterdam Center for Language and Communication and the Institute of Logic, Language, and Computation. At North American universities, linguistics is sometimes considered to be a social science.

said for history of social science.[466]

The historiographical tools of the flow of cognitive goods framework and the perspective of disciplinary activity have enabled me to study the multidisciplinary development of the social sciences. By framing the cases as flows of cognitive goods and discussing how instances of disciplinary activity resulted in discipline formation, I could combine and compare the different historical cases to form a broader, practice-oriented historical narrative on the emergence of social science disciplines. The two research chapters illustrated different aspects of this story and due to my abstracted perspective I could collate them.

4.4 Ideas for Future Research

The methodology as applied in this dissertation suggests a range of other historical research projects. This dissertation has presented but two examples of cases in which data collection practices were employed in various disciplines, many more can be found, and the discussed cases could lead to further investigations too. What was the role of the questionnaire or of these statistical approaches in other disciplines? How can the disciplinary activity of embedding these data practices in other disciplines be compared to the cases discussed in this dissertation? Such research questions can lead to new insights in how data practices were shared between disciplines. Focussing on data practices opens possibilities to study disciplines, disciplinary boundaries, and interdisciplinarity, though this has not yet been the explicit focus of the current literature on data histories. As I have shown in this dissertation, data histories have a lot to offer towards studying the historical development of disciplines.

Another avenue of possibly promising research concerns a further examination of Adolphe Quetelet's role in nineteenth century academic disciplines. In my research I have shown how he was an influential figure in the internationalisation of statistical methods–or methods for the observation sciences as he himself would call them–while Quetelet can also be considered as important in the internationalisation of knowledge production in general. Judging, for example, by Quetelet's correspondence

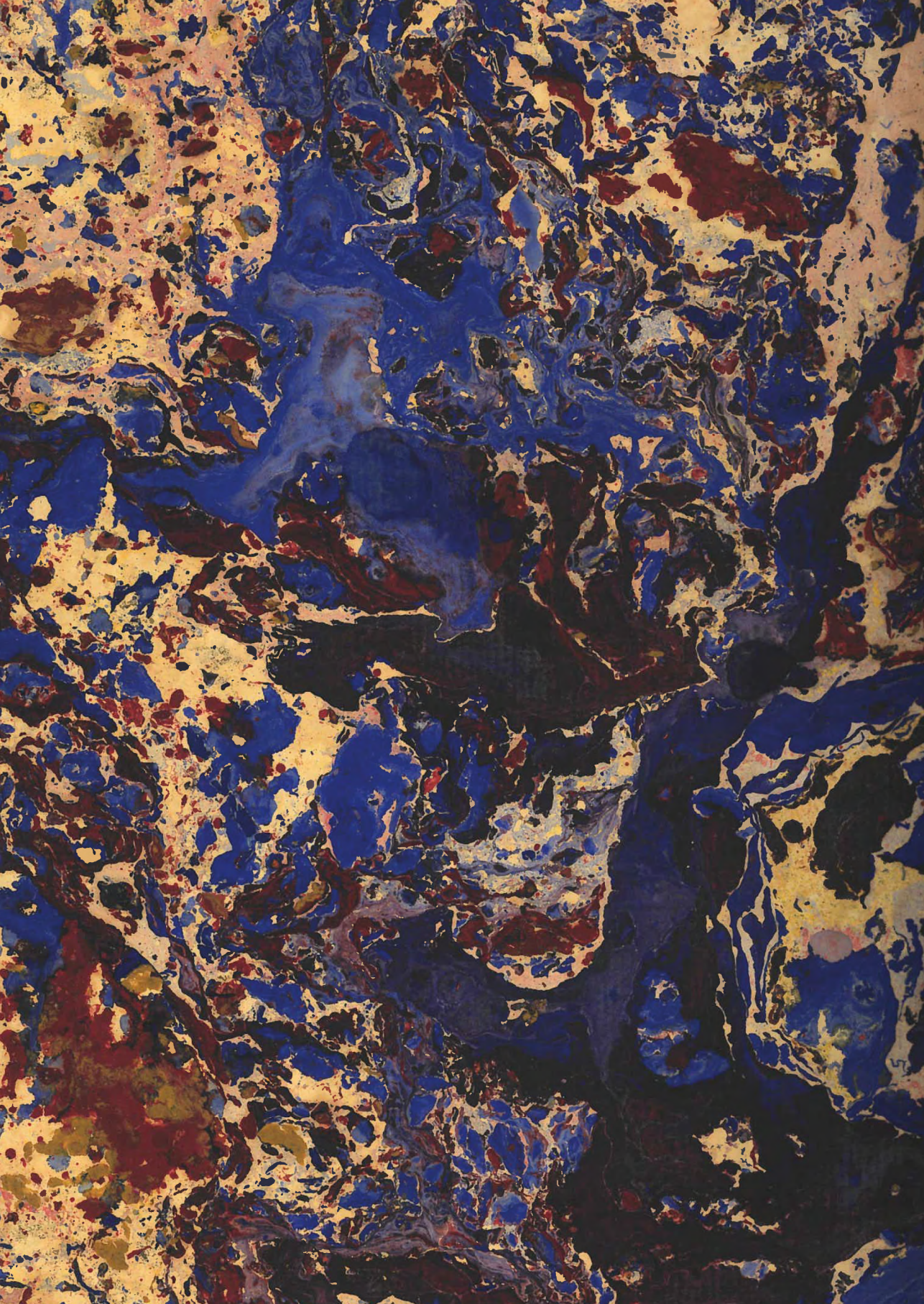
466 A good discussion of this exact point can be found in Backhouse, R.E. & Fontaine, P. (2014) "Introduction" in: R.E. Backhouse & P. Fontaine [eds] A *Historiography of the Modern Social Sciences*. Cambridge University Press, New York, pp 1-28, p 8-19. The edited volume *The Modern Social Sciences* by Theodore Porter and Dorothy Ross presents the most thorough historical overview of the social sciences to this date: Porter, T.M. & Ross, D. [eds] (2003) *The Cambridge History of Science: Volume 7, The Modern Social Sciences*. Cambridge University Press, Cambridge.

which reached far and wide, he would be an intriguing object of study to understand multidisciplinarity and internationalism in knowledge production of the nineteenth century.[467] What effect did Quetelet's endeavours have on increasingly specialised and institutionalised academic disciplines? Quetelet also wrote some history of science himself. His books *Histoire des sciences mathématiques et physiques chez les Belges* (1864) and *Sciences mathématiques et physiques chez les Belges du commencement* XIXe *siècle* (1866) show a positivistic and rigid view of science, based mostly on the disciplines of physics and mathematics. How does this perspective on science compare to his international and multidisciplinary projects to collect observations? Such questions can lead to new insights towards one of the most influential, and definitely one of the most well-connected, scholars of the nineteenth century.

