

# Unity Makes Strength

An evaluation of 25 years History & Philosophy of Science in Utrecht, 1988 – 2013



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## Foreword

Ideas for this thesis have come a very long way. Originally therefore, I wanted to write a thesis about the globalisation of science. Coming from a globalisation geography background during my Bachelors, I remember the 'flash of insight'-feeling it gave, when I realised that the history of science too could (and perhaps should) be studied in this context. Following supervisor's suggestion, I decided to take the discipline of the History of Science as my research subject, at the micro-scale of the University of Utrecht, initially with the intention of revealing how this discipline has been transformed by internationalisation.

Along the way, the broader focus has shifted towards intellectual programmes and the legitimisation of research, while globalisation has eventually disappeared out of sight. Yet, my initial inspiration in globalisation geography studies of knowledge and innovation has come back in a different way, providing an intellectual framework that has enabled me to conceptualise the evolution of research disciplines in an enlightening way. However, adapting the tight, analytical models and quantitative representations of these studies to a small-scale, qualitative case study, was a tough challenge to overcome. It continuously implied compromising the methodological flexibility so important for historical research, and often 'over-theorising', as my supervisor once strikingly formulated: shooting at an empirical mosquito with theoretical cannonballs. After an exhaustive period of trying to shoehorn my story into a rigid theory-methods-analysis format, I entirely re-shaped my final product according to a more flexible, narrative-based structure.

Accomplishing a project of this size would have been unthinkable without a climate containing the right quietness and structure in order to remain sufficiently focused. It have been my loving parents who have, with their dedication, created this environment for me so that I could bring the opportunity of following an excellent academic study to a provisionally satisfying and hopeful end. Next to my parents, a word of thanks to prof. dr. Mijnhardt for his characteristic supervision. I am also intensely grateful for the help of drs. Palm for his constant advice, provision of valuable documents as well as personal stories throughout this research. I want to thank innovation economist prof. dr. Koen Frenken, who has given me the right amount of support to transform the theoretical aspirations that I had into something doable and realistic. I also want to thank Tommi Benders and DJ Umb to whom I owe the opportunity the get into music blogging, which has not only provided necessary relaxation but has also lead to valuable insights into socio-cultural dynamics that apply to both academic disciplines and music. But most of all, I am grateful to God Who has created me with the capacity to understand, to create and to investigate, Who has placed me in an

environment where this has been possible more than anywhere else imaginable and Who deserves the only *real* glory I hope to have served with this work.

What could be a more appropriate title for this thesis than the Latin phrase that has adorned the façade of the location of one of the current Institute's progenitors for so many years: 'Concordia Res Parvae Crescunt'. The official English translation is: 'Unity Makes Strength', but literally, and much more strikingly, it be translated as 'Unity Makes Small Things Grow'. This motto, once used by the Dutch Republic of united provinces, almost seamlessly applies to context of the small 'united academic provinces' called History and Philosophy of Science, endangered if left by themselves but potentially strong together. At the same time, it is a normative plea for even more unity, more actual collaboration in the future, which is never strongly articulated but constantly present between the lines. A plea which, paradoxically, has taken me a year in almost complete isolation to flesh out.

Victor R. Evink

*Lelystad, 4 July, 2014*

## Unity Makes Strength

*An evaluation of 25 years History & Philosophy of Science in Utrecht 1988-2013*

### ABSTRACT

History and philosophy of science are two different yet commonly associated academic disciplines, grouped together in joint faculties and institutes in many places around the world as well as on the highest, international level of organisation. A similar fusion took place at the University of Utrecht in 1988. In this study, I demonstrate that this fusion, which was mainly driven by financial considerations, has not resulted in closer intellectual integration, in spite of the shared institutional structure or a shared physical working space. With three historical reconstructions, I suggest that the disciplinary purposes of research in the history of science, biohistory and foundations of physics were very different at the onset of unification. Additionally, their only shared purpose they have had from the beginning, science-education and reflexive general education for prospective scientists, has turned out inadequate as a catalyst for collaborative creation of professional knowledge. For that reason, I propose innovation studies as a new future partner-discipline for professional history of science.

**Keywords:** History of Science, Philosophy of Science, Innovation Studies

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# 1. Introduction

## 1.1. *A marriage of convenience?*

ON 11 OCTOBER 2013, it was 25 years ago that the Department of History and Foundations of Mathematics and the Natural Sciences – since 1997 renamed the Institute for History and Foundations of Science (IHFS) – officially saw the light. The four members – *The Institute for the History of the Exact Sciences* (established in 1956);<sup>1</sup> *The Biohistorical Institute* (established in 1956);<sup>2</sup> *The Department for Research in the Foundations of Physics*,<sup>3,4</sup> and the *Department for History of Mathematics*<sup>5</sup> – embarked on a matrimony that would bring historical scholarship under one organisational roof with philosophy of science in general and foundations of physics in particular.<sup>6</sup> At this silver anniversary, it is good to look back at the quarter of a century spent together. This will inevitably involve some challenging questions. What was their marriage based on in the first place? Do these rationales still apply today? How have they benefited from each other? Where do, or where should, they belong on the map of the broader academic landscape? And what is their intellectual purpose? Are they a ‘reflexive activity’ inside the world of science itself? Are they subdivisions of the fields of history and philosophy that happen to have science as their object of investigation? Do they investigate ‘science’ at all?

The marriage-metaphor is not my own. As early as 1973, the philosopher of science Ronald Giere wrote an article called *History and Philosophy of Science – Intimate Relationship or Marriage of Convenience?* This enhanced book review of R.H. Stuewer (ed.)’s ‘Historical and Philosophical Perspectives of Science’ was in fact a devastating criticism of the whole enterprise that this book represented: the fusion of history and philosophy of science (HPS) into an integrated research programme.<sup>7,8</sup> Looking back on just a little more than five years of intensive unification zeal, Giere concludes that the grand ambitions had failed. At least, the project hadn’t lived up to the expectations of an imminent creation of a single, integrated discipline. Hopes had peaked at a 1969 conference at the University of Minnesota, where a full-blown research programme was proposed in

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<sup>1</sup> Van Berkel, K. *Dijksterhuis – Een Biografie*. Uitgeverij Bert Bakker, 1996, pp.442,443

<sup>2</sup> Palm (1986), p.437

<sup>3</sup> Mansfeld (1986), p.494

<sup>4</sup> Snelders (1986), p.402

<sup>5</sup> In fact, the Department of the History of Mathematics and the Natural Sciences and the Department of Research in the Foundations of Physics had already been unified since 1986, whereas in 1988 only the Biohistorical institute was added. For a more detailed overview see Section 2.1.

<sup>6</sup> IGGAR 1988, p.1

<sup>7</sup> Giere (1973), pp.282-297

<sup>8</sup> Donski & Dickson (2010), p.1

which historians and philosophers together would collaboratively examine a number of small, well defined research areas. According to Giere however, the few papers that resulted from this programme either yielded historical accounts with poor, suggestive or no philosophical conclusions at all, or philosophical accounts that remained locked into inconclusive argumentation about the relation between philosophical principles and historical examples. In fact, even the closest circle of contributors could not reach consensus.<sup>9</sup> And with the plan largely abandoned already within five years, one wonders how such a large scale development could ever have been based on such a feeble ground.<sup>10,11</sup>

## **1.2. Reasons to Marry**

About decade earlier, in order to secure membership of UNESCO's *International Council of Scientific Unions*, historians and philosophers of science had been forced to merge into one broad organisation: the *International Union of the History and Philosophy of Science*.<sup>12</sup> The Minnesota conference was specifically organised to reflect on the intellectual rationale for this union.<sup>13</sup> The unification project seemed even more promising now the philosophy of science was undergoing a paradigmatic transformation, now known as the 'historical turn'. Instead of the conventional formalistic reconstructions of scientific rationality, empirical and historically oriented studies came in fashion among philosophers of science, stimulated and explored by philosophers such as Thomas Kuhn and Paul Feyerabend.<sup>14</sup> And indeed, in the decades that followed, joint departments, research projects and study programmes emerged all over the United States and beyond, such that HPS came to appear to the outside world as a truly unified meta-study of science.<sup>15,16,17</sup>

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<sup>9</sup> Basically, the spectrum of philosophical stances towards the philosophical import of historical examples lies between the extremes of logicism and historicism. The former position holds that principles of scientific rationality exist independent of time and practice such that philosophical standards have the final authority to judge scientific practices as more rational or less irrational. Inversely, the second position holds that scientific rationality develops historically and that therefore, scientific practices have the final authority to judge philosophical reconstructions as more adequate or less adequate. For a detailed treatment of these matters see e.g. Burian (1977), pp.1-42

<sup>10</sup> Giere (1973), pp.282,283,286-290

<sup>11</sup> Hull, 2000, pp.77

<sup>12</sup> This top-down decision from the ICSU was heavily resisted by historians of science, not so much by the philosophers, see 2.3 (Van Ulsen, 2000, pp.27-29).

<sup>13</sup> Giere (1973), p.282

<sup>14</sup> This approach has never been uncontroversial. Just as philosophers have usually firmly rejected historians prying into epistemological territory, historians have criticised this historical philosophy as just bad history, judged by professional standards (Hull, 2000, p.77).

<sup>15</sup> Bird (2008), pp.74-79

<sup>16</sup> Paradoxically, Kuhn himself was actually critical of the idea that both disciplines could be really fused. Although he defended the philosophical relevance of actual instances of cognitive change in science, yet he maintained that the History of Science as a discipline had its own specific set of concerns and approaches that were – or even should be – clearly distinct from those of contemporary philosophy of science (Bird, 2008, pp.73,74).

However, as Giere has noted, once together on shared office floors, historians and philosophers of science did not actually collaborate or even engaged in the kind of innovative intellectual crossbreeding that the apostles of unification tried to promote. Despite the enthusiasm of a passionate few, an effective intellectual foundation for such integration was still far away.<sup>18</sup> And in absence of a clear mutual desire, the historical turn was in fact merely paying lip-service to pragmatic motivations at the organisational level.<sup>19,20</sup>

Giere's criticism reveals an underlying problem. Apparently, the widely accepted view in both disciplines that the "*philosophy of science without the history of science is empty, but history of science without the philosophy of science is blind*",<sup>21,22</sup> wasn't enough to produce concrete research areas of mutual concern and on such a scale that collaboration could become fruitful. As I will argue in this study, although both disciplines are situated between the sciences and the humanities, both disciplines originally had, and often continue to have, deeply different goals. By the late 1950s however, both disciplines got caught up in the same position. Regardless of how the goals of the disciplines were regarded by scholars within the fields themselves, two urgent social purposes became their new justification *sine qua non*: the promotion of 'scientific literacy' and mitigation of the growing gap between the 'Two Cultures' in academia.

### **1.3. Reasons to Fight**

Educating the general public about science had become an important priority in post-war America. As a result of war-time pressure, innovations in communication technology, medicine and industry but also the pernicious power of nuclear weapons were visibly transforming the world, an urge was felt that non-scientists were in desperate need of better basic understanding of science and its role in society.<sup>23,24</sup> Perhaps the most important category of 'non-scientists' were academic humanities scholars, some of which would also end up at important social positions in politics and law. This idea has become inseparably associated with the famous oration from 1959 about the Two Culture by the British chemist and novelist C.P. Snow. Snow observed that literary intellectuals on the one hand and

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<sup>17</sup> Important examples include Stanford University's Patrick Suppes Center for History and Philosophy of Science (<http://www.stanford.edu/dept/cisst/center.html>) and Cambridge University's Department of History and Philosophy of Science (<http://www.hps.cam.ac.uk/dept>).

<sup>18</sup> Persisting controversy has primarily revolved not so much about the importance for philosophers of more attention for *real science* but rather of the importance of *past science* compared to *present science* and especially the

<sup>19</sup> Hull (2000), p.76

<sup>20</sup> Giere (1973), pp.282,283,290-296

<sup>21</sup> Bird (2008), p.79

<sup>22</sup> Lakatos, (1970), p.91

<sup>23</sup> Kuhn (1984), p.31

<sup>24</sup> Van Berkel (1988), pp.40-44

scientists on the other hand had become almost completely isolated from each other. As Snow argued, loss of the long cherished unity of knowledge could be disastrous for future intellectual culture. As a result, universities had to face two stringent challenges: keeping their own intellectual wings together as well as educating non-experts in general.<sup>25,26,27</sup>

In pursuit of a way to tackle these issues at the same time, eyes were fixed on fields and activities that naturally combined both sides of the divide. Since this powerful rationale legitimised the multiplication of courses, professorships and research programmes, history of science (HS) and philosophy of science (PS), the two most obvious candidates, were in a situation of natural competition. In fact, it has been argued that HS only got the chance to gain ground because, by the late 1950s, the messy, stale and highly esoteric state of PS had made this field inadequate for the job.<sup>28</sup>

Although this newly assigned role successfully stimulated the expansion and professionalisation of the discipline, it is doubtful whether HS has ever performed well in it. Critics have argued that using history for the purpose of science education would either distract students, and corrupt their confidence in science, while the ‘propagandistic’ representation of science desired by scientists would compromise the intellectual integrity of HS as a professional historical discipline.<sup>29</sup> Moreover, with increasing professionalisation, the role as a mediator between the Two Cultures quickly lost its appeal among historians of science themselves as an outdated form of legitimation.<sup>30,31</sup>

#### **1.4. Giere revisited**

25 years later, one may ask whether this fusion was really just a marriage of convenience, in the beginning as well as in the long run. Even if it was not, Giere’s metaphor, which has featured in debates about the relation between the two disciplines ever since, has surely hit a nerve. Within a year, Ernan McMullin, philosopher of science and one of the original proponents of the unification project, responded that Giere’s conclusions were premature. Instead he argued that theory assessment, one of the prime research areas in PS “cannot avoid reference to the history of science”.<sup>32</sup> Not much later, Michael Burian stated even more strongly that both disciplines are

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<sup>25</sup> Kagan (2009), p.1

<sup>26</sup> Snow (1959), pp.1-23

<sup>27</sup> Kagan (2009), pp.vii-xii

<sup>28</sup> Kuhn (1984), p.31,32

<sup>29</sup> Brush (1974), pp.1164-1170,1176-1179

<sup>30</sup> Kuhn (1984), p.31,32

<sup>31</sup> Van Berkel (1988), p.50

<sup>32</sup> McMullin (1974), p.586

inextricably connected, not only because philosophers' intuitions need a reality-check, but because scientific theories themselves are historical entities.<sup>33</sup>

The quest has continued and has only become more complicated with the advent of different social science approaches. As recently as 2010, an edited volume has appeared named *Discourse of a New Method – Reinvigorating the Marriage between the History and Philosophy of Science*. Whereas Lakatos, McMullin and Burian primarily regard the issue of theory assessment as the two disciplines' shared concern, this book explores a different range of starting points such as Michael Friedman's plea for closer integration of HS with the history of philosophy, which has traditionally been part of philosophy whereas its intellectual content and methodology could, like HS, also be subsumed under the umbrella of intellectual history.<sup>34</sup>

Despite a broad consensus that *real science* should have at least *some* bearing on PS and that both *pure* logicism and *pure* historicism are equally untenable, a tension has remained, not so much about the relevance of 'past science' but about the relevance of the 'history of science' *as practiced by professional historians of science*. Simplified rational reconstructions of historical episodes, such as advocated by Lakatos, have indeed little to do with professional conceptions of the development of science. Friedman's 'historicised history of philosophy' on the other hand, is hardly recognisable as philosophy and may merely the result in just the next dispossession of a discipline away from philosophy.<sup>35</sup>

Perhaps an even more stringent issue is the same question in opposite direction: how do historians of science perceive the relevance of PS for their own work? This issue involves the sorts of questions that are asked and the sorts of explanations that are brought forward in HS research. Particularly: what sorts of factors (rational, natural, social, cultural, psychological or personal) are considered relevant? Do different situations (scientific success or failure) require different sorts of explanations? What are the boundaries of science and thus of 'internal' and 'external' factors? And what should be the explanatory status of modern scientific knowledge and concepts? These questions concern the HS' own theoretical, methodological and philosophical foundations.