A third prospective related to my dissertation has already been mentioned above and it concerns a comparative study of first instances of international, disciplinary congresses. A comparative study of multiple first international disciplinary congresses could show the various roles of these events in disciplinary and interdisciplinary processes. To perform such a study, the same historiographical framework can be applied as put forward in this dissertation, using flow of cognitive goods to identify interactions between disciplines and disciplinary activity to connect these interactions with the particular practices of scholars.

All in all, there is still much to see when we observe disciplines. This dissertation has not only given some indications towards interesting cases, but also provided a historiographical framework to research them. By constructing a shared foundation from which to examine multiple disciplines, new questions about the activity within and between these disciplines can be asked. In a time when knowledge is increasingly considered a multi, inter, or even post-disciplinary product, historical studies into the dynamics of disciplines can be both informative and reflexive.

467 The large correspondence of Quetelet can be found at the archives of Royal Academy of Belgium (Archives contemporaines, Papiers Quetelet, Correspondance Générale). Excitingly, recent research has uncovered letters to and from Quetelet and Egyptian astronomer, mathematician, and engineer Mahmud Ahmad Hamdi al-Falakī (1815-1885). Transcription by Gert Huskens and Cécile Shaalan in preparation of a forthcoming article on Quetelet-al-Falakī, The Royal Academies for Science and the Arts of Belgium, Fonds Quetelet, Correspondence de A. Quetelet, 1684.



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Published Work

Parts of Chapter 1 Section 1.3 are based on previously published work in:

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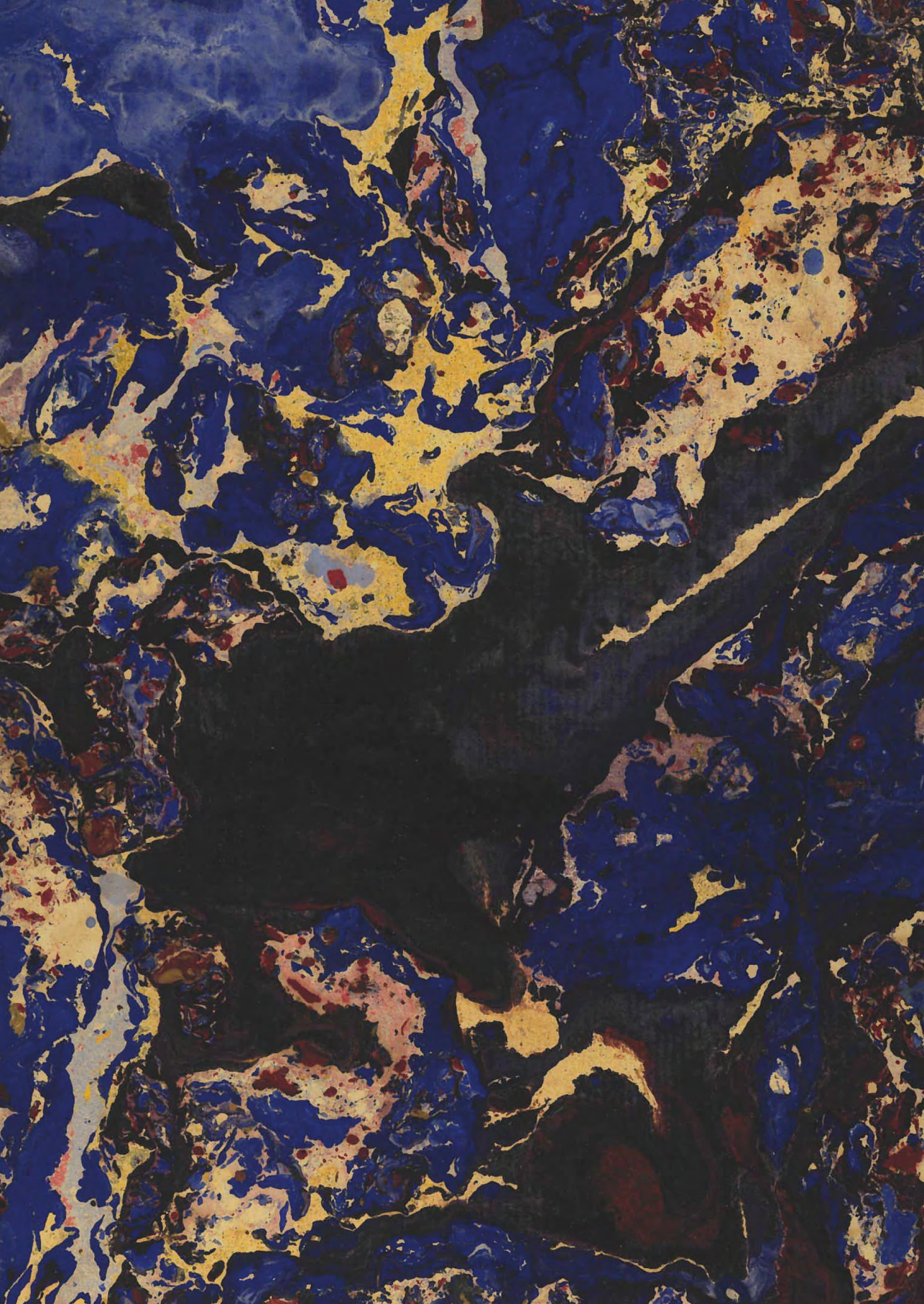
Mojet, E. (2018) "Discussing Disciplinary Development: The role of the First International Congress of Linguists (1928) in the formation of the discipline of general linguistics." Blogpost: *History and Philosophy of the Language Sciences*. https://hiphilangsci.net/2018/02/14/first-international-congress-of-linguists/



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Acknowledgements

"... But all my words come back to me
In shades of mediocrity
Like emptiness in harmony
I need someone to comfort me..."
Simon & Garfunkel

Five years is a long time: I have been inspired and supported by so many people along the way, I could never mention all of them. I thank everyone reading this for their engagement with my work.

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er with Karen Hollewand. I really enjoyed this experience because it taught me more about the different opportunities in academia, and I want to thank all participants, and Karen in particular, as well as the hard-working project leaders Marieke Hendriksen and Fokko Jan Dijksterhuis, for this opportunity.

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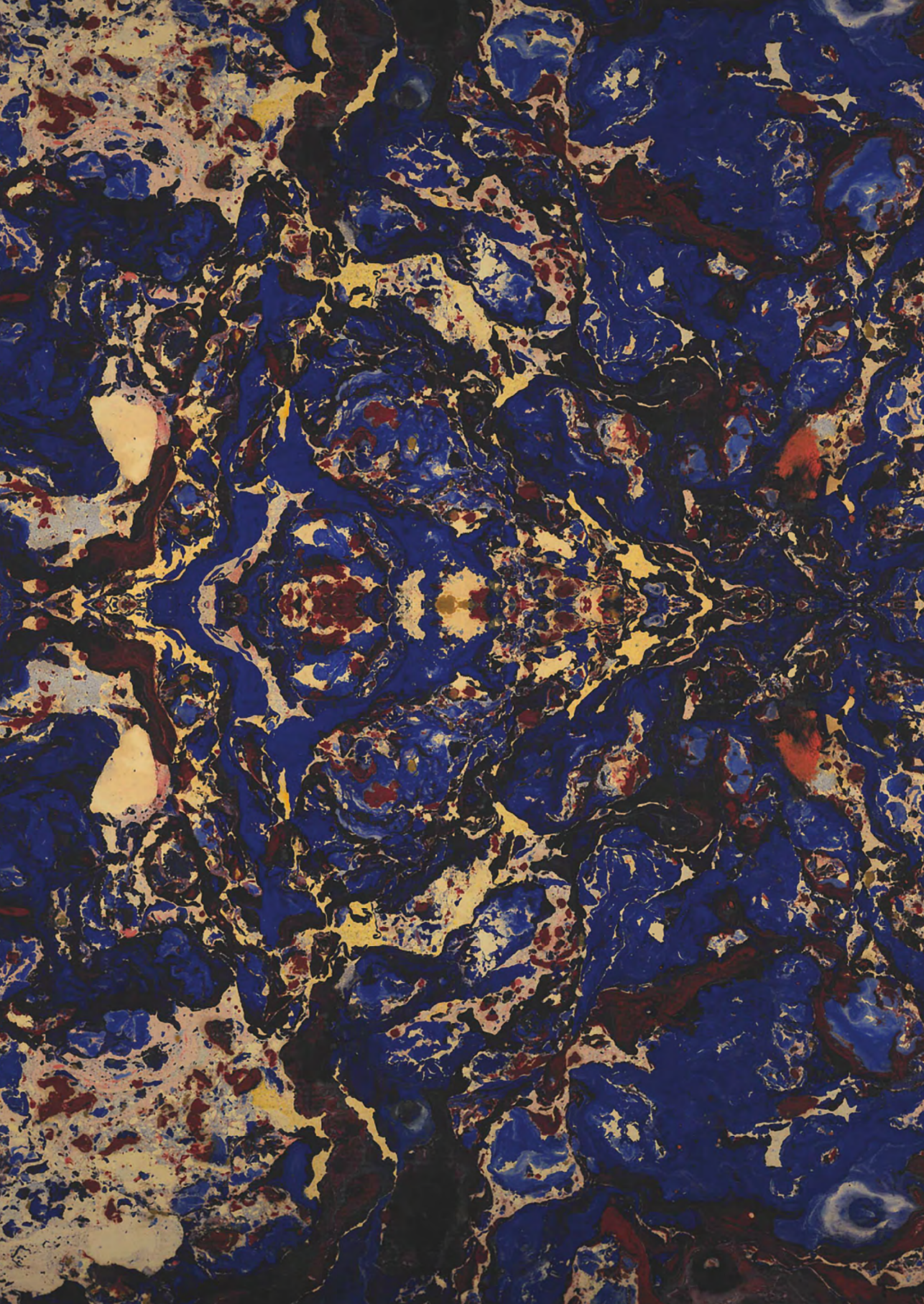


Dedication

Dedication

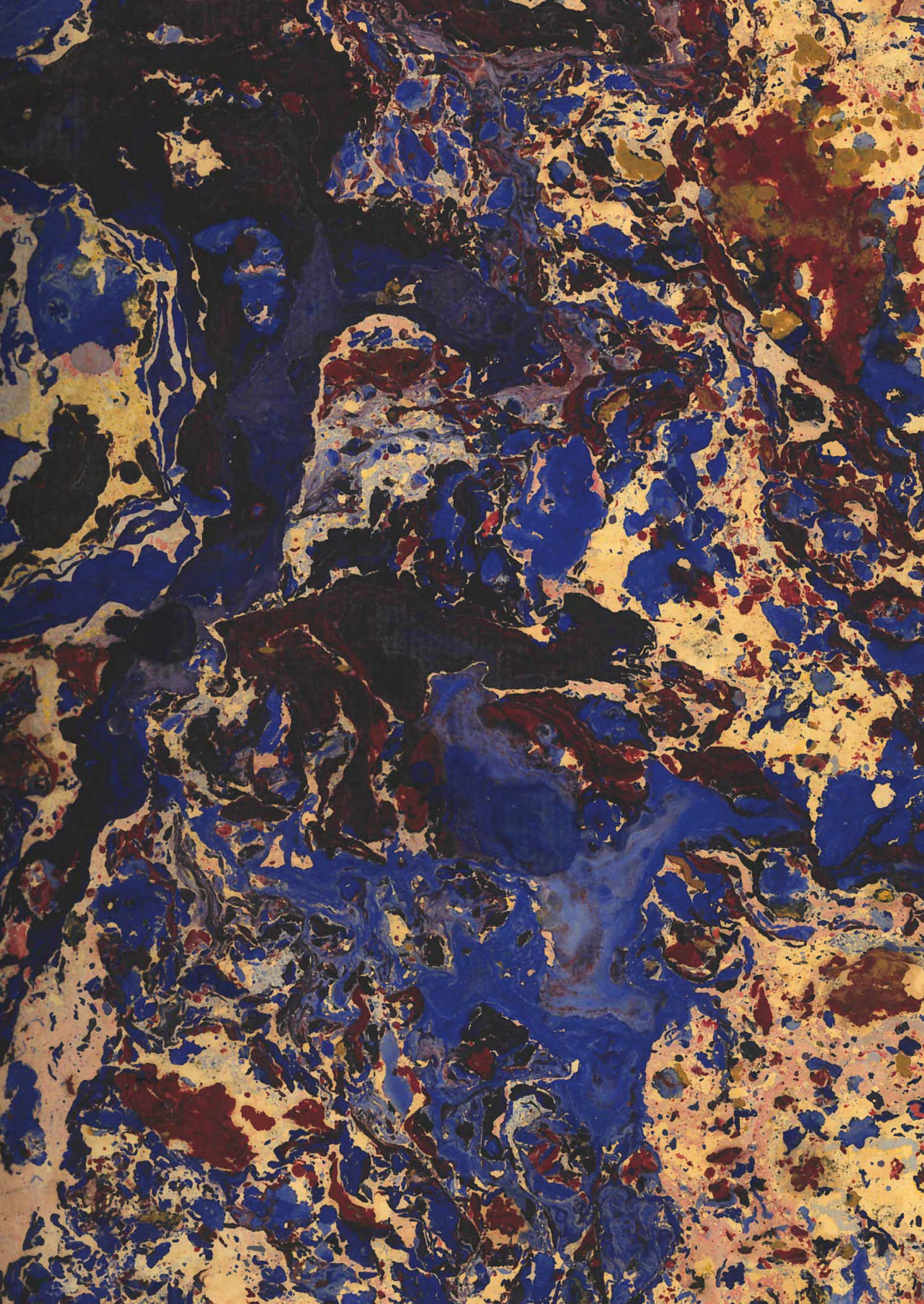
Hendrika Nicoline (Heinke) 1932 2020

Gerrigje Esmeralda Nicoline (Emma)