### **1.5. Happily ever after?**

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<sup>33</sup> Burian (1977), pp.38-40

<sup>34</sup> Domski & Dickson (2010), pp.3-8

<sup>35</sup> Friedman's most important contribution to the philosophy of science is situated at the level of fundamental epistemology, where he argues for an updated neo-Kantian position as an alternative to the relativistic epistemologies which had become prevalent in science studies. Even without accepting his neo-Kantianism, Domski & Dickson claim that Friedman's approach to building a new fundamental epistemology may be a fruitful way to escape the impasse in science studies (Domski & Dickson, 2010, pp.15-17; Friedman, 2001)

The 'Two Culture'-problem has aggravated and both HS and PS have been notoriously unable to counter it, even though they are nowadays represented in many research institutes and programmes all over the world. It is therefore important to evaluate how the two disciplines have developed in these years. How, for example, has the rhetoric with which historians and philosophers legitimate their existence changed over time? Has this affected their position among their neighbouring disciplines? And what, in turn, may be their prospects for the future in the context of a changing academic landscape and changing societal demands?

These questions have guided my analysis of the recent history of HPS in Utrecht. I will demonstrate that the intellectual projects and purposes of the different research groups have been vastly different and that these differences have for a large part been shaped by the underlying intellectual goals ('axiologies') driving the different research lines. While unification was a strategic decision that enabled the research lines to continue, these differences in underlying intellectual goals have persisted and have never been harmonised sufficiently for an integrated programme to emerge. In the discussion section, I will argue that a long-term marriage between HS and PS can only be maintained if better conditions are created for the exchange of knowledge, methods and concepts and actual collaboration in a way that can mutually benefit both research lines, not only in terms of 'ceremonial legitimation' but also intellectually.

I will suggest that the multidisciplinary research areas of innovation and complexity, research lines that are already present in Utrecht, offer a potentially fruitful common ground where HS, PS and even research in the foundations of physics (FP) may possibly integrate more closely among themselves and connect more effectively with neighbouring research at the same time.

## 2. The Story of an Unhappy Marriage

Historians and philosophers of science in Utrecht have grown apart while living together. By the time they were forced to merge into one department, between 1986 and 1988, their knowledge bases were widely different and cognitive distance between them enormous. Today, this is still very much the case and there are few signs that any changes will result in the immediate future. After 25 years of sharing a common organisational structure of which and 15 years at the same physical location, it is reasonable to consider how this situation has developed. Especially, why have two of the four research lines that merged in the late 1980s, general history of science (HS) and 'biohistory' (BH) (tab.1), integrated so successfully while the other lines have not?

### 1.) *The Institute for the History of the Exact Sciences (IHES)*

## 2.) *The Biohistorical Institute (BHI)*

## 3.) *The Department for Research in the Foundations of Physics (DRFP)*

## 4.) *The Department for History of Mathematics (DHM)*

**Table 3.1** – *The four different research lines merged into the Institute\* for History and Foundations of Science\*\**

\* Formerly: Department

\*\* Formerly: Mathematics and Science

(Source: IHFS-AR)

First of all, historians of science have professionalised in a ‘centripetal’ fashion,<sup>36</sup> drawing researchers closer together from different research topics, such as different disciplines of science, but with comparable intellectual challenges and daily research practices. In addition, these researchers have also become professional historians, both intellectually and institutionally. This means that their work has increasingly come to comply with the scholarly standards of historical research and also that HS researchers have increasingly taken part in the institutions such as journals and organisations that belong to the wider disciplinary umbrella of historical scholarship, cultural history in particular. Finally, sociological approaches and explanations for scientific knowledge have increasingly been integrated into their intellectual and methodological repertoire.

Although PS in general has also undergone a thorough ‘historical’ and even a ‘social turn’, these trends have barely affected FP research in Utrecht. Instead, research in this area has been confined either to highly technical philosophy or, to ‘exegetic philosophy’, sometimes supplemented only with very traditional idea-historical historiography. Organisationally too, the IHFS has remained divided into two independently operating ‘sections’, focused on very different intellectual areas, even though a growing shared intellectual space between historians and philosophers of science was becoming increasingly available elsewhere.

### **2.1. *History of science and its purposes***

Wherever HS first emerged, it has been practiced extensively as an amateur activity long before it became a recognised professional, academic discipline. Although most disciplines in both natural sciences and humanities have gradually acquired professional institutions since the mid-19<sup>th</sup> century, HS remained almost exclusively the domain of amateurs well into the late 1950s.<sup>37</sup> These amateurs were usually teachers in the exact sciences, retired scientists or physicians who carried out their

<sup>36</sup> N.B. Stuart Blume first coined this term in his 1974 book *Toward a Political Sociology of Science* (Spiegel-Rösing, 1977, p.17)

<sup>37</sup> Kuhn (1984), p.29

research as a hobby. Their work was often motivated by a vision about the role of science as an element of civilisation and national prestige, leading to studies with a strong present-oriented and nationalistic character – described by Cohen (2013) as “paper monuments”<sup>38,39,40,41,42</sup>.

In the Netherlands too, it were the amateur scholars rather than professionals who had taken the initiative to organise in a scholarly society. Immediately upon its establishment in 1913, the Dutch ‘Society for History of Medicine, Mathematics, Natural Sciences and Technology’ (*Genootschap voor Geschiedenis der Geneeskunde, Wiskunde en Natuurwetenschappen; Gewina*) counted 240 members,<sup>43</sup> even though the first permanent chairs had to wait until the first decade after WWII.<sup>44</sup> These first chairs included R. Hooykaas (1946) at the Free University in Amsterdam as well as E.J. Dijksterhuis (1953) at the University of Utrecht, who are both considered as the most important pioneers of a professional HS in the Netherlands.<sup>45</sup>

Intellectually, the works from Dijksterhuis and Hooykaas,<sup>46</sup> are regarded as watersheds in professionalisation of the discipline. They were among the first historians of science inside the Netherlands to step outside of the common practice of nationalistic or ‘commemorative’ historiography. Instead they considered the history of science an activity to be pursued for its own sake and ‘past science’ to be studied primarily against the intellectual background of its own time instead.<sup>47</sup> This intellectual professionalisation, described by Palm (1986) as disciplinary ‘emancipation’,<sup>48</sup> did not only involve the emergence of a very own set of problems and approaches but also acquaintance with the concepts and methods of ‘general professional historiography’.<sup>49</sup>

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<sup>38</sup> Van Berkel (1988), pp.414,415

<sup>39</sup> Snelders (1987), pp.345-348

<sup>40</sup> Cohen (2013), p.195

<sup>41</sup> Baneke (2013), pp.123,147

<sup>42</sup> Theunissen & Visser (1990), pp.143-149

<sup>43</sup> N.B. this number had actually decreased over the years to 160 in 1940 (Baneke, 2013, pp.133,140).

<sup>44</sup> N.B. before that time, only a number of ‘privatdocenten’, lecturers, partial teaching duties in HS and an occasional temporary professorship had existed before. These include: medical history professor Abraham Hartog Israëls (1867) whose chair disappeared after his retirement; Prof. E.C. Van Leersum (1904) who had a partial teaching duty in medical history in Leiden until his retirement in 1920; the chemist F.M. Jaeger (1908); privatdocent in the history of physics and mathematics J.A. Volgraff (1911); privatdocent in medical history J.G. De Lint (1928); and lecturer in medical history G.A. Lindeboom (1950) (Palm, 1986, p.40; Lindeboom, 1963, p.11,12; Dijksterhuis, 1963, p.34; Burger, 1948, p.13; Snelders, 1987, pp.344,345; Burger, 1948, pp.13,14; Snelders, 2013, Biografisch woordenboek van Nederland, *Volgraff, Johan Adriaan (1877-1965)*, URL: <<http://resources.huylens.knaw.nl/bwn1880-2000/lemmata/bwn2/vollgraff>>).

<sup>45</sup> The third was R.J.Forbes (1946), who specialised in the history of technology, at the Municipal University of Amsterdam (Dijksterhuis, 1963, p.34).

<sup>46</sup> I.e. most important in this respect were Dijksterhuis’ *Val en Worp* (1924) and *De Mechanisering van het Wereldbeeld* (1950) and Hooykaas’ *Het Begrip Element in zijn Historische Ontwikkeling* (1933) (Cohen, 2013, p.188; Snelders, 1987, pp.345,346).

<sup>47</sup> Cohen (2013), pp.188,189

<sup>48</sup> Palm, 1986, p.39

<sup>49</sup> Notably, historian Pieter Geyl drew Dijksterhuis into his fierce dispute in the 1950s against a scholarship that searches for determined patterns and regularities in human history. Parallel to Butterfield’s theme of the Whig Interpretation, the existence of patterns and laws had been an intellectual dispute in Dutch historiography since the 19<sup>th</sup> century, which now entered a new round as young historians such as Jan Romein, inspired by Marxism and the growing social-sciences, reopened the debate (Van Berkel, 1996, p.413; Tollebeek, 1996).

Dijksterhuis as well as and Hooykaas (each in different ways yet both more than any of their colleagues) also took part in national as well as international institutions such as the Royal Dutch Academy of the Sciences (KNAW)<sup>50</sup> and the abovementioned International Congresses of the HS. Dijksterhuis, probably for the 1961 English translation of his masterpiece *The Mechanisation of the World Picture*, was rewarded in 1962 with the highest possible sign of recognition in the field: the HSS's George Sarton Medal.<sup>51</sup>

Nevertheless, if professional history of science is studied for its own sake instead of for the benefit of current science and complies with scholarly standards that are principally judged by disciplinary peers, both Dijksterhuis and Hooykaas had one foot in the world before professionalisation and one in the world after. Before his appointment, Dijksterhuis, a mathematician by training, was a secondary school teacher of mathematics and physics and intensively concerned with strategies to make mathematics education more effective. Specifically, one of the main problems he attempted to tackle was the early development of the gap between the Two Cultures in secondary education, which was already subdivided in a separate humanistic (alpha) and an exact (beta) programme. Since alpha students of classical culture became disengaged from mathematics and physics this early, he suggested that Greek mathematics, which had historically been an integral part of Greek culture, would be much more effective to spark their interests than obligatory 'textbook-mathematics'. As a professor too, he considered it the one of the main tasks of the historian of science to demonstrate that science and mathematics had always been an integral part of culture. Yet the idea of 'science as culture' had a quite different connotation for Dijksterhuis than it would acquire in the later movement of cultural studies of science.<sup>52</sup> His purpose was not to criticise the idea of 'scientific exceptionalism' and scientists who regarded objective science as anyhow superior to man-made culture. On the contrary, he intended to criticise humanistic scholars who seemed under the delusion that culture could be adequately appreciated without any attention for or even with hostility towards science and mathematics. His treatment of past science against the background of its own cultural context stemmed precisely from the motivation to make this point and to restore the accessibility of science by means of its history.<sup>53</sup>

Similarly, the chemist Hooykaas consciously disagreed with his teacher Ernst Cohen, whose views of scientific theories of the past was strongly characterised by the notion of 'progressive insight'. The orthodox Calvinist Hooykaas fiercely resisted the notion that people of the past, including scientists

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<sup>50</sup> N.B. Dijksterhuis, mathematician by training, was consciously appointed to the Letters Section of the KNAW in the role of historian, and not to the Physics Section (Van Berkel, 1996, pp.381-383).