Gerrigje (Gerrie) 1925 2019

Mijn beide grootmoeders zijn in de laatste jaren van mijn promotietraject overleden. Ik ben heel dankbaar dat ik kan zeggen dat ze me echt hebben gekend, dat ik met ze over mijn werk heb kunnen praten en dat ik ze zolang heb mogen meemaken. Ze waren allebei sterke, slimme en lieve vrouwen, allebei heel erg op hun eigen manier. Ik draag hun beider namen en ik draag mijn proefschrift aan hen op.

Both my grandmothers passed away during the final years of my PhD project. I am thankful to be able to say that they really knew me, that I was able to talk about my work with them, and that they were a part of my life for so long. They were both strong, bright, and loving women, very much in their own way. I have been given both their names, and I dedicate my dissertation to them.



English Summary

English Summary

Observing Disciplines: Data Practices In and Between Disciplines in the 19th and Early 20th Centuries

This dissertation observes how disciplines shared data practices. Data practices enable scholars and scientists to transform observations into data that can be systematically collected and analysed. Observations and observation practices have shaped the foundations of the modern sciences and humanities, providing the basis for arguments, evidence, or inspiration to scholars throughout all disciplines. The sharing of observation practices between disciplines shows that disciplinary boundaries are permeable, it does not tell us how they are maintained. Practices of data collection and analysis from observations were shared between disciplines while at the same time disciplines also enforced certain boundaries. This tension between shared practices and creating boundaries, between the disciplinary and interdisciplinary, is the central theme of my dissertation.

Relationships between disciplines and the sharing of practices are rather abstract things to study. To do this I apply a new set of historiographical tools. In this dissertation I use the historiographical framework of flow of cognitive goods. Cognitive good is an umbrella term for the shared epistemic tools of knowledge-making disciplines that can be transferred across disciplinary boundaries, such as methods, instruments, concepts, theories, or models amongst many others. In order for these cognitive goods to travel, or to flow, they need to have a certain degree of autonomy: they need to be recognisable. Nevertheless, cognitive goods are not immutable and are dependent on the context in which they are used: they are defined by and used in a community of users.

The cognitive goods in this dissertation are the data practices of using the statistical approach as propagated by Adolphe Quetelet and the questionnaire research as employed by Jules Gilliéron, Antoine Meillet, and others. The flow of cognitive goods framework enables a coherent overview of how certain data practices are shared between disciplines, and thus a study of the mesolevel of historical analysis, the level on which disciplines act. These cognitive goods are subsequently embedded in the individual disciplines, which sometimes require adaptations. By considering the shared data practices as cognitive goods this dissertation can examine processes of discipline formation.

The modern notion of discipline—as institutionalised social entities encompass-

ing research and education with agreed-upon methods, topics, and practice—is relatively recent, emerging in the first half of the nineteenth century and following structural transformations of the university systems. Discipline formation is multifaceted: social, political, and institutional factors play a role in decisions of what is considered part of the discipline or outside it. The content of the research and the methods or objects of study also clearly play a role in the forming of an academic discipline. Discussions between scholars on the methods or objects of study of disciplines have their influence on and are often influenced by the work of individual scholars.

In order to combine the abstract level of disciplines and the particular level of individuals, and in order to analyse not only the sharing of cognitive goods but also the emergence of disciplinary boundaries, this dissertation employs the concept of disciplinary activity. Disciplinary activity can signify the appropriation or embedding of certain practices within an individual scholar's research in order to meet disciplinary criteria. It can also be expressed by the debates and discussions between scholars about such disciplinary criteria. I show how disciplinary activity involves interdisciplinarity: the boundaries of disciplines are negotiated after they have been crossed. Both interdisciplinary and disciplinary perspectives are necessary when studying the developments of disciplines and their practices.

Deriving from the central theme of the tension between sharing data practices and creating disciplinary boundaries I pose a main research question and two subsequent questions: *How did comparable observation practices become part of different nineteenth and early twentieth century academic disciplines? How did these practices develop in different disciplinary contexts? How were the different disciplines influenced by the sharing of these practices?* I have concentrated on practices dealing with data from observations by nineteenth and early twentieth century scholars through two historical cases to operationalise these research questions. The cases focussed on disciplines whose boundaries were unclear or in the process of being defined, namely botany and linguistics, which uncovered multiple instances of tension between disciplinary and interdisciplinary interactions.

Recent scholarship has described how a focus on data practices can connect historiographies which have been treated separately in the past: history of data is material, inclusive, and political. My research takes this approach further: centralising data practices can help to cross disciplinary boundaries since these practices are shared and borrowed between disciplines. I focus specifically on statistical data practices used to study plants and on the questionnaire research method to collect linguistic data.

My dissertation consists of four chapters. Chapter 1 is the Introduction where I lay-out the theoretical framework for my research. I introduce the historiographical framework of flow of cognitive goods and disciplinary activity and my research cases. Chapters 2 and 3 discuss these research cases–Chapter 2 on statistics and botany and Chapter 3 on the questionnaire and linguistics. In Chapter 4 I combine and compare the results from my two research cases and draw conclusions on how data practices were shared between disciplines and on how this sharing influenced both the data practices and the disciplines in question.

The separate yet connected research cases are both situated in the nineteenth and early twentieth centuries, and mostly in France and Belgium. While both cases focus on different data practices and different disciplines, together they narrate the nineteenth and early twentieth century development of emerging social science disciplines–from a mix of moral and political sciences to institutionalised social science disciplines such as sociology–and, especially, how the social sciences related to the natural sciences and the humanities. This dissertation offers a multidisciplinary and praxiological approach to the history of the sciences, the humanities, and the social sciences. I show how, through the development of statistical methods in various disciplines, it became possible to measure and observe abstract concepts such as a society or a population. By looking at the use of statistical methods in botany and in social research, I demonstrate a connection between the natural sciences and the social sciences. In addition, I examine the relationship between the humanities and the social sciences through the use of the questionnaire method in linguistics and various social sciences such as sociology (or ethnology) and psychology. The development of the questionnaire to collect data on regional dialects involved an increasing focus on the social situations of the speakers, providing a direct link between these disciplines.