<sup>51</sup> History of Science Society, *The Society: The George Sarton Medal*, URL: [http://www.hssonline.org/about/society\\_sarton.html](http://www.hssonline.org/about/society_sarton.html)

<sup>52</sup> E.g. Dear (1995) & Rouse (1995)

<sup>53</sup> Van Berkel (1996), pp.450-455

that held different theoretical views than current scientists, were somehow less rational than today. Although Hooykaas' interests extended far beyond this theme, his courses at the Free University which were obligatory for all science students, mainly served the purpose of equipping prospective scientists with a corrected view of the presumed conflict between science and religion. Hooykaas' history of science provided such a view precisely by demonstrating that past scientists could at the same time be honest, rational scientists and deeply devout Christians without compromising reason.<sup>54,55</sup>

Although Dijksterhuis and Hooykaas, who between 1953 and 1963, and between 1966 and 1976 respectively have both occupied the HS chair in Utrecht,<sup>56,57</sup> have greatly contributed to the intellectual professionalisation of the discipline, most institutional contribution should be ascribed to Hooykaas' successor in Utrecht, prof. H.A.M. Snelders. Unlike Dijksterhuis and Hooykaas, who both supervised very few doctoral students,<sup>58</sup> prof. Snelders (himself one of Hooykaas' doctoral students) supervised as many as 12 new doctoral dissertations and generated a much ampler new generation of professional historians of science.<sup>59</sup> Unlike before, this generation of new historians of science did not exclusively consist of scientists who had to acquaint themselves with historical methods, but also increasingly of students with a history training who lacked specialised knowledge about the content of the scientific disciplines they wished to investigate.<sup>60</sup>

This implied that since Snelders, qualifying as a professional historian of science did not only imply complying with scholarly standards of HS as an entirely independent discipline, but also with the same scholarly standards that applied to historical studies of different phenomena than science. At the same time, whereas both Dijksterhuis and Hooykaas had been quite specific in their research areas, Snelders preferred a solid HS with equal attention for the different disciplines, including chemistry and biology. For Snelders personally, this meant the disciplinary emancipation of chemistry, particularly in the Netherlands from behind the shadow of physics.<sup>61</sup> It was during Snelders' time as a professor in Utrecht that the fierce debate erupted among historians of science worldwide, about the proper causal-explanatory role of factors considered 'external' to science on the development of specific scientific knowledge, the consequences of which are still very much noticeable today. Having specialised in the influence of romanticism and 'Naturphilosophie' on

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<sup>54</sup> Flipse (2013), pp.288,289

<sup>55</sup> Flipse (2008), pp.383-385

<sup>56</sup> *Catalogus Professorum Academiae Rheno-Traiectinae, Prof. dr. E.J. Dijksterhuis*, URL:

<<http://profs.library.uu.nl/index.php/profrec/getprofdata/495/1/1/0>>

<sup>57</sup> *Catalogus Professorum Academiae Rheno-Traiectinae, Prof. dr. R. Hooykaas*, URL:

<<http://profs.library.uu.nl/index.php/profrec/getprofdata/930/2/3/0>>

<sup>58</sup> Dijksterhuis supervised only 3 and Hooykaas only 4 doctorates (Brookman, 1983, p.335,336).

<sup>59</sup> See Appendix 2

<sup>60</sup> Vermij (2013), p.316

<sup>61</sup> E.g. Snelders (1992), p.1

German science in the 19<sup>th</sup> century during his own promotion, the problem of externalism was not unknown to Snelders. Yet for his insistence on a solid, primarily disciplinary history of science, he has remained ambivalent towards this drastic 'externalist turn', which often implied a shift of the entire intellectual focus from scientific disciplines towards the socio-cultural context in which scientific activities were practiced.<sup>62</sup> It was at this very turning point when his research group became organisationally unified with a research group that investigated the philosophical foundations of the theories of modern physics.

## ***2.2. The intellectual projects of philosophy of science and foundations of physics***

Unlike the HS, which was a specialism before it professionalised, PS was part of professional philosophy before it specialised. In the mid-20<sup>th</sup> century, this 'general' philosophy was a scattered landscape of multiple different thought-schools and heritages which' main intellectual division was between the overtly science-critical 'Continental' traditions<sup>63</sup> and the few schools that were characterised by a strong epistemological and methodological respect for exact sciences. These latter schools had appropriated 'the crumbs under the tables of the sciences' as their domain, defining the purpose of philosophy not as asking grand questions but as solving, with equally rigid methods, the logical problems that leak out of the backside of the knowledge-factories of science.<sup>64,65</sup>

Especially after WWII, the latter schools had become concentrated in the US while the continental traditions remained overwhelmingly dominant in continental Europe. As a result, a vacuum emerged in Europe for an independent institutionalisation of 'scientific philosophy'. For the small but increasingly important field of symbolic logic in particular, most recognition could be gained in a separate association for Logic, Methodology and Philosophy of Science, organised in close proximity to the exact sciences themselves instead of the humanities.<sup>66</sup> The emergence of a professional, separately institutionalised PS in the Netherlands was the reflection of this mainly international development.

In the Netherlands, philosophy had been accommodated in the Faculty of Letters whereas the number of philosophy professors was restricted to only one per university. This had created a very superficial and literary oriented philosophy, without outspoken contributions to epistemological

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<sup>62</sup> Snelders (2013), unstructured interview

<sup>63</sup> These include idealism, phenomenism or existentialism, which have been leading schools especially in Germany and France and hence are subsumed under the umbrella term of 'continental' philosophy.

<sup>64</sup> MacIntyre (1982), pp.105-111

<sup>65</sup> Van Ulsen, 2000, p.37

<sup>66</sup> Ibid., pp.23-25,29,30

debates and an ever larger gap with the natural sciences.<sup>67,68,69,70</sup> In the 1940s however, the rapidly growing student numbers as well as the idea that a scientifically oriented philosophy could contribute to the unity of academic knowledge created an urge to expand philosophy chairs at universities and to split teaching duties in order to allow for specialisation. The first professors with a specific teaching duty in PS were the logician E.W. Beth (1946) at the University of Amsterdam and the chemist A.G.M. Van Melsen (1945) at the Catholic University Nijmegen.<sup>71,72,73</sup> In Utrecht,<sup>74</sup> the physicist J.B. Ubbink was appointed as a lector in 1955, as an extraordinary professor in 1961 and eventually as a full professor in 1966.<sup>75</sup>

By the time he was appointed a professor Ubbink had just begun to manifest himself as a spokesperson of 'the scientist's point of view' in philosophy during the 1950s. Particularly, he fiercely defended the epistemological primacy of science against the neo-Thomist Catholic philosopher Van Melsen, who advocated a restoration of 'natural philosophy', practiced by philosophers, in order to provide more sophisticated philosophical foundations for the sciences. This was the beginning of a successful philosophy career. In the 1960s, Ubbink became an editor and eventually 'editor in chief' of the central Dutch philosophy journal, the General Dutch Journal for Philosophy and Psychology.<sup>76,77,78</sup>

While PS emerged out of philosophy as a separate discipline, the physics community underwent the large-scale transition towards a research culture dominated by the Big Science-model. Under stringent pressures to maintain consensus for large-scale teamwork, fundamental issues that could not be settled by conventional means, such as the philosophical implications of quantum theory,

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<sup>67</sup> I.e. since the Dutch HEA (1876)

<sup>68</sup> Faasse (2012), pp.17,18

<sup>69</sup> McAllister (1997), p.192

<sup>70</sup> Peijnenburg (2009), p.469

<sup>71</sup> Van Berkel (1996), p.421

<sup>72</sup> Van Ulsen (2000), pp.17,18,21

<sup>73</sup> Braakhuis (1995), p.79

<sup>74</sup> N.B. according to Van Berkel (1996), in Utrecht, the process took much longer because it is not immediately clear that one desired a scientifically oriented philosopher from. In 1950, the classicist K. Kuypers was first appointed as an extraordinary professor for systematic philosophy, and thus also received the responsibility for education in PS-related issues. However, the necessity for a philosopher who could bridge the gap with the natural sciences remained (Van Berkel, 1996, p.423).

<sup>75</sup> Van Berkel (1996), p.592,593

<sup>76</sup> In 1946 and 1955, Van Melsen had published books about the relationship between modern science and philosophy. Three more of such books would follow between 1960 and 1983 (Braakhuis, 1995, p.80).

<sup>77</sup> Ubbink considered Van Melsen's characterisation of science as an 'un-philosophical derivative of a hidden materialist agenda', a misunderstanding of science. Science, as Ubbink saw it, did involve a great deal of active natural philosophy, as speculations about nature did lead to hypotheses which could eventually be tested by experiment. He considered the chances negligible that van Melsen's independent 'speculative armchair philosophy' could add anything significant to science. Ubbink rejected Van Melsen's metaphysical realism (applied in order to defend the transcendence of reason) as unscientific dogmatism. "If any conclusion of science acquires the status of metaphysical truth, you rob yourself of the academic freedom to change your beliefs based on further insights, which is so essential to science." As the prime example, Ubbink mentioned the falsification of the Kantian categories of reason by the theories of relativity and quantum mechanics. He also mocked Van Melsen's blatant ignorance of modern logic (Ubbink, 1957).

<sup>78</sup> E.g. Ubbink (1955), pp.81-86

were increasingly barred from physics' intellectual territory. This particularly in the education setting, where the rapid increase of student numbers, classroom sizes and student-staff ratios rendered fundamental discussions about the interpretation and the philosophical consequences of quantum mechanics practically impossible.<sup>79</sup>

During the 1970s, as a response to the rigid 'shut up and calculate' culture in physics fostered by the stringent academic circumstances that were most notable in the United States, a network of young physicists, with often a predilection for phenomena on the fringe of the conventional scientific worldview, organised into informal discussion groups devoted to the fundamental and philosophical aspects of quantum mechanics. The model for and social epicentre of this movement was The Fundamental Fysiks Group, an informal group created in 1975, consisting of unconventional physicists from San Francisco who created an broad discussion network that explored the borderlands between quantum theory and new world-views including psy-phenomena. This involved frequent circulation of literature. This literature was published in newly established specialised journals as well as in physics journals, which occasionally continued to accept papers on foundational topics. At the University of Amsterdam, the American example was followed with an informal discussion group called the Quantum Club, which drew students from physics as well as from philosophy and was closely connected to the American network.<sup>80,81</sup>

D.G.B.J. Dieks, trained in theoretical physics as well as philosophy, had been a member of this group and had acquired close contacts with leading international researchers in the developing field. In 1981, he would write a doctoral dissertation in Utrecht, supervised by Ubbink, named 'A discussion of some relations between physics, the foundations of physics and the philosophy of science'.<sup>82</sup> Importantly, Dieks' research connected the above described 'intellectual programme' of PS with the intellectual programme of Foundations of Physics (FP) as a new discipline emerging out of physics itself: creating room for a more thorough philosophical reflection on physical theory, unconstrained by the tight pressures of the Big Science-machine. Paradoxically, this intellectual programme, particularly when practiced as part of philosophy rather than physics, is in a sense akin to Van Melsen's vision that Ubbink had attacked so fiercely.

### ***2.3. Biohistory and the necessity of viable institutions***

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<sup>79</sup> Kaiser (2010), pp.15-20

<sup>80</sup> Ibid., pp.xiii-xxvi

<sup>81</sup> Ibid., pp.221

<sup>82</sup> Catalogus Professorum Academiae Rheno-Traiectinae, *Prof. dr. D.G.B.J.Dieks*, URL: <http://profs.library.uu.nl/index.php/profrec/getprofdata/483/2/2/0>

When HS and FP were unified, two more a research groups were merged into this remarkable organisational coalition, one of which no longer exists as a discipline. Even between 1956 and 1988, when Utrecht was home to the prestigious but only Biohistorical Institute in the world, biohistory as an academic discipline was supported by a minimal institutional framework. In fact, most of the career of the Utrecht 'biohistorian' Frans Verdoorn consisted of explaining what a full-fledged discipline of biohistory would look like and defending why it deserved its own place on the academic map.<sup>83</sup>

Before he started the Biohistorical Institute in Utrecht, Verdoorn, a botanist by training, had been a successful publisher of botanical literature as well as historical biographical overviews of the field of botany, with extensive connections to the international botanical community. In Boston (Mass.), where he had fled with his publishing company during WWII, he became involved in the Biohistorical club. It was there where the peculiar disciplinary approach of biohistory was developed: an exploration of the manifold areas in between the humanities and the life sciences in the broadest possible sense.<sup>84</sup>

Although George Sarton, generally regarded as the spiritual father of the history of science, chaired the Biohistorical club, Verdoorn's conception of the purpose of biohistory was quite different from, even in direct conflict with the HS, which Verdoorn once described with the Biblical words "vanity of vanities." During his time in Utrecht, where Verdoorn would further develop his own intellectual programme, this conflict would clearly manifest. In a successive series of presentations and an eventually never finished *Vademecum Biohistoricum*, Verdoorn eventually defined biohistory as the "the historical relationships of plants, animals and man in science, early medicine and culture." This would involve research areas such as the history of biology alongside subjects such as the historical relations between man and other species in folklore art or literature, including circuses and cooking.<sup>85,86</sup> Importantly, keeping the history of biology as a research area part of the intellectual territory of biohistory implied resistance to the ever stronger 'centripetal' force of the history of science.

This conflict became strikingly apparent when Hooykaas appointed the young and bright biologist Lodewijk Palm, as his assistant. Particularly, Palm would work on annotated editions of the letters of the Dutch naturalist and lens maker Antonie van Leeuwenhoek as part of the research programme of the Institute for the History of Science (IHES). This infuriated Verdoorn so much that he demanded that the IHES were renamed into the Institute for History of the *Inorganic* Sciences (IHIS) in order to make sure that Hooykaas' and later Snelders' group would not move further into the intellectual

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<sup>83</sup> Theunissen (2013)

<sup>84</sup> Theunissen (1990)

<sup>85</sup> Snelders (2013) unstructured interview

<sup>86</sup> Palm (2013) unstructured interview

territory of the history of biology. And when Rob Visser donated a print of his dissertation to Lodewijk Palm, he whispered: “never tell the boss whom you’ve got it from.”<sup>87</sup>

Nevertheless, despite Verdoorn’s efforts to demarcate his intellectual territory, his own institute and professorial chair remained biohistory’s only visible institutions. And even these two institutions were by no means without doubts, not even in Utrecht. It was Verdoorn’s money, acquired with his successful publishing activities, which enabled him to start a capacious institute, with an extensive library, rather than a specific demand. And although Verdoorn may have convinced the Faculty of Mathematics and Physics, the subfaculty of biology in particular, of the significance of biohistory, other parties were not that easily won over. Since 1961, a professorial chair for biohistory had been requested from the minister of education,<sup>88,89</sup> was repeatedly rejected because “there [was] an inadequate understanding of the merits of a chair for Verdoorn.”<sup>90</sup> Also the University Board, who negotiated with the minister about the exact distribution of the maximum of new available chairs, was not very eager to give biohistory any priority.<sup>91</sup> Eventually, it would last until 1965 until Verdoorn, who had served as a lector since 1956, finally became a full professor.<sup>92</sup>

But still, there were no journals and no scholarly societies, neither in the Netherlands nor elsewhere. Most importantly, Verdoorn’s concept of biohistory has never been adopted in any other place. Apart from Piet Smit, who would become Verdoorn’s successor in 1980, there has never been a viable population of academically accredited ‘biohistorians’. After Verdoorn’s retirement in 1976, the project of institutionalising ‘biohistory’ as an independent discipline was given up.<sup>93</sup> Ironically, this implied that even the addition *Inorganic* was also no longer necessary. In 1978, the IHIS changed its name into Institute for the History of Science (IHS).<sup>94</sup>

When in 1988 the BHI and IHS were merged, ‘history of biology’ had de-facto become the exclusive focus area of the institute. But the history of biology had given up its struggle to resist the lure of HS much earlier already. Whereas Verdoorn was never a member of Dutch society for the history of science, Gewina, Piet Smit in fact was.<sup>95</sup> And while under Verdoorn, the major part of the BHI’s output had consisted of documentation and classification for possible future biohistorical research, after him the default platform for the publication and communication of research shifted rapidly towards the institutions of the HS, both nationally and internationally.<sup>96,97</sup> Like genomes need

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<sup>87</sup> Ibid.

<sup>88</sup> I.e. the Higher Education Act from 1876, which was about to be replaced by the 1960 Academic Education Act (AEA)

<sup>89</sup> FC 1959, 19 Dec., Item 7 (139-J)

<sup>90</sup> FC 1962, 1 Oct., Item 5 (139-J)

<sup>91</sup> FC 1963, 21 Oct., Item 12 (139-J)

<sup>92</sup> FC 1965, 8 Apr., Item 3 (139-J)

<sup>93</sup> Theunissen (1990), p.161

<sup>94</sup> I.e. ‘Instituut voor Geschiedenis der Natuurwetenschappen’ (Palm, 2014, non-structured interview)

<sup>95</sup> Palm (1996), p.50

<sup>96</sup> Theunissen (1990), p.156

organisms and populations, intellectual programmes need viable institutions in order to survive. If the institutions fail, research lines may only have a chance to survive inside institutions different from their own.

#### **2.4. An arranged marriage of economic convenience**

Until the mid-1980s, research in the history and foundations of science had been scattered over the different faculties and sub-faculties in small groups, centred around a professorial chair. In 1985, the faculty-board decided, against the individual professors' will,<sup>98</sup> that the different groups should be concentrated in order to coordinate their research and education more efficiently. Direct reasons for this decision were stringent financial pressures combined with new legal requirements, consequences of an academic world that was now reaching the limits of its growth capacity under the government's financial means.<sup>99</sup>

Since the 1970s, legal arrangements<sup>100</sup> had requested that research and education were registered and organised in 'departments' (*vakgroepen*) with collective 'research programmes'. Yet, it would last until the 1980s, when stricter conditions and the first extensive budget cuts were introduced,<sup>101</sup> that Universities were truly forced to prune their expenditures. This required giving certain research lines selective priority over others and concentrating similar lines of research from different universities into national structures: 'concentration points' (*zwaartepunten*) by means of local as well as national mergers, relocations and dissolutions of research groups or even entire departments.<sup>102,103,104,105,106,107</sup> Presented with this situation, small, semi-individual groups were regarded undesirable by any university direction or faculty board.<sup>108</sup>

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<sup>97</sup> Visser (2014), unstructured interview

<sup>98</sup> Palm (2013), unstructured interview

<sup>99</sup> Van Berkel, 2011, pp.394

<sup>100</sup> I.e. the University Management Restructuring Act (UMRA; *Wet Universitaire Bestuurshervorming, WUB*), the Policy Document on Science Policy (PDSP; *Nota Wetenschapsbeleid*) from 1975 and more pronouncedly in the Policy Document on University Research (PDUR; *Besleidsnota Universitair Onderzoek, BUOZ*) from 1979 (De Onderwijsraad. *Onderwijsbeleid Sinds de Jaren Zeventig. Werkdocument bij het advies 'Dereguleren met Beleid, Studie naar Effecten van Deregulering en Autonomievergroting'*, 2000, p.188, URL <[http://www.onderwijsraad.nl/upload/publicaties/441/documenten/werkdocument\\_onderwijsbeleid.pdf](http://www.onderwijsraad.nl/upload/publicaties/441/documenten/werkdocument_onderwijsbeleid.pdf)>; Faasse, 2012, p.154).

<sup>101</sup> I.e. the 1982 operation Task-Division and Concentration (TDC) and its 1986 successor Selective Growth and Shrinkage (SGS)

<sup>102</sup> Faasse (2012), p.147

<sup>103</sup> Ibid., pp.150,151

<sup>104</sup> Veenstra P.C. & Kals, J.A.G. *Commentaar op Beleidsnota Universitair Onderzoek*. Universiteit en Hogeschool, Vol.26 (3), 1979, p.5, URL <<http://alexandria.tue.nl/repository/books/430616.pdf>>

<sup>105</sup> De Onderwijsraad (2000), p.194

<sup>106</sup> N.B. *Direct* financing of universities ('first funding flow') on the basis of explicit quality conditions *beforehand* ('conditional financing') has been a relatively short-lived episode that was started, parallel with the beginning of the TDC, in 1982 but abolished again in 1992, in favour of a more retrospective quality check (Baggen, 1995, p.103; De Onderwijsraad, 2000, pp.201,208).

Yet, if the intellectual projects pursued by the individual professors were so vastly different from each other however, the question remains how the faculty board could ever consider bundling together precisely *these* particular research lines. I think the answer to this question is twofold. On the one hand there is evidence that university managers regarded HS and PS as related, even interchangeable activities from the very beginning. On the other hand, since the mid-1950s, the highest international organisations of HS and PS had already been part of a combined International Union of History and Philosophy of Science, which created a ‘working format’ that could (and indeed would) be copied on other levels such as national organisations and local university departments. Important examples include Stanford University<sup>109</sup> and Cambridge University.<sup>110</sup>

Like in Utrecht, at the international level too, the two disciplines and their intellectual objectives were worlds apart. In 1953, when the still independent International Union of Philosophy of Science (IUPS), aspired ICSU-membership, it was the ICSU which demanded that the IUPS merged with the IUHS into a single organisation. Independent membership was no option. Philosophers, being under more urgent pressure for recognition of their activity as a separate and, importantly, scientific discipline, were generally happy, whereas historians fiercely resisted. Nevertheless, under fierce pressure from the ICSU, the IUPS eventually merged with the IUHS in 1956, forming the International Union of History and Philosophy of Science (IUHPS).<sup>111</sup> Yet, this construction has remained very shallow: divided into a separate Division of History of Science (DHS)<sup>112</sup> and a division of Logic, Methodology and Philosophy of Science (DLMPs), each of which kept organising their activities separately.<sup>113,114</sup>

Although the IUHPS very probably provided the most visible example format to be copied in local departments, faculties and programmes, overlap has existed well before that time. The most important example may have been George Sarton, appointed at Harvard in 1911 as a ‘lecturer in philosophy’, but with a teaching duty that was mainly historical.<sup>115</sup> Similarly, in 1944, Dijksterhuis had occupied a temporary teaching position at the University of Amsterdam for *Logic and the History of the Exact Sciences*, for which logician Beth had also been an important candidate. And when, in the early 1950s, the University of Utrecht also decided to create a separate chair for scientifically

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<sup>107</sup> Faasse (2012), p. 156-165

<sup>108</sup> Palm (2013), Unstructured interview

<sup>109</sup> Patrick Suppes Center for History and Philosophy of Science, *About the Center*, URL: <<http://www.stanford.edu/dept/cisst/center.html>>

<sup>110</sup> University of Cambridge, Department of History and Philosophy of Science, *About the Department*, URL: <<http://www.hps.cam.ac.uk/dept/>>

<sup>111</sup> Van Ulsen (2000), pp.28-31

<sup>112</sup> As of 1989, History of *technology* was included as one of the DHS’ focus areas, making the DHST (Cubru, 2013)

<sup>113</sup> Van Ulsen (2000), *The Birth Pangs of the DLMPs*, URL: <<http://www.dlmpst.org/pages/history.php>>

<sup>114</sup> International Union of History and Philosophy of Science, Division of History of Science and Technology, *The Members’ Vade Mecum*, URL <<https://sites.google.com/a/dhstweb.org/www/themembers%27vademecum>>

<sup>115</sup> Garfield (1985), p.119

oriented philosophy, Dijksterhuis was initially the main nominee. Interestingly, Dijksterhuis himself turned down his candidacy because he did not consider himself a professional philosopher.<sup>116</sup>

As for biohistory, the university had sought from the very beginning to subsume Verdoorn's activities under Dijksterhuis' direction. Verdoorn's resistance, in combination with his money, was probably sufficient to get initial green light for his project.<sup>117</sup> But thirty years later, without this money, and with history of biology as the single remaining line of an otherwise failed project, to integrate with HS was the only thinkable alternative for biohistory, if not to disappear altogether. Finally, history of mathematics had initially been part of the teaching duty of the HS chair. In 1966, when Hooykaas was nominated, specialised in the history of scientific ideas but not (as Dijksterhuis and his first successor Ravetz had been) in the disciplinary history of mathematics and physics, the commission was aware of this shift of intellectual focus. Already then, it was suggested that someone else should continue education in the history of mathematics.<sup>118</sup> Only in the early 1980s this plan was eventually materialised, after Bos, whose dissertation about Leibnizian calculus had been co-supervised by Ravetz, started his own research line in the Mathematical Institute.

The unification of this specific combination of research lines is a striking example of the hypothesis that factors external to intellectual projects themselves, such as the objectives university boards and demands from society in combination with financial circumstances, determine to a major extent not only which kinds of intellectual projects are viable in the long run but also in which institutional configurations these projects are most likely to be organised. Such a configuration, which includes a specific organisational framework, a specific housing location, a specific distribution of knowledge backgrounds, skills and wider embedding in institutional structures such as professional identities, will bring about a very specific 'proximity situation'. This proximity situation may or may not affect the direction in which knowledge creation will develop.

## ***2.5. Living together, apart***

After WWII, most humanities disciplines began to organise in institutes for the first time. Whereas formerly, it had been common for professors to collect their own personal libraries and receive students for classes at their private homes, an institute could provide a location for offices, larger classrooms and larger libraries.<sup>119</sup> This created a shared working space where scholars could exchange knowledge in a much more intensive way compared than before, when meetings of scholarly societies provided the only possible means of face-to-face communication among peers.

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<sup>116</sup> Van Berkel (1996), pp.420-424

<sup>117</sup> Ibid.

<sup>118</sup> FC 1966, 31 Jan., Item 3., (139-J)

<sup>119</sup> Reinink (1986), pp.264-267

In 1985, together with the establishment of an official, separate chair for the History and Social Function of Mathematics, a ‘department’ structure was created: the Department for History of Mathematics and Science which would include the members of Snelders’ IHS together with the historians of mathematics in the Mathematical Institute. Yet, from the beginning, the faculty board desired an as far-going as possible concentration of research, which would also include Ubbink’s DRFP and the BHI, where Verdoorn’s successor Smit was about to retire. As a second round therefore, the DRFP was included in 1986, making the Department of History *and Foundations* of Mathematics and Science. Two years later, in 1988, a final round of unification would draw the entire biohistory group into the new DHFMS.<sup>120</sup> Between 1986 and 1997, a department structure has existed as a ‘superstructure’ next to the IHS such that the history of mathematics chair could remain full part of the Mathematical Institute.<sup>121,122</sup> Eventually, in 1997, the broader DHFMS and the still independently existing IHS were fused into one single organisational structure: the Institute of the History and Foundations of Mathematics and Sciences (IHFS).<sup>123,124</sup> Nevertheless, similarly as in the UIHPS, the historical research lines on the one hand and FP on the other hand have continued as two separate sections: superficially unified, but again almost completely independent in practice.<sup>125,126</sup>

Metaphorically, it was as if HS and PS were married but slept in separate beds: living together, yet apart. This can even be interpreted quite literally in the sense that the two sections have remained separated in space until 1999. When the BHI was established, Verdoorn had acquired a spacious office building in the ‘Miquel House’ at the Nieuwegracht 187.<sup>127</sup> In the earliest years, the IHFS was accommodated together with the BHI.<sup>128</sup> In 1967, an office-building of its own was acquired at the Janskerkhof 30, where the Institute remained until the organisational unification between IHS and BHI in 1988, when the HS group moved ‘back’ into the Nieuwegracht-location.<sup>129</sup> The DRFP, in turn, was lodged together with most other physics research and education in the Buys Ballot Laboratory, Princetonplein 5, on the newly built Uithof campus. Upon its establishment, the

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<sup>120</sup> IHFS-AR 1988, p.1

<sup>121</sup> IHFS-AR 1985, p.1

<sup>122</sup> IHFS-AR 1997, p.2

<sup>123</sup> I.e. Instituut voor Geschiedenis en Grondslagen van de *Wiskunde* en Natuurwetenschappen (IGGWNS)

<sup>124</sup> IHFS-AR 1997, p.2

<sup>125</sup> Theunissen (2013), semi-structured interview

<sup>126</sup> N.B. in the IHFS-AR’s between 1986 and 2004, the overviews of personnel and education are presented separately for both sections.

<sup>127</sup> N.B. until the BHI moved into this building, which had belonged to the famous Utrecht Botanist Miquel, the University’s Hortus Botanicus had been located in these gardens. In 1970, the Hortus was officially relocated to the new Uithof campus (SSH Short Stay, Nieuwegracht 187 (Miquelhuis), *The Building*, URL: <[http://www.sshxl.nl/shortstay/cm/accommodations/utrecht\\_nieuwegracht\\_miquelhuis.html](http://www.sshxl.nl/shortstay/cm/accommodations/utrecht_nieuwegracht_miquelhuis.html)>).

<sup>128</sup> Although Dijksterhuis did not desire an institute of his own, he acquired one because Verdoorn preferred to keep HS and biohistory institutionally separated (Van Berkel, 1996, pp.442,443).

<sup>129</sup> IHFS-AR 1988, p.1

Mathematical Institute too had acquired a building at the Uithof campus, Budapestlaan 6, where the history of mathematics was accommodated as well (fig. 3.X).