Chapter 2 presents how statistical and quantitative methods were developed in varying research contexts and introduces the pivotal work of Adolphe Quetelet in social statistics. Quetelet's application of these statistical methods, which he had learnt as an astronomer, meant they could be used on many different projects involving observations, spread out over different disciplines. To Quetelet these general observations did not belong to a particular discipline but to a larger, overarching project of observation sciences. Quetelet formed and instructed a network of observers, involving correspondents across Europe and from the colonies, who sent him letters and tables containing data from their observations. These observers were not necessarily scientifically trained, yet Quetelet did recognise them as playing an important

role in his new science. This led to Quetelet's work being criticised for not being able to uphold a standard of rigour deemed necessary for the sciences.

In Chapter 2 I focus on how statistical methods were increasingly employed in the discipline of botany to study the relationship between temperature and plant development. To see how Quetelet's wide-ranging methods were adopted and adapted by specific disciplines, I examine the case of one of Quetelet's observers, Charles Morren, and their botanical observations and discussions. Quetelet and Morren statistically studied the foliage, flowering, fruiting, and falling leaves for multiple plants over the course of several years. By doing so they hoped to gain understanding of the Belgian climate and its effect on plants, as well as compare their findings to those of other observers in different countries. This resulted in discussions on how to standardise their observations in order to make a comparative study of the topic.

Morren and Quetelet disagreed on what should be observed; Morren took the side of the botanists who believed Quetelet's approach was too general, whereas Quetelet aimed at creating an international network of observers making many general observations. Quetelet placed himself directly in the tradition of the German naturalist Alexander von Humboldt in wanting to observe a large amount of phenomena, ranging from meteorite showers to flowering of plants or from suicide rates to chest spans of soldiers. Morren and other botanists such as Jules Planchon and Julius Sachs, however, required more specific observations to investigate the topics of their discipline.

Through the lens of disciplinary activity I argue that the botanists can be seen determining what should be part of their discipline and what should be left out: more specific observations on plants were required. Nevertheless, Quetelet had a broad influence on many disciplines: scholars adopted and adapted his statistical methods in their own research. This had as a consequence that the statistical methods themselves became more sophisticated and advanced, enabling the study of intangible objects such as a society or a population through the use of statistical data practices.

Chapter 3 also centres on the observation of an intangible object: spoken language and dialects. To collect data on language, scholars worked with questionnaires. The questionnaire is seen as a data collection method, which, based on questions, enables the systematic study of a certain object that is otherwise difficult to grasp. Questionnaires are best defined, however, by the research project in which they are used. This is done in Chapter 3, where several examples of questionnaires to collect data on languages are discussed.

Two influential research projects—the *Atlas linguistique de la France* and the

Sprachatlas, led by Jules Gilliéron and Georg Wenker respectively—illustrate how the questionnaire was adapted to the purpose of the specific research. The questionnaires enabled the scholars to not only collect data on spoken language, but also on various social factors that were believed to influence differences in language. Indeed, the questionnaire method was not only part of language studies, as I show, but also employed in social science research such as sociology, ethnology, and psychology.

A notable development was the introduction of the fieldworker questionnaire instead of postal questionnaires. The postal questionnaire was employed by Wenker in his project to map the language varieties in several German speaking regions. While Wenker obtained a large amount of detailed data, his questionnaires were filled in by many different people who were not necessarily trained in linguistics or phonetic notations and hence their responses contained many uncertainties. To deal with this issue, Gilliéron decided to send one fieldworker to collect data on languages spoken in many different villages in France. Gilliéron argued that this method was more rigorous and could meet the standards of linguistic research.

Chapter 3 also shows how the field of language studies developed towards a discipline of general linguistics. Different approaches towards a single discipline of linguistics were discussed, including different attempts to generalise the study of language by scholars like Georg von der Gabelentz, Ferdinand de Saussure, and Antoine Meillet in the final decades of the nineteenth century. These developments are linked to developments in the emerging discipline of sociology through the use of the questionnaire and especially through the work of linguist Antoine Meillet.

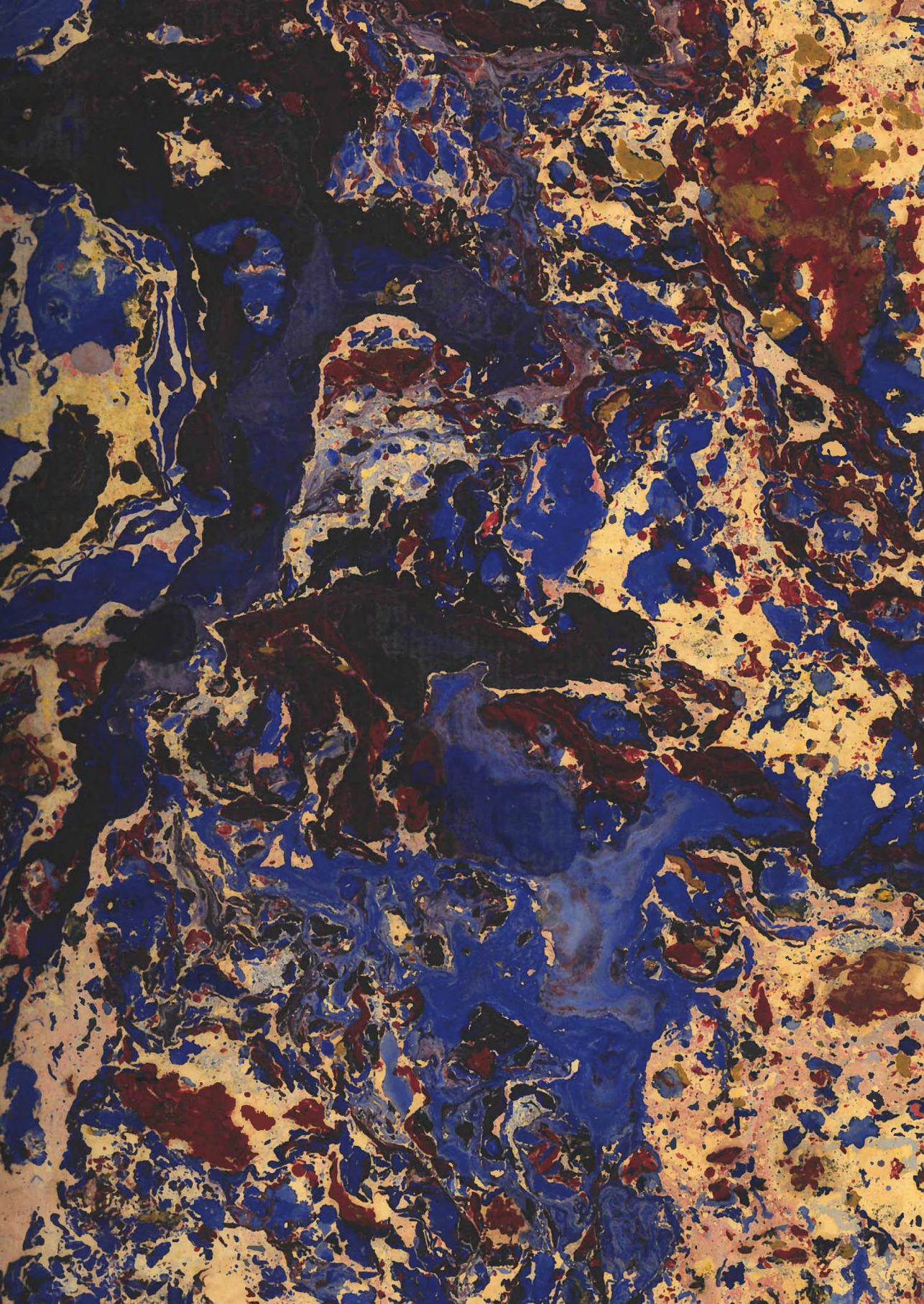
Meillet was among the early followers of Émile Durkheim's sociology in Paris and actively collaborated on Durkheim's journal. He used Durkheim's notion of a 'social fact' to understand language change and deemed it important to collect data on many different languages to examine this. Meillet proposed to use questionnaires to collect these data and to map the world's languages. These languages could only be collected with the help of international linguists and required agreements on the methods and practices employed, and thus Meillet initiated the organisation of a Congress of Linguists. At the first International Congress of Linguists, held in 1928 in The Hague, the role of the questionnaire in linguistic research was discussed. This resulted in a standardised international questionnaire developed by Marcel Cohen, a student of Meillet. Cohen was affiliated to the Institute of Ethnology in Paris and used ethnological questionnaires as a template for his linguistic version. This shows how closely the social sciences were involved with other disciplines, in this case linguistics. A direct connection can be made between Cohen and Meillet's linguistic