In 1999, both sections finally acquired a shared location in the Buys Ballot Laboratory, and in 2008, the institute as a whole relocated from the Buys Ballot Laboratory to the building of the Mathematical Institute,<sup>130</sup> yet on a different floor than the historians of mathematics. Historians of mathematics however, who never acquired an individual institute, retained their offices among their colleagues in the Mathematics Institute itself.<sup>131</sup> In 2004 however, history of mathematics became fully independent from HPS and the IHFMS was renamed into the Institute of History and Foundations of Science (IHFS).<sup>132,133,134</sup>

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<sup>130</sup> Renamed the Hans Freudenthal building in 2013

(<<http://www.uu.nl/faculty/science/NL/actueel/nieuwsfaculteit/Pages/Wiskundegebouw-wordt-Hans-Freudenthalgebouw.aspx>>).

<sup>131</sup> IHFS-AR 1999, p.3

<sup>132</sup> I.e. Instituut voor Geschiedenis en Grondslagen van de Natuurwetenschappen (IGGN)

<sup>133</sup> IHFS-AR 2004, p.1

<sup>134</sup> Compare: IHFS-AR 2003, p.3



*Janskerkhof 30*



*Miquel House, Nieuwegracht 187*



**Figure 3.1** – *Physical Locations of the different research lines*

**HS:** Janskerkhof 30

**BH:** Nieuwegracht 187

**HM:** Budapestlaan 6

**FP:** Princetonplein 5



*Building of the Mathematical Institute, Budapestlaan 6 (Currently known as the Hans Freudenthal building)*



*Buys Ballot Laboratory, Princetonplein 5*

The main question to be answered now is to what extent the research programmes have, on the intellectual level, come closer together and whether either a shared organisational structure or a shared working space has been of any influence. In technical terms, has ‘cognitive proximity’ increased among the different research groups? The idea of cognitive proximity refers to a shared

background in knowledge or skill, most conveniently approximated in large-scale quantitative analyses by measuring the degree of overlap in citations. Since citation analysis was not possible for study,<sup>135</sup> I have investigated 'intellectual integration' on the basis of a qualitative description of the particular research projects and how they have developed over time. This also involves a comparison of publication media and attendance of conferences between the different research lines.

In 1988, when all four research lines were all officially unified in one organisational structure for the first time, the new department consisted of 24 academic members (excluding the BHI's secretary and bookbinder). After this peak moment, the number of researching members has gradually decreased to 16 in 2002, the latest year where a personnel file is included in the IHFS-AR documents. Regarding that the size of all four research groups have come down a bit, it is likely that before they were all included in 1988, the individual groups together had more researchers and that unification has served efficiency in favour of the faculty management (fig. 3.2). Since the annual reports of both the IRF BHI have gone lost during one of the relocations, this assumption could not be checked. Based on the number of publications and publishing authors after 2002, it can be expected that this decrease in size has continued until the late 2000s and has stabilised since.

In 1988, these 24 academic members included two professors: prof. H.A.M. Snelders (general history of science) and prof. H.J.M. Bos (history of mathematics), whereas both prof. P. Smit (biohistory) and prof. J.B. Ubbink (foundations) had retired only a few years earlier (tab.3.2). Besides the professors, there has always been a variety of Associate Professors, Research Assistants and doctoral candidates, later designated with the newer terms such as PhD student and Postdoc. More or less 20% of the total number of members has remained part of the department for an extended period of time, whereas others have left after the completion of a few years' research project. These longstanding members are for general HS: Harry Snelders, Lodewijk Palm, Cees de Pater, Klaas van Berkel and Frans van Lunteren; for biohistory: Bert Theunissen and Rob Visser; for history of mathematics: Henk Bos and Jan Hogendijk; and for foundations of physics: Dennis Dieks, Jos Uffink, Henk de Regt and Fred Muller (fig.3.2).<sup>136</sup>

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<sup>135</sup> Of all 145 different journals that were identified in IHFS-AR's publication list, only about 42% has been indexed in Thomson Reuters' Web of Knowledge. For the 20 most frequently occurring journals, this percentage was not much higher (55%) and with the absence of a citation index for the single most important medium for the history section throughout the entire period, the Dutch HS journal TGGWNT/Gewina/Studium, coverage would become heavily skewed towards the foundations section (see Appendix 2). Citation overlap analysis to assess 'cognitive proximity' was therefore not possible.

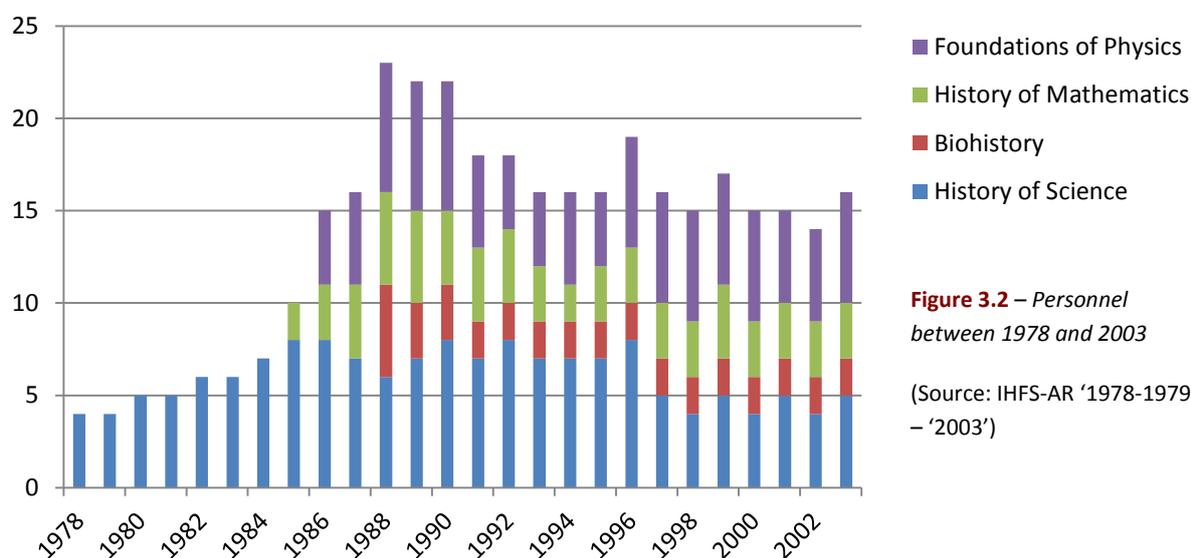
<sup>136</sup> See Appendix 2

HS	HM	BH	FP
Dijksterhuis* (1953 - 1963)	Dijksterhuis* (1953 - 1963)	Verdoorn (1957 - 1976)	Ubbink* (1961 - 1985)
Ravetz* (1964 -1965)	Ravetz* (1964 -1965)		
Hooykaas* (1966 -1976)		Smit (1980 - 1986)	
Snelders (1977 - 1995)	Bos (1985 - 2005)		Hilgevoord* (1987 - 1992)
Van Helden (2000 - 2002)			
Theunissen (2004 - )	Hogendijk (2005 - )		Dieks (1993 - 2014)

**Table 3.2** – Successive occupation of the different professorial chairs

\* = Double-appointed

(Source: Catalogus Professorum Academiae Rheno-Traiectinae, URL: <<http://profs.library.uu.nl/>>)



Since these long-term researchers have been able to pursue their own research interests most intensely and have also guided every round of new researchers entering the department, it is conceivable that their long-term research projects have most prominently shaped the interest profile of the groups as a whole. According to Snelders, “when I started pursuing a broad history of all scientific disciplines, including physics, chemistry and biology, we discovered that there were many blind-spots: events and persons in the history of Dutch science nothing had been written about before. I recruited people to fill in those gaps.”<sup>137</sup>

Most of these studies were mostly of a ‘biographical’ nature, focused on a single scholar and his intellectual and/or social environment. Another distinguishable number of research topics were

<sup>137</sup> Snelders (2013), non-structured interview

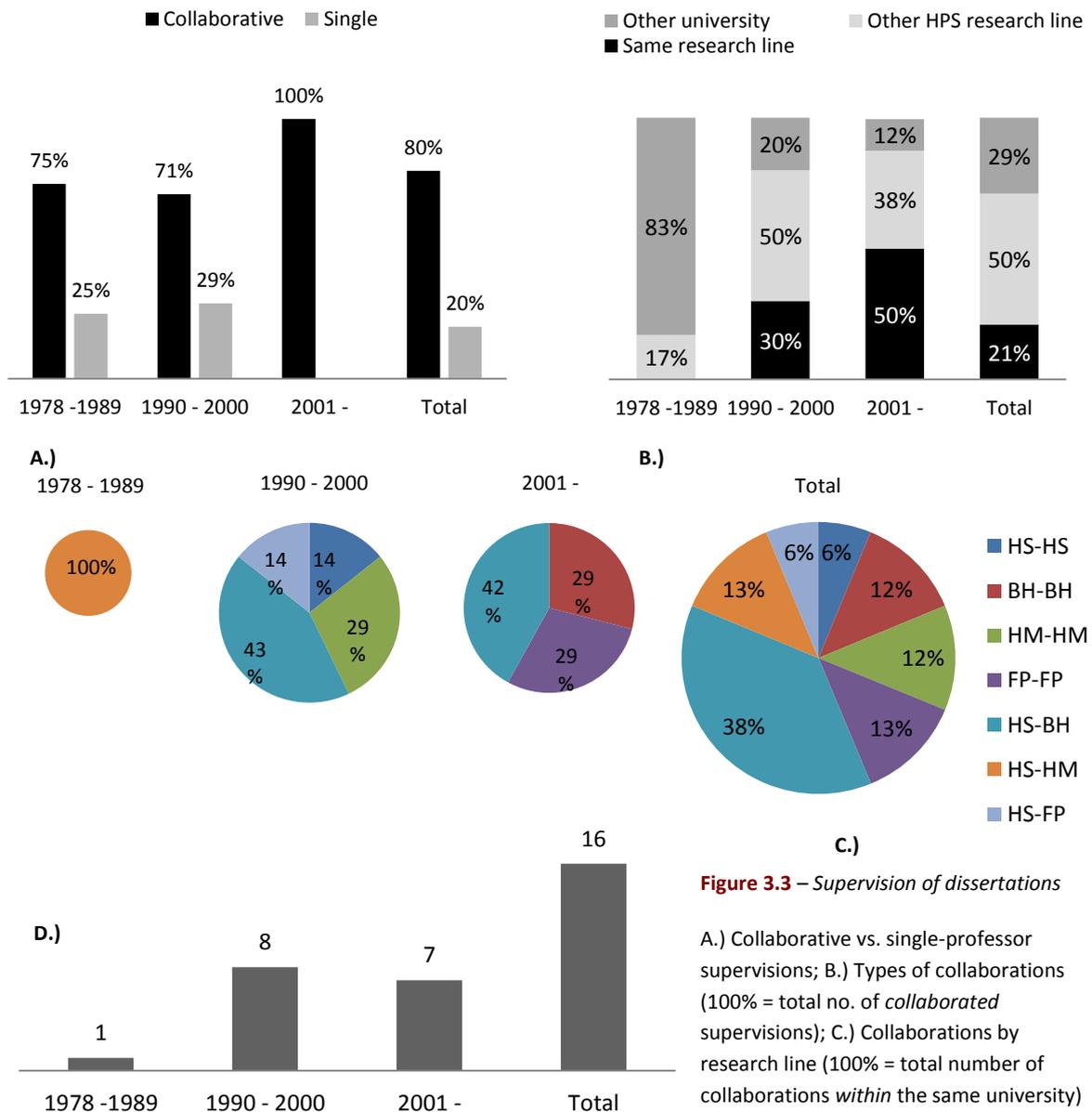
focused on intellectual concepts or schools of thought and their development through time. Strikingly, when comparing the descriptions of the research topics of the different research lines systematically over time, it appears as if they have hardly changed. Topics investigated by the different research lines at the moment of unification, were still the topics researched by 2003, the last year that descriptions of research projects were included in the IHFS-AR documents (table 3.2).

For the remnants of the biohistory group, consisting only of Bert Theunissen and Rob Visser,<sup>138</sup> the primary research topic has been the history of biology in the Netherlands from the late 19<sup>th</sup> to the mid-20<sup>th</sup> century. For the history of mathematics group, it was a mixture of different topics, the most prominent of which was Jan Hogendijk's research of medieval and ancient Arabic and Persian mathematics. Finally, for the foundations of physics group, the philosophical interpretation of a number of concrete theoretical concepts in modern physics has remained the most important common research interest.

	1978 – 1989	1990 – 2000	2001 -*	Total	
<b>HS*</b>	<i>Century Netherlands 18<sup>th</sup> 19<sup>th</sup> Chemistry</i>	<i>Netherlands Science 19<sup>th</sup> Century History</i>	<i>Netherlands Letters Reception Newtonianism Spread</i>	<i>Netherlands Century Science 19<sup>th</sup> History</i>	
<b>BH</b>	<i>Dutch Century History Evolutionary Relation</i>	<i>1940 Biology History Dutch 1860</i>	<i>1940 History Netherlands 1800 Biology</i>	<i>1940 History Biology Dutch Evolutionary</i>	<p><b>Table 3.2</b> – 5 most frequently occurring terms in the descriptions of research topics</p> <p>Word count tables were obtained with the online wordcloud generator Tagul (URL: &lt;<a href="http://www.tagul.com">www.tagul.com</a>&gt;)</p> <p>(Source: IHFS-AR '1978-1979' – '2003')</p>
<b>HM</b>	<i>Mathematics Century Geometry 17<sup>th</sup> History</i>	<i>Mathematics Early Modern Géométrie Medieval</i>	<i>Arabic Willebrord Snellius Medieval 1626</i>	<i>Mathematics Medieval Arabic Modern History</i>	
<b>FP</b>	<i>Quantum Mechanics Foundations Interpretation Concept</i>	<i>Mechanics Quantum Interpretation Theory Physics</i>	<i>Quantum Theory Mechanics Physics Interpretation</i>	<i>Quantum Mechanics Interpretation Theory Physics</i>	

<sup>138</sup> Based on intellectual interest, it can be argued that W.J. Van der Schoor can also be counted as 'biohistory'. However, since I wanted to investigate overlap in research interest, I counted every new researcher in the group as 'HS', unless stated that they were a member of the Mathematical Institute.

An explanation for the apparent persistent differences in intellectual interest inside the unified department may be that the researchers occupying an intellectual middle position have left the group after finishing their PhD, while the permanent researchers and their existing research programmes have stayed. There is some indication that this has happened, as half of the collaboratively supervised dissertations – the large majority of all doctoral dissertations – were collaborations between professors from different research lines of HPS.