endeavours and the disciplinary specialisation of sociolinguistics.

In both central research chapters of the dissertation I have found that international disciplinary congresses are important sites of disciplinary activity: questions on the preferred methodology of a discipline are discussed explicitly here. Such discussions lead to the consolidation of disciplinary boundaries. Scholars discussed in both parts of my dissertation were influential in organising these interactions: Quetelet took up a leading role in the organisation of the International Statistical Congresses and Meillet was the driving force behind the first International Congress of Linguists. I show that congresses can be seen as events that on the one hand played an important role in the creation and consolidation of disciplinary boundaries, and on the other hand where interdisciplinary activity, and consequently flows, took place. At congresses, questions about the discipline's boundaries were discussed and research methods were explicitly debated; they functioned as sites of interdisciplinary flow as well as disciplinary activity.

In my research I have used the flow of cognitive goods together with the concept of disciplinary activity to illustrate how scholars made agreements about the data practices they intended to use in their disciplines. These agreements shaped the boundaries of their disciplines, as they determined the research methods and research questions which belonged to the disciplines. This perspective on discipline formation is practice-based and discusses processes of specialisation, hybridisation, and professionalisation in an active way.

All in all, there is much to see when we observe disciplines. This dissertation has not only given various indications towards interesting cases, but also provided a historiographical framework to research them. By constructing a shared foundation from which to examine multiple disciplines, new questions about the activity within and between these disciplines can be asked. In a time when knowledge is increasingly considered a multi, inter, or even extra-disciplinary product, historical studies into the dynamics of disciplines can be both informative and reflexive.



Nederlandse Samenvatting

Nederlandse Samenvatting

Observing Disciplines: Data Practices In and Between Disciplines in the 19th and Early 20th Centuries

In mijn dissertatie schrijf ik over hoe wetenschappers uit verschillende disciplines in de negentiende en vroege twintigste eeuw gebruik maakten van dezelfde soort praktijken om hun observationele data te verzamelen, te bewaren en te analyseren. Deze negentiende-eeuwse wetenschappers baseerden hun onderzoek op observaties die moesten voldoen aan bepaalde standaarden om te worden gezien als wetenschappelijk. Deze standaarden verschilden tussen disciplinaire contexten, terwijl de wetenschappelijke praktijk veel overeenkomsten toonde. Mijn onderzoek gaat over deze spanning tussen de gedeelde wetenschappelijke praktijk en de verdelingen die ontstaan door disciplinaire grenzen. Dit is behoorlijk abstract en daarom heb ik mijn onderzoek concreter gemaakt door te kijken naar hoe wetenschappers in de negentiende en vroege twintigste eeuw werkten met data vanuit observaties.

Observaties speelden een belangrijke rol in het produceren van kennis in verschillende negentiende-eeuwse disciplines, zowel in de geesteswetenschappen als in de natuurwetenschappen. Sommige wetenschappers observeerden de natuur, waar anderen observaties deden van hoe mensen communiceerden. Vanuit deze observaties werden data geproduceerd en dit konden numerieke en beschrijvende data zijn. Ik heb de manieren waarop wetenschappers omgingen met deze data datapraktijken genoemd, zoals ook gedaan wordt in recent historisch onderzoek. Daarin wordt vooral gekeken naar hoe historisch onderzoek naar het concept data verschillende perspectieven kan samenbrengen, ook wel datageschiedenis genoemd. Datageschiedenis heeft in deze onderzoeken te maken met materialen, met politieke invloeden, en met een inclusievere kijk naar kennisproductie. Voor mij betekent datageschiedenis juist een manier om disciplinaire grenzen te kunnen overstijgen: datapraktijken werden gedeeld tussen disciplines waarin onderzoek gedaan werd op basis van observaties. In die nieuwe contexten werden deze datapraktijken aangepast, zodat ze zouden voldoen aan de standaarden van die discipline. Juist in het eigen maken van datapraktijken observeer ik hoe wetenschappers dachten over die standaarden en waar de grenzen van hun discipline lagen. Hieruit blijkt ook de dubbele lading van mijn titel: ik observeer hoe wetenschappers in verschillende disciplines omgingen met observaties.

Mijn doel voor dit onderzoek is om te kijken naar hoe disciplines en disciplinaire

grenzen werken bij het produceren van kennis. Hierom richt ik me op de negentiende en begin van de twintigste eeuw. Deze historische periode wordt vaak gezien als de tijd waarin nieuwe disciplines ontstaan en disciplinaire grenzen werden gedefinieerd op een manier die we vandaag de dag nog steeds herkennen. Wat gezien wordt als de moderne wetenschappelijke discipline, namelijk een geïnstitutionaliseerde sociale entiteit bestaande uit een combinatie van onderwijs en onderzoek, is gevormd in de negentiende eeuw door processen van specialisatie, hybridisatie en professionalisering. Vakgebieden zoals biologie, sociologie en taalkunde werden in de negentiende eeuw voor het eerst neergezet als wetenschappelijke disciplines en oudere disciplines zoals geschiedenis, natuurkunde en rechtsgeleerdheid verstevigden hun grenzen. In de historische casussen van mijn onderzoek kijk ik naar wat disciplinaire afbakeningen betekenden voor de wetenschappelijke praktijk.