**Figure 3.3 – Supervision of dissertations**

A.) Collaborative vs. single-professor supervisions; B.) Types of collaborations (100% = total no. of collaborated supervisions); C.) Collaborations by research line (100% = total number of collaborations within the same university)

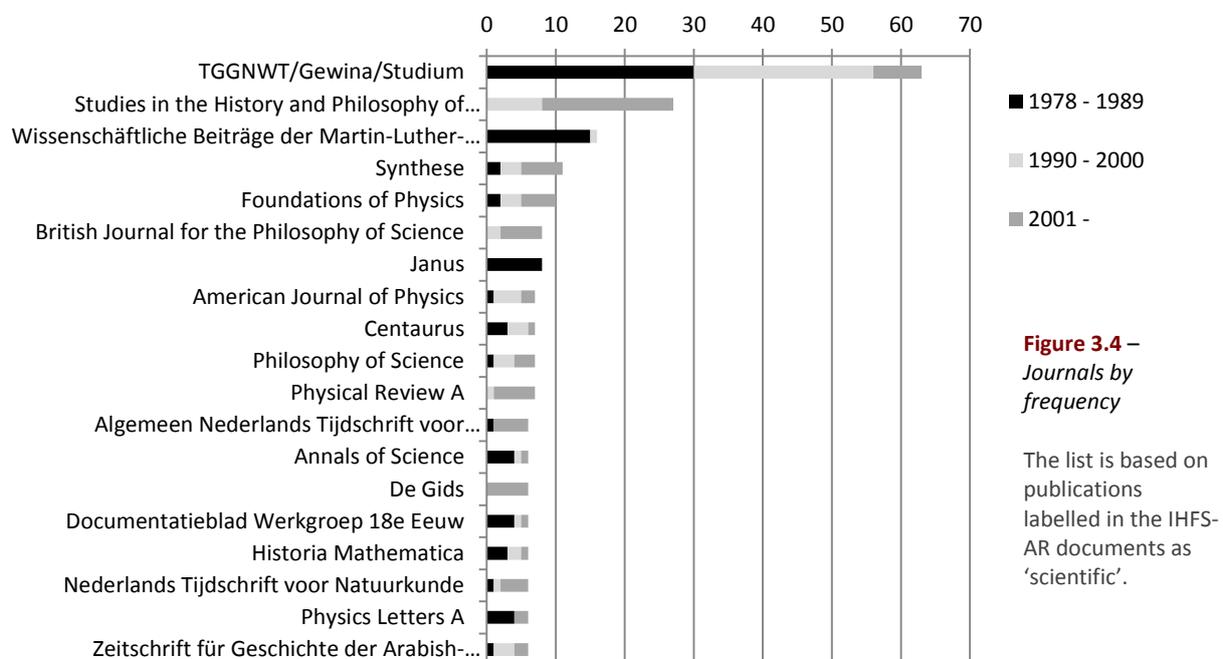
(Source: IHFS-AR '1978-1979' – '2012')

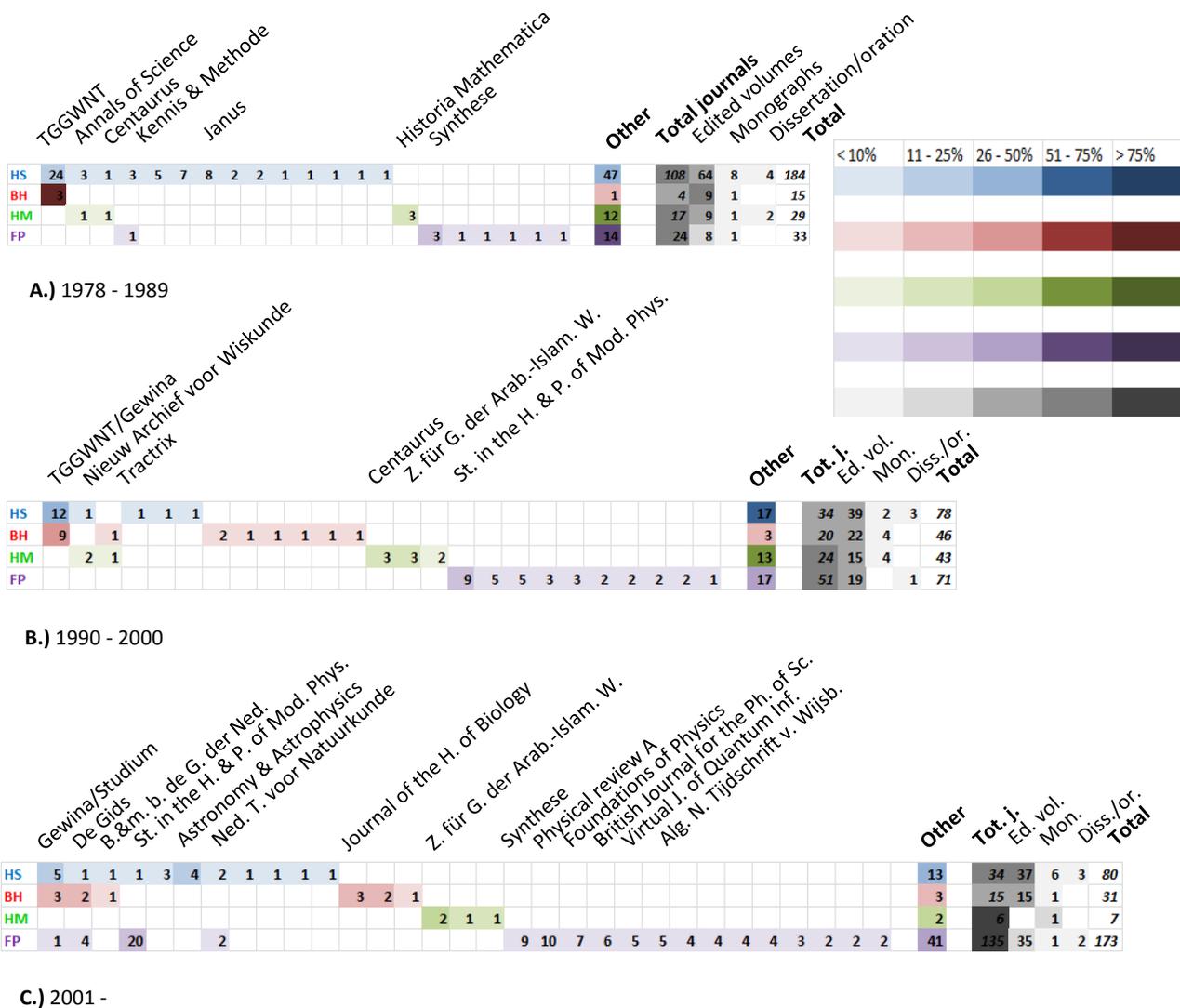
Specifically, the majority of collaborative supervisions of dissertations took place between professors from the HS line and from the biohistory line, Snelders, Van Lunteren, Visser and Theunissen, whereas co-supervisions between HS and FP (Snelders-Dieks) or between HS and HM

(Snelders-Bos, Bos-Hakfoort) occurred only incidental (fig.3.3). This recurring collaboration, which has remained more or less the same since 1990, suggests that the research lines of HS and BH were much more integrated than expected from the thematic analysis above.

Additionally, it may have been possible that cognitive integration has also occurred in terms of citations. In practice, means that the different research lines could have studied different topics, but with increasingly similar intellectual backgrounds and tools. Since a citation analysis was not possible, I was interested how much overlap there has been in the journals in which the different research lines have published their own work, and to what extent this has changed over time, since journal destinations tell something about which audience is considered most appropriate for this newly created knowledge.

Remarkably, about 16 % of all publications in journals of the department as whole, have gone to one single journal, the journal of the Dutch (later Dutch-Belgian) society for the history of science (Gewina), originally published as the *Tijdschrift voor Geschiedenis der Geneeskunde, Wiskunde, Natuurwetenschap en Techniek*, later as *Gewina* and *Studium*. The second most frequently occurring journal, *Studies in the History and Philosophy of Modern Physics*, was good for another 6%, while as much as 30% are covered by the five most frequently occurring journals (those occurring 10 times or more). The rest of the frequencies decline almost asymptotically, with 19% of the total number of journal-publications going to journals that occur only once (fig.3.4) (app.2).





**Figure 3.5** – Publication profiles of the different research lines

Numbers represent absolute frequency, shades represent relative frequency. Coloured shades are relative to the total number of journal-publications, whereas grey shades are representative to the total number of publications labelled 'scientific'.

(Source: IHFS-AR '1978-1979' – '2012')

For the overlap analysis, all journals were included that occurred more than 3 times, the other journals were included as 'other' and since researchers have published in them only incidentally, no significant overlap could have been the case. These journals were then sorted first by overlap, then by research line and then by number of publications (fig.3.5).

Strikingly, whereas HS and BH have largely integrated, the HM research line has not. Considering the suggestion made in section 3.3, that institutions are vital for the development of an intellectual activity, these findings seem to support the expectation that, after 'biohistory' had lost its separate

institutions, the most logical step was to merge into the existing institutional framework of HS. Since the research done in the group was already oriented on the Netherlands, society Gewina and its corresponding journal, which shared such focus on Dutch science, were the most obvious candidates. Instead, the intellectual orientation of the HM group (medieval and ancient Arabic and Persian mathematics) were such that other existing alternatives were more appropriate than Gewina.

Another surprising observation for who doesn't know the IHFS from the inside already, is that the journal *Studies in the History and Philosophy of Modern Physics* has barely become a shared medium for the different research lines. It has become the main destination for publications from the FP section, but not for the historians,<sup>139</sup> even though this journal is in fact a specialised branch of the journal *Studies in the History and Philosophy of Science*, which was the main product born out of the unification project born out of the Minnesota conference discussed in the introduction. Next to the most straightforward explanation that most researchers from the HS and BH lines were not oriented on topics in modern physics, another reason may be that, as Dieks has explained, most historical studies published in this journal are intellectually very different from what the historians from the IHFS produce. Whereas the latter have moved towards a very socio-culturally oriented history, describing scientists, practices, institutions and knowledge in their social and cultural context, the few historical studies that are featured in *SH&PMP* are almost exclusively detailed, 'internalist' studies of scientific ideas.<sup>140</sup> Since philosophers who study the foundations of specific scientific theories are also usually the ones who have evaded the social turn in the general philosophy of science, the influence of socio-cultural studies has barely penetrated the intellectual area occupied by this journal.

But perhaps most remarkably of all is that for all lines of research, publication in incidental journals is much higher than in frequently occurring journals. This has not changed very much between 1988 and 2012. Specifically, for the HS and BH, *TGGWNT/Gewina/Studium* has been only journal of considerable overlapping interest, even within the same research group. Other frequently featured journals like *Janus* (1978 – 1989) or *Astronomy & Astrophysics* (2000 -) were only relevant for single scholars. Only the FP section has in the later decades moved towards a publication profile with a small but solid number of core-journals. These varied from physics journals (*Physical Review A*) to general-philosophy journals (*Synthese*) and included both international (*Studies in the H. & P. of Mod. Phys.*) and Dutch-language journals. And whereas both the FP section and the HM research line have

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<sup>139</sup> Part of this finding can be explained by the my own categorisation choice, counting Jeroen van Dongen, a historian specialised in early 20<sup>th</sup> century physics, as belonging to the FP section. Had I counted him into the HS section, much more overlap would have been the result.

<sup>140</sup> Dieks (2014), non-structured interview

increasingly published in journals, HS and BH have retained an average ratio 50:50 publications in journals compared to edited volumes and monographs.

These findings suggest that the historians of the IHF have not only remained at a fair distance, intellectually, from the philosophers of physics from the foundations section, they have also remained at a considerable distance from each other, with separate research projects for each individual scholar that are not necessarily part of an integrated whole. The conducted interviews provide a possible explanation for this finding. For many historians of science, scholars themselves are responsible for the 'application' and 'legitimation' of their knowledge and activities, in the form of popular articles in magazines, newspapers or contributions to educative materials. As both Theunissen and Palm explain: "the primary 'application' of the history of science is in science education. Many early historians of science, like Dijksterhuis, were themselves teachers. This link still exists. Next to the few professionals, there is still a considerable number of amateurs doing historical research in their spare-time. Many of those are teachers who are convinced of the value of history in communicating science to new generations of students."<sup>141,142,143</sup>

This educative role has remained a constant factor, from the days of Dijksterhuis and Hooykaas to the present.<sup>144</sup> Only the direction has reversed. Instead of educating the general public and humanistic scholars about the indispensable social and cultural significance of the exact sciences, prospective scientists themselves have now become the primarily addressed targets. And rather than the importance of science for society and culture, the importance of society and culture for science has now become the main message. In his inaugural oration on 13 April 2005, Theunissen coins the term 'context subjects': subjects which provide a background that enables young scientists to reflect on their own activity and social role and should therefore be an essential element of their education.<sup>145</sup> Accordingly, this reflexive *bildung* is also the primary area of collaboration between the different research lines. Theunissen: "in the education we provide to beta students we work closely together to present history and philosophy as two sides of the same medal, two different, yet equivalent ways to acquire a more solid understanding of science."<sup>146</sup>

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<sup>141</sup> Palm (2013), non-structured interview

<sup>142</sup> Theunissen (2013), non-structured interview

<sup>143</sup> I omitted a comparison of those publications labelled as 'scientific' compared to those labelled as 'professional', with the book-reviews subtracted, sorted by research line. This might make the analysis too long but could also make it stronger.

<sup>144</sup> Hooykaas allegedly said: "if you want to understand what science is, you can approach it from two directions, from history or from philosophy, but those two are very different" (Palm, 2013, non-structured interview).

<sup>145</sup> Theunissen (2005), pp.7,9

<sup>146</sup> Theunissen (2013), non-structured interview

## **2.6. Addition to the family**

Whereas these basic rationales for marriage have not significantly changed nor seem to have strengthened at all, the family has nevertheless been extended with the creation of the Descartes Centre for the History and Philosophy of the Sciences and the Humanities in 2007. This newly established organisation has been the result of the vision of the cultural historian prof. dr. W.W. Mijnhardt to draw closer together research and education in the history of not just the natural sciences but all academic disciplines. Long before these ideas materialised, in preparation for his 1987 dissertation 'Tot Heil van 't Menschdom: Culturele Genootschappen In Nederland 1750-1815' about the diverse landscape of learned societies in the 18<sup>th</sup> century Netherlands in which the boundaries of disciplines were very fluid, he turned to Snelders' group for consult, only to find out that their intellectual focus was so dominantly determined by current disciplinary boundaries that they considered research questions like his' outside of their domain. Also, before the creation of Descartes Centre, a chaotic range of reflexive historical activities had emerged independently in several faculties of the University of Utrecht that were not coordinated neither with the IHF nor with each other. With the arrival of the Descartes Centre, these independent activities were brought into closer contact with each other and also new professorial chairs have been created in those areas where reflexive historical research was still lacking. Importantly, the Descartes Centre has been designed as a 'virtual institute' neither concentrating its different research activities in space, nor replacing existing organisational structures. Instead, by creating an efficient, coordinating superstructure, activities in history and philosophy of the different disciplines are supported in close organisational and spatial proximity to those disciplines themselves.<sup>147,148,149</sup>

Additionally, Mijnhardt sees a complementary function for the history of science as a discipline, which is not so much directed towards prospective scientists but rather towards policy makers and research managers. According to Mijnhardt, historians of science should be a critical voice in the debate about science policy, the role of science in society and the structural organisation of the science system. The way Mijnhardt conceives this, such critical voice should attack oversimplified representations of science that lead to policies which may generate perverse incentives, unjustly disadvantage intellectual activities like humanistic scholarship over other activities way or grant corporate interests too much influence in the direction and selective financing of research.

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<sup>147</sup> Mijnhardt (2013), non-structured interview

<sup>148</sup> Baneke (2013), p.46

<sup>149</sup> International Advisory Board Descartes Centre Utrecht (2011), *Evaluation Report of the Meeting 1-3 June 2011*, p.2,4,5

In spite of the more integrally historical orientation of this initiative, philosophy, and not just PS or FP but also other neighbouring areas such as the philosophy of religion and mathematical logic, have been integrated in the Descartes Centre. As Mijnhardt explained, the Descartes Centre would be the ultimate shield against the allegations of irrelevance and budget cuts that these small, reflexive research and education activities would have faced when left alone in their own faculties and institutes. The University Board realised the importance of a platform concentrating all these activities together. Mijnhardt: “there was only one condition from their side, that I should take the philosophers on board. Two independent Descartes Centres would have been too much.”

Like with the initial marriage 25 years earlier, reasons were a shared function (*reflection on science*) combined with the shared benefit of being protected against the administrative dangers of surviving alone. In retrospect, it can be regarded as an almost exact continuation of the legitimation strategy that has brought HS and PS together ever since the formation of the IUHPS in 1956 and applied in 1988 in Utrecht. And if the common, shared intellectual basis and disciplinary purposes remain as limited as the HS and FP research lines have been throughout the past 25 years, one can only guess what the future may hold.

### 3. Conclusions and Discussion

#### ***3.1. Findings from this research***

After more than 25 years of History & Philosophy of Science in Utrecht, it can be cautiously concluded that these different lines of research have lived together peacefully and have even developed an amicable relationship over the years, yet they have remained almost entirely separate on the intellectual level. It remains unanswered to what extent overlap in destination-journals give an adequate picture of the level of integration between the different research lines. In fact, many co-authored works were published in edited volumes and an even larger number of edited volumes contained contributions from multiple members of the group as a sort of hidden ‘semi-collaborations’. Also, single-authored contributions from both the history section and the foundations section to the same edited volume did, although still sparse, occur more than once.

Additionally, it is not clear yet how this constellation in Utrecht has been related to the wider landscape of disciplines, in the Netherlands as well as internationally. In Princeton, a previously combined programme in HPS has recently parted ways, whereas at other universities in the Netherlands too, HS and PS research lines have ended up over the years in different constellations, none of which mirrors the Utrecht situation. Finally, it is not clear yet what the role has been of the

national and international institutional frames. The clearly observable significance of society Gewina and its journal for the historians suggest that these institutional frames have exerted much pressure to nurture, strengthen and solidify these institutional frames, at least to a much larger extent than the equivalent in PS has done for the philosophers. Future research is needed to elucidate these open-ended questions, preferably in a broader context that involves not just one institute at one university but also its broader landscape of comparable academic activities elsewhere.

The other conclusion is that an overarching, shared goal for knowledge creation is lacking and that the dominant focus on education as the only commonly accepted 'purpose' is often tacitly assumed, but hardly questioned. Especially historians of science are often personally rather than collectively responsible for the legitimation of the knowledge they create and have remained at considerable cognitive distance from even their closest colleagues in the group. Moreover, the intellectual development which the history of science has undergone since it emerged as a professional discipline has created tension with regard to its educative purpose. Specifically, a more externalist, 'anti-monumental' or even science-critical history of science will likely perform poorly as a tool in science recruitment. This dilemma was already acknowledged as early as 1974, when Stephen G. Brush published a sharp article in *Science* titled 'Should the History of Science be Rated-X', in which he points out the vast differences between science education of the 'textbook tradition' and history of science as understood by professional historians. According to Brush, the kind of education necessary to train and especially to inspire a prospective scientist, which requires a picture of science as an honest quest for truth and of past heroes as lightening examples, is at odds with a realistic picture of science's past.<sup>150</sup> Similarly an increasingly relativistic philosophy of science too will probably perform poorly, not only in recruiting a prospective scientific workforce but also in its traditional role as a public defence of science against science-critical tendencies or even 'denialism' in popular culture.

This latter subversive relativism was precisely the source of controversy in the heated intellectual conflict during the 1990s, known as the 'Science Wars', in which scientists, who had been largely unbothered by either HS or PS before, responded to the radical epistemological relativism as to an early, dangerous fire or infective disease worthy to be extinguished once and for good.<sup>151</sup> At stake is the legitimacy of science studies, be it HS, PS or studies from a social-science perspective (STS). As described above, the 'disciplinary self-reflection' for scientists, which has taken the place of science promotion and recruitment as the main educational goal, is indeed much better suitable for a HS, PS and STS. According to Theunissen (2005), acquaintance with at least one of these disciplines is not only an optional piece of luxury for prospective scientists, it is vital intellectual equipment that makes

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<sup>150</sup> Brush (1974), pp.1164-1179

<sup>151</sup> Hull (2000), pp.61-64

education worthy of the label 'academic'. In his own words: "doing research like headless chicken isn't that difficult." Quite the opposite, in many cases, extensive specialisation and high competition in the scientific system have made 'mere application' of prescribed procedures and practices and forgetting about anything else the most successful attitude and have transformed much academic education into a form of 'vocational training'.<sup>152</sup>

### ***3.2. Future perspectives***

However, reflexive education may imaginably become to be too limited a goal for advanced and detailed creation of knowledge in the future. It might therefore be desirable to consider auxiliary options, not as a replacement of existing objectives, but as a complementary outlook, which at the same time opens new possibilities and may give a renewed intellectual impulse to the realisation of existing goals. Mijnhardt's idea of HS and STS as a voice in the debate around science policy and management can be a promising starting point and provides opportunities to apply a socio-cultural for a different purpose than merely attacking the epistemic authority of 'objective science'. Where Theunissen expects that that society will not know what to do with large numbers of professional historians of science,<sup>153</sup> such newly developed applications for professionally generated knowledge may nevertheless increase the carrying capacity for more of them.

Specifically because the existing system of science organisation and evaluation is currently under attack, representations of science that have helped shape this system, scientometrics in particular, are very much in need not just of correction but of constructive refinement. I would consider it a role for future historians of science not only to deliver criticism, but also to contribute to a more refined solution constructively. Since science, technology and scholarship are part of an integrated network together with broader culture and the economy, professional 'knowledge about knowledge': how it emerges, circulates and changes along the way across different sectors of society and culture, will contribute to such a deeper understanding of the role of knowledge not only inside the boundaries of what we designate as science, but in the world at large. This will in turn enable better management of our knowledge and information-based economy, including the science system.

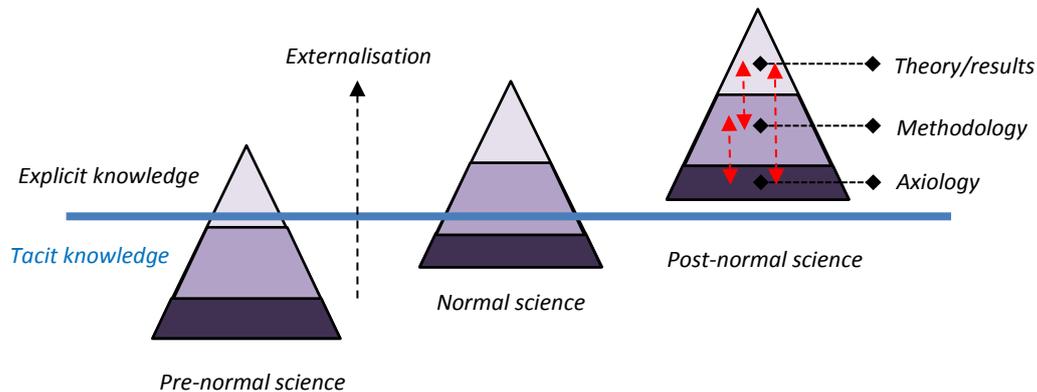
With such a constructive rather than critical task, innovation studies may be a potential fruitful disciplinary ally, particularly for HS research. As I will show in Appendix 1, the way knowledge creation is studied innovation studies involves much of the same theoretical concepts that are also used in STS and socio-culturally oriented HS and PS studies, but now with a much more practical outlook. In Utrecht, there is a thriving group of innovation researchers, which often have a different

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<sup>152</sup> Theunissen (2005), pp.7-9

<sup>153</sup> Ibid., p.7

disciplinary background but nevertheless share a great deal of the cognitive background with historians of science from the IHFS (e.g. Latour, SSK literature) and are trained in social science concepts and methods that may potentially give HS research more structure and coherence. Such integration can be initiated on the level of the training of Master and PhD students, by offering information and access about courses in both disciplines, similarly as is currently the case with communication and education.<sup>154</sup>



**Figure 4.1** – *The iceberg of knowledge creation*

The articulated outcomes of knowledge creation, the theories and results are like the tip of an iceberg. In those areas of study where there is no consensus, most of the methodology remains unarticulated. Externalisation, the conversion of tacit knowledge into explicit knowledge involves the articulation and standardisation of methods. In this process, the axiologies behind these methods typically remain tacit still. The democratisation of research could be compared to hoisting the whole iceberg above the sea, with the risk of unravelling the normal-science consensus.

However, becoming involved in a constructive, and therefore necessarily technocratic, intellectual programme, comes with a risk. Many social sciences in general, to which innovation studies and much STS research are no exception, strive or have striven towards becoming paradigmatic ‘normal science’. If there is one lesson that the sociology of scientific knowledge, from Ludwik Fleck to Bruno Latour and beyond, has taught us, is that if methods or cognitive approaches reach consensus-status they necessarily bring along an intellectual agenda. Dominant axiologies, which lead to their corresponding most effective methods (control of variables) and eventually corresponding knowledge monopolies as well as dominant retrospect representations of history. A situation where a similar same principle is applied to society or human history will effectively be a totalitarian state. For that reason, democratising the axiology of a constructive, technocratic historiography should be an inherent element and primordial challenge connected to such a project (fig. 4.1).

<sup>154</sup> I have considered to include an archive analysis of the educational transfer between the ‘lerarenopleiding’ all the way to the current Master programme Science Communication and Education and HPS, which has always existed, sometimes more intense than in other times, and compare this to the completely independently emerging and developing innovation-management studies, which has grown with almost no interest in HPS, nor even knowledge about its existence, and the other way around. I excluded it not to make the thesis too long, but I am still doubting whether or not to go deeper into it.

As Tollebeek (1996) describes, the history of historiography, which has been characterised by similar tendencies of desire to become an objective science with almost every other generation since the mid-19<sup>th</sup> century, has taught historians the important lesson that no representation of history can be justified by means of retrospect and that a 'free', and 'faithful' scholarship will not converge upon one 'true' representation of the past but will rather unravel commonly endorsed, storied understandings of the past and generate equally valid alternative representations from the perspectives of Catholics, Jews, the working class, immigrants, blacks, indigenous peoples, women, gays or even animals, which may even question concepts that are almost unanimously accepted as 'given' such as national identity or gender.

Does this mean that, echoing the tenets of postmodernism, constructive, technocratic historiography, as part of an integrated, multidisciplinary social science programme, is not possible at all? Not even historians but also innovation studies have received this criticism. Specifically, the concept of innovation bears the risk of letting the same old Whiggishness that historians of science have sought so much to avoid, in again via the back-door. A history of innovations, whether it are technological innovations or innovations in music or fashion, is prone to track merely those innovations that have been relevant for perspective-point P, from a specific time in the past until the present. The risk is that the main intellectual question will be to explain why those specific innovations were adopted there and then, ignoring innovations which were 'not relevant' from point P or have become a dead-end.

As I understand it, this depends on the intellectual foundations with which historians in such a project approach the past. This touches one of the central issues in the foundations of historiography: the role of the story. Virtually all representations of the past generated by historians come in the form of a story, with a plot that features protagonists with goals and intentions, who act, achieve and fail. Relative to those goals and actions, there are resistances to be overcome, learning moments to go through and decisive moments and occurrences that are crucial to the eventual outcome which transforms the past into the present. In order to convey a narrative, in literary art just as well as in scholarship, information is selected, structured and presented in a specific, understandable order.<sup>155</sup> Since narratives themselves can be understood as heuristic techniques that provide scenarios which intentional, acting humans can use to structure information from a highly complex environment, it can be expected that narratives have always been and often remain to be the most successful representations of human society and culture. Yet this does not mean that they are the only thinkable representations, nor does it mean that human society and culture are truly

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<sup>155</sup> E.g. Kreiswirth (2000), pp.239-316

built up from aggregated narratives. A continued quest for alternative representations leads to a highly speculative intellectual area that might perhaps involve philosophy and the foundations of physics in a way not previously considered.