Om op een systematische manier naar het oversteken van disciplinaire grenzen te kijken, gebruik ik bepaalde historiografische instrumenten. Deze instrumenten maken het mogelijk om overeenkomsten en verschillen tussen de historische casussen te analyseren. Voor datgene dat oversteekt, de datapraktijken die gedeeld worden tussen onderzoekscontexten, gebruik ik een overkoepelende term: cognitieve goederen. Cognitieve goederen kunnen onder andere theorieën, methoden, instrumenten, waarden, of modellen zijn, en in mijn onderzoek zijn het praktijken. Om ervoor te zorgen dat deze cognitieve goederen tussen contexten kunnen bewegen, ook wel flow van cognitieve goederen genoemd, moeten ze als autonoom herkend kunnen worden. Dit betekent echter niet dat cognitieve goederen niet kunnen veranderen. Integendeel, in mijn onderzoek laat ik zien hoe er aanpassingen worden gedaan aan de praktijken als ze in een nieuwe context toegepast worden. Cognitieve goederen worden gedefinieerd door de context waarin ze gebruikt worden.

Waar het volgen van cognitieve goederen helpt om het delen tussen disciplines in kaart te brengen, gebruik ik een ander historiografisch instrument om te kijken naar hoe grenzen tussen disciplines werken, namelijk disciplinaire activiteit. Hiermee bedoel ik de activiteit van wetenschappers om bijvoorbeeld bepaalde praktijken toe te eigenen en eigen te maken binnen hun discipline. Ik gebruik het ook om te kijken naar discussies tussen wetenschappers over de standaarden en regels van hun discipline. Deze disciplinaire activiteit is echter ook interdisciplinair: de grenzen van disciplines komen het sterkst naar voren als er flow plaatsvindt. Hieruit blijkt dat zowel interdisciplinaire als disciplinaire perspectieven meegenomen moeten worden in het bestuderen van disciplinaire grenzen en wetenschappelijke praktijken.

Aan de hand van de instrumenten binnen het flow van cognitieve goederen

kader samen met disciplinaire activiteit, observeer ik hoe vergelijkbare datapraktijken onderdeel worden van verschillende negentiende- en begin twintigste-eeuwse disciplines. Ik kijk daarnaast naar hoe deze praktijken veranderen als ze in een andere disciplinaire context belanden en hoe de disciplines zelf ook veranderd worden door het delen van deze praktijken. In de twee casussen die ik heb gekozen zijn de disciplines volop in ontwikkeling en worden de disciplinaire grenzen bediscussieerd. Het gaat mij om de negentiende-eeuwse discipline van plantkunde en de negentiende- en vroeg twintigste-eeuwse discipline van taalkunde. Deze casussen laten meerdere momenten van spanning zien tussen disciplinaire en interdisciplinaire ontwikkelingen.

Ik kijk naar hoe statistische datapraktijken werden gebruikt bij het observeren van planten in plantkunde en hoe de vragenlijst gebruikt werd om data te verzamelen binnen taalkunde. Mijn dissertatie bestaat uit vier hoofdstukken: een eerste, theoretisch hoofdstuk waarin ik het analytisch kader van mijn dissertatie, hetgeen ik zojuist in het kort beschreven heb, introduceer; twee onderzoekshoofdstukken waarin ik de twee historische casussen bespreek; en een vierde, concluderend hoofdstuk waarin ik alle eindjes aan elkaar vast knoop en conclusies trek over hoe datapraktijken werden gedeeld tussen disciplines en hoe dit delen werd beïnvloed en invloed had op zowel de datapraktijken als de disciplines in kwestie.

De twee casussen—statistiek in plantkunde en vragenlijsten in taalkunde—worden in aparte hoofdstukken beschreven maar zijn wel verbonden. Ze spelen zich beide af in de negentiende en begin twintigste eeuw, vooral in Frankrijk en België. Samen geven ze een beeld van hoe de sociale wetenschappen steeds sterker naar voren kwamen als wetenschappelijke disciplines. Deze ontwikkeling, van een onbestemd geheel aan morele en politieke wetenschappen tot geïnstitutionaliseerde disciplines zoals sociologie, stond vooral in het teken van hoe deze vakgebieden zich verhielden ten opzichte van de natuur- en geesteswetenschappen. Mijn onderzoek biedt dan ook een multidisciplinaire en praktisch perspectief op de geschiedenis van de sociale, natuur- en geesteswetenschappen omdat ik kijk naar hoe datapraktijken tussen deze drie gedeeld en ontwikkeld werden.

Het eerste onderzoekshoofdstuk, hoofdstuk 2, gaat over de praktijken die gepresenteerd werden door Adolphe Quetelet in zijn werk naar sociale statistiek. Quetelet had als doel om deze statistische datapraktijken, die hij had geleerd als sterrenkundige, te gebruiken bij veel verschillende soorten data in allerlei disciplines. Hiervoor wilde hij een aparte, overkoepelende discipline ontwikkelen, namelijk een observatiewetenschap. Hij maakte hiervoor gebruik van een internationaal netwerk aan obser-

vanten en correspondenten die hem brieven stuurden vol data van hun observaties. Om dit alles in goede banen te leiden, organiseerde hij verschillende wetenschappelijke congressen. Zijn correspondenten waren zelf niet altijd wetenschappelijk getraind, wat leidde tot kritiek van andere wetenschappers, omdat de verzamelde data niet wetenschappelijk genoeg zou zijn.

Ik kijk in hoofdstuk 2 vooral naar hoe er gebruik gemaakt werd van statistische datapraktijken in plantkunde om een verband tussen plantontwikkeling en externe factoren zoals de temperatuur te observeren. Hiervoor bestudeer ik het werk van een voormalig student en latere collega van Quetelet, Charles Morren, die data van botanische observaties stuurde naar Quetelet. Uit de correspondentie tussen Quetelet en Morren blijkt dat ze verschilden van mening over wat er geobserveerd moest worden en hoe dit gestandaardiseerd moest worden. Morren laat hierin zien dat hij getraind is als botanicus, terwijl Quetelet juist een overkoepelende discipline nastreeft. Morren, maar ook andere botanici, bekritiseerden Quetelet omdat ze vonden dat er specifiekere observaties gedaan moesten worden naar de planten zelf, het studieobject van hun discipline.

Als conclusie van hoofdstuk 2 laat ik zien dat de botanici bezig zijn met disciplinaire activiteit: ze willen bepalen wat er onderdeel van hun discipline is en wat er buiten valt. Dit deden ze bijvoorbeeld tijdens internationale, disciplinaire congressen, waar Quetelet en Quetelet's methoden expliciet werden genoemd en bekritiseerd. Toch was het werk van Quetelet heel invloedrijk en werden zijn statistische datapraktijken in een groot aantal disciplines toegepast. Een gevolg hiervan was dat de statistiek zelf zich verder ontwikkelde en geavanceerder werd, waardoor ongrijpbare entiteiten zoals een samenleving of een populatie gemeten en geobserveerd konden worden.

In hoofdstuk 3 wordt ook gewerkt aan het observeren van een ongrijpbare entiteit, namelijk gesproken taal en dialecten. Hiervoor wordt door taalwetenschappers gebruik gemaakt van een vragenlijst als methode om data systematisch te verzamelen. De vragenlijst kan daarom gezien worden als een dataverzamelingsmethode, die het best gedefinieerd wordt door hoe die gebruikt wordt. Dit wordt behandeld in hoofdstuk 3 aan de hand van verschillende historische voorbeelden van hoe vragenlijsten gebruikt werden om data over taal te verzamelen.

Twee grote, invloedrijke projecten spelen een belangrijke rol in dit hoofdstuk: de taalatlassen van Jules Gilliéron, *Atlas linguisitique de la France*, en Georg Wenker, *Sprachatlas*. Deze laten zien hoe de vragenlijst werd aangepast binnen bepaalde onderzoeksprojecten. De vragenlijst zorgde ervoor dat wetenschappers niet alleen

data over gesproken taal konden verzamelen, maar ook data over sociale factoren werd verzameld, aangezien ook deze factoren van invloed zouden kunnen zijn op het taalgebruik. Dit verband werd in de negentiende eeuw voor het eerste gelegd en ik laat zien hoe dezelfde vragenlijsten zowel werden gebruikt binnen de taalkunde als binnen sociale wetenschappen, zoals sociologie en etnologie.

Een noemenswaardige ontwikkeling van de vragenlijst is het aanstellen van een veldwerker, die de vragenlijst ging afnemen in het onderzoeksgebied. Deze aanpak werd gezien als een vervanger van het verspreiden van de vragenlijst via de post of via de krant, zoals Wenker had gedaan voor zijn *Sprachatlas*. Hij stuurde zijn vragenlijst naar schoolmeesters in verschillende Duitssprekende gebieden. Hiermee verzamelde hij een heleboel gedetailleerde data, maar deze schoolmeesters waren niet getraind om de vragenlijsten in te vullen. Om deze reden beargumenteerde Gilliéron dat een veldwerker nauwkeuriger data zou kunnen verzamelen en stuurde hij één persoon op pad om met de fiets vier jaar lang verschillende plaatsten in Frankrijk te bezoeken om mensen te interviewen. Hieruit blijkt hoe wetenschappers op verschillende manieren omgingen met datapraktijken en verschillende standaarden erop nahielden.

Hoofdstuk 3 laat ook zien hoe de discipline van taalkunde zich ontwikkelde richting een algemene taalwetenschap. Ik bespreek verschillende benaderingen om tot een algemene discipline te komen, zoals voorgesteld door Georg von der Gabelentz, Ferdinand de Saussure, en Antoine Meillet in de laatste decennia van de negentiende en de eerste decennia van de twintigste eeuw. Deze ontwikkelingen laten ook de nauwe connectie zien tussen de opkomende sociologische discipline en de taalkunde, vooral aan de hand van het gebruik van de vragenlijst en het werk van de taalkundige Antoine Meillet.

Meillet was één van de eerste wetenschappers die betrokken was bij Émile Durkheim's sociologie in Parijs en werkte ook met Durkheim samen. Meillet nam Durkheim's begrip van een sociaal feit over in zijn verklaringen van taalontwikkeling en vond het daarbij belangrijk om data van zoveel mogelijk verschillende talen te verzamelen. Hij stelde voor hiervoor een internationale, standaard vragenlijst te ontwikkelen, maar dit kon alleen als taalkundigen over de hele wereld het eens konden worden over de standaarden en regels van een dergelijke vragenlijst. Om dit te bereiken, en om taalkundigen op een internationale schaal bijeen te brengen, stelde Meillet voor om een internationaal congres te organiseren. Op het eerste Internationale Congres voor Linguïsten, die werd gehouden in Den Haag in 1928, werd de rol van de vragenlijst binnen taalkunde besproken. Als resultaat van het congres werd

een voorstel gedaan voor een internationale, standaard vragenlijst door een student van Meillet, Marcel Cohen, die ook geaffilieerd was aan het Instituut voor Etnologie in Parijs. Cohen maakte gebruik van etnologische vragenlijsten om tot zijn taalkundige vragenlijst te komen. Dit laat zien hoe nauw verbonden de sociale wetenschappen waren met andere disciplines, in dit geval taalkunde. Aan het eind van hoofdstuk 3 bespreek ik hoe deze connectie uiteindelijk leidde tot het vakgebied sociolinguïstiek als subdiscipline van taalkunde.

In beide historische casussen van mijn dissertatie laat ik zien hoe internationale congressen een belangrijke plek zijn waar disciplinaire activiteit plaatsvindt: tijdens congressen worden vraagstukken aangaande de methodologie en de onderzoekspraktijken van een discipline expliciet besproken. Zulke gesprekken konden leiden tot het verstevigen van disciplinaire grenzen of juist in het creëren van extra ruimte binnen de discipline voor deelgebieden. Historische actoren uit de beide hoofdstukken van mijn dissertatie hebben een belangrijke rol gespeel in de organisatie van dit soort congressen. Ik laat zien hoe congressen bestudeerd kunnen worden als disciplinaire activiteit, maar ook als een plek waar interdisciplinaire interacties samenkwamen.

Concluderend, in mijn onderzoek laat ik zien hoe disciplinaire grenzen worden vastgesteld en verstevigd door disciplinaire activiteit van de wetenschappers. Wetenschappers maakten afspraken over hoe bepaalde datapraktijken gebruik moesten worden in hun discipline, waarmee zij het onderzoek dat binnen hun discipline als wetenschappelijk werd gezien afbakenden. Op deze manier naar disciplines kijken als geïnstitutionaliseerde, sociale entiteiten behandelt discipline formatie als een actief proces. Alles bij elkaar is er dus veel te zien als we disciplines observeren. Mijn dissertatie geeft een aantal interessante casussen, maar ook een analytisch kader om deze mee te bestuderen. Door te kijken naar wat er gedeeld wordt tussen disciplines kunnen er nieuwe onderzoeksvragen gesteld worden over de activiteiten binnen en tussen disciplinaire grenzen. Tegenwoordig hebben we het juist vaak over interdisciplinair onderzoek en kennis die ontstaat door het oversteken van disciplinaire grenzen. Daarbij is het goed om ook na te denken over hoe disciplines eigenlijk werken, want dat kan leiden tot nieuwe observaties.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