So far, PS as a discipline has remained fundamentally 'a-social'. Quite the opposite, it has served as a safe haven for philosophers trying to avoid 'the social'. As I suggest tailoring HS even more onto social systems and the functional character of knowledge, the nature-oriented and ontology-oriented approach of FP seems impossible to benefit from such approach. However, by conceptualising science, as many modern philosophers of science do, as a distributed, cognitive system which communicates and continuously updates models of its environment, a social conception of knowledge, combined with an innovation perspective, may perhaps contribute to a new intellectual interface. Like other biological systems, social knowledge systems such as swarms of bees and ants, have recently been discovered by physicists as physical phenomena with many similarities with direct implications for applied fields such as artificial intelligence and robotics. Importantly, current-day physicists have increasingly come to regard complexity as a third frontier of physics, comparable to the quantum world and the macro universe, which have been the main 'frontiers of physics' in the 20<sup>th</sup> century.

This may imply that like quantum theory and relativity, 'complexity' should in fact also belong to the intellectual territory of the philosophy of physics. Due to the similarities between the complexity of simpler biological systems and the complex dynamics of human society studies in the 'philosophical foundations of complexity' could potentially benefit reflections on the philosophical foundations of biology and of the social sciences and humanities. Nevertheless no articles on complexity could be detected so far in the currently most influential FP journal: *Studies in the History and Philosophy of Modern Physics*. Also, the intellectual distance between the emerging field of 'complexity science' in physics, evolutionary biology and the neurosciences on the one hand, and in the philosophy of the social sciences and humanities on the other hand is still enormous. It therefore remains very doubtful whether such intellectual interface would be viable in practice. For the interface between HS and innovation research however, this is very different. Here, a first start has been made already.

In 2010, Prof. Theunissen, manager of the Descartes Centre as of this year, has published a book, *De Koe*, in which he has described how scientific knowledge about breeding cattle has interacted with existing knowledge and practices among farmers and how, under specific circumstances, insights from scientists have diffused out of the laboratory into wider practice, but in a way that thoroughly defies simplistic ideas of an unidirectional relation from scientific knowledge towards practical applications. Currently, two PhD programmes are devoted to an extension of this research, from

cows to sheep and pigs, as part of an integrated research programme. In personal conversations, the PhD students working on these programmes have in fact indicated that they have, without me mentioning it, have in fact come to realise that their research, in terms of the issues and questions it deals with, is in fact a form of innovation research and that knowledge of innovation theory could potentially be useful for their work.<sup>156</sup>

Additionally, in his 2005 oration, Theunissen has mentioned an earlier, comparable study as an example of research into the ‘circulation of knowledge’. Together with ‘the fluid boundaries of disciplines’, ‘circulation of knowledge’ has become one of the central focus areas of the Descartes Centre. When it comes to the history of science, these are the kind of research areas which are most combinable with an innovation approach.

Finally, there are signs on the horizon that the solid, systematic research programme pursued by the Descartes Centre also revitalises both HS and PS’ original task of providing a humanistic, self-critical reflection on academia as a whole and on the specific intellectual activities taking place inside its walls. Since such reflection seems more necessary than ever in today’s world, where science and scholarship are increasingly under economic, political and cultural pressure, it is important that this task remains a main, explicit focus. Doing this for academia as an integrated whole rather than for specific disciplines in isolation, as the Descartes Centre pursues, is an essential element of such task against the background of an increasingly interdisciplinary research landscape. Recent initiatives like Science in Transition, of which the Descartes Centre is one of the main organisers, is a hopeful example that combines the best of both worlds: critical and constructive, humanistic and carefully, realistically technocratic.

And whether or not history and philosophy of science will survive another 25 years in its current constellation or whether its intellectual heritages will rearrange into something else, unity, even in a superficial form, has so far provided sufficient strength for small things to endure hardships and to grow, and will hopefully continue to do so.

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<sup>156</sup> Van der Laan (2014), non-structured interview

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- 1.) The IHFS' 'Annual Reports' (IHFS-AR),<sup>157</sup> available from 1978 – 2012. Until 2003, these reports give a detailed, nearly uniform overview of all academic and organisational activities of the institute and its members, including those activities carried out at other institutes. These activities include publications, research projects, education, colloquia as well as partnerships with other researchers and groups.
- 2.) Information about formal decision making (e.g. changes in organisational structures or funding) was retrieved from notes of department meetings, departmental correspondence, meetings of the Faculty of Mathematics & Physics's everyday management, *Facultas Contracta*, 1956-1987 ([Arch. 139-J](#)).
- 3.) 1 hour semi-structured as well as shorter non-structured interviews have been conducted with prof. Dieks, prof. Theunissen, Drs. Palm and Dr. van Dongen, Prof. Snelders and Prof. Visser, Dr. Muller and PhD student S.F. van der Laan who have been personally involved in the developments investigated in this study.

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<sup>157</sup> As a result of a number of consecutive organisational mergers, the 'department' repeatedly changed its name. Throughout this research I will refer to it as the 'IHF', which has always been the most inclusive term as some institutes co-existed with the IHF, each of which included a limited subset of the department's total number of members.

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## List of Abbreviations

BH	<i>Biohistory</i>
BHI	<i>Biohistorical Institute</i>
DHFMS	<i>Department of History and Foundations of Mathematics and Science</i>
DHM	<i>Department of History of Mathematics</i>
DHS/DHST	<i>Division of History of Science (and Technology)</i>
DLMPS	<i>Division of Logic, Methodology and Philosophy of Science</i>
DRFP	<i>Department of Research in the Foundations of Physics</i>
FP	<i>Foundations of Physics</i>
HM	<i>History of Mathematics</i>
HPS	<i>History and Philosophy of Science</i>
HS	<i>History of Science</i>
ICSU	<i>International Council of Scientific Unions</i>
IHFMS	<i>Institute for the History and Foundations of Mathematics and Science</i>
IHFS/IHF	<i>Institute for the History and Foundations of Science</i>
IHES	<i>Institute for the History of the Exact Sciences</i>
IHIS	<i>Institute for the History of the Inorganic Sciences</i>
IHS	<i>Institute for the History of Science</i>
IUHPS	<i>International Union of History and Philosophy of Science</i>
IUHS	<i>International Union of History of Science</i>
IUPS	<i>International Union of Philosophy of Science</i>
PS	<i>Philosophy of Science</i>
STS	<i>Science, Technology &amp; Society</i>

## Appendix 1: The innovation-model of knowledge creation

Since I advocate closer integration of HPS not only with each other but also with other fields concerned with understanding science, I decided to review a number of commonly used theories in the interdisciplinary field of innovation studies, attempting to demonstrate how such approach can possibly provide a new intellectual tool for studies in the history of science, scholarship and universities.

Innovation studies are a relatively new and highly interdisciplinary field between economics, economic sociology, economic geography and management theory, interested in the economic aspects of (technological) innovation and the role of knowledge in the economy. Instead of treating firms as passive response automata to market input and knowledge no longer as a 'Black-Box', innovation studies conceptualises them as centres where active and collective knowledge creation takes place.<sup>158,159,160,161</sup> The formal models of and insights in the dynamics of knowledge creation that have arisen from this approach can in turn be applied to gain a better understanding of the mechanism by which knowledge in general and scientific knowledge in particular, is created, transmitted and transformed as part of an integrated system together with its continuously changing environment.

According to Godin (2012), one of the main aspects in which the innovation perspective differs from earlier economic research on technological change is its focus on the commercialisation of new products.<sup>162</sup> This may seem limited, overly economic and far removed from the intellectual concerns of the HS, but the interest in the emergence of wholly new products, new markets and new problems, bears much more resemblance to economic history than to the static market-models of traditional economics. Its theoretical basis is evolutionary economics, with its focus on solving problems necessarily relative to specific corporate agendas and their wider contexts, gives innovation studies a 'historical' and contextual outlook.

Questions that innovation scholars investigate are:

- *Where do new inventions come from?*
- *Which socio-economic problems are new inventions designed to solve?*
- *How do new inventions become economically profitable?*

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<sup>158</sup> Nonaka & Takeuchi (1995), pp.50-66

<sup>159</sup> Spender & Grant (1996), p.5-7

<sup>160</sup> Morgan (1997), pp.494,495

<sup>161</sup> Gertler (2003), p.76

<sup>162</sup> Godin (2012), pp.( 403,404,412-424)

- *How do new inventions compete (economically) with established practices and with other new inventions?*
- *Which kinds of conditions are beneficial for innovation as a source of competitive advantage?*
- *What is the relation between academic science, technology, corporate interests and markets in a knowledge-intensive economy with specialised R&D?*

In these all areas, studies in the history (and 'present') of science, scholarship, medicine, technology and society have almost directly shared interests with innovation scholars starting from an economic perspective. Historians of science too are interested in origins, successes (or failures), diffusion and change of scientific ideas. Specific questions in the HS, particularly after the 'externalist turn', are:

- *Where do new ideas come from?*
- *How do broader research cultures emerge and how do they become successful or established?*
- *How do established ideas change or become overthrown by other ideas?*
- *What is the relation between scientific ideas, research traditions and their socio-economic and cultural context (which includes technologies and commercial markets)?*

Many studies in the history of science have theoretically been inspired by studies of science, technology and society (STS), which come in three types: 1.) postmodern studies, which deconstruct science's 'epistemic superiority' claims without passing further judgment; 2.) activist studies, which aspire to overthrow the underlying 'epistemic politics' of science and democratise its goals applications,<sup>163</sup> and 3.) Policy Studies, which aspire systematic appraisal of scientific productivity and quality in order to increase economic and prestige returns for science policy.<sup>164,165</sup>

Particularly influential in historical studies of science are social-constructivism and, more recently, Actor Network Theory.<sup>166,167</sup> These theories, developed in intellectual movements critical of science and its unquestioned authority in Western society, treat scientific knowledge as collective and goal-directed, a function not only of physical reality but also of purpose-driven human action.<sup>168,169,170</sup> In that role, SSK has generally been employed with an emancipatory agenda,

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<sup>163</sup> Rouse (1995), pp.69-61

<sup>164</sup> Rip (2002), pp.60,61

<sup>165</sup> Wouters (1999), p.131-135

<sup>166</sup> Shapin (1982)

<sup>167</sup> E.g. Latour (2005); Fountain (1999)

<sup>168</sup> Ibid., pp.14-17

<sup>169</sup> Shapin (1982), p.179

<sup>170</sup> N.B. this does not imply that knowledge is a function *only* of human purposes either. The degree of epistemological relativism lies exactly in the determination of the ratio nature/purposes. Besides, Bruno Latour has argued that drawing a border between nature and purposes is meaningless because actors and their intentions are just as much constructed by the physical world as the other way around. These things remain an area of philosophical investigation and lie far outside the scope of this thesis. For practical reasons, I will hold that the 'nature of nature' places constraints on 'possible forms of knowledge', whereas purposes and interests enter the process of knowledge creation at multiple levels such that an internalism-externalism border cannot be observed in practice. I am aware that short characterisations of this kind are

challenging the claims of objective and rational superiority of modern Western science over rival knowledge systems, such as those of indigenous peoples, precisely by applying the tools originally developed to analyse non-Western knowledge systems, to modern science.<sup>171,172</sup> An innovation approach could be typified as ‘applied social constructivism’. Unlike emancipatory STS, innovation studies are not interested in challenging the authority of science, but in gaining a structural insight of the processes by which knowledge is created, interacts with its environment and changes over time, treating the notion that knowledge is ‘socially constructed’ not as the end-point of investigation but as a starting point for gaining constructive benefits from an adequate insight in these processes.

At any particular place and at any moment in time, activities that we classify as scientific research can be conceptualised as a particular constellation of specific knowledge, methods, ways of doing and organising as well as more hidden ultimate goals and purposes (axiologies). These structural elements can vary from architectural designs of working spaces to organisational structures, specific theories, models and vocabularies, technological devices or writing styles, all of which have separate histories and have come together in a specific way because they were introduced and adopted during some period in time. Some elements remain relatively constant over long periods of time, whereas others are changing fast and are continuously being challenged by new, rival equivalents. Additionally, although analytically separable, these elements do not diffuse in isolation but are engaged in intricate, symbiotic relationships which makes that an innovation on one level will almost inevitably bring along changes on a whole range of other levels as well.

Following influential scholars such as Ludwik Fleck and Thomas Kuhn, historians and sociologists of science have paid much attention to the social transmission and the collective character of knowledge, both when it comes to beliefs, systems of meaning and interpretation, practical skills or forms of organisation. Especially in the more recent years, this has involved studies that ‘trace back’ change to the borrowing of pre-existing concepts, methods and approaches from other scientific disciplines or even wholly different areas of culture and their active adaptation to new contexts and practices. One of the best chronicled examples is the early mathematisation of physics, epitomised by Newton’s *Principia*, and its subsequent spread towards the rest of academia, even into areas where mathematisation turned out to be a strikingly unsuccessful intellectual project. Finally, descriptions of specific skills and local research cultures, often in relation to wider distribution of practices and habits in the discipline or in science as a whole, are also an important element of many studies in the history of science.

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prone to an oversimplification that does not do justice to the richness and philosophical radicalness of the abovementioned intellectual traditions. I willingly admit pushing agenda of intellectual ecumenism and, therefore, this eclectic attitude.

<sup>171</sup> Bloor (1979), p.1-18

<sup>172</sup> McAllister (2002) p.12

Knowledge creation, such as described by e.g. Nonaka & Takeuchi (1995) or Gertler (2003), is based on the idea that knowledge consists of two different but mutually convertible types of knowledge: tacit knowledge and explicit knowledge.<sup>173,174</sup> Explicit knowledge refers to verbalised forms of knowledge that are codified as written text, mathematical formulas, graphs and images or digital codes, whereas tacit knowledge refers to subjective, context-specific, experience-based 'know-how'.<sup>175</sup> According to Nonaka & Takeuchi (1995), the creation of new knowledge can be described as a continuous, collective activity of converting tacit and explicit knowledge in a repetitive spiralling process. In this process, four inseparable phases can be distinguished, which occur simultaneously and mutually influence each other:

- 1.) Socialisation: social exchange and multiplication of tacit knowledge by imitation and prolonged interaction with the physical environment;
- 2.) Externalisation: the conversion of tacit into explicit knowledge by means of the communication of metaphors and images, and, thus, the elements that make up personal contexts of interpretation;
- 3.) Combination: the creative process in which new connections between existing pieces of explicit knowledge are established and new applications are found for existing ideas; and
- 4.) Internalisation: the integration of existing, explicit ideas into new, tacit contexts of practice and interpretation, by means of practical acquaintance (fig. 3.1).<sup>176,177</sup>

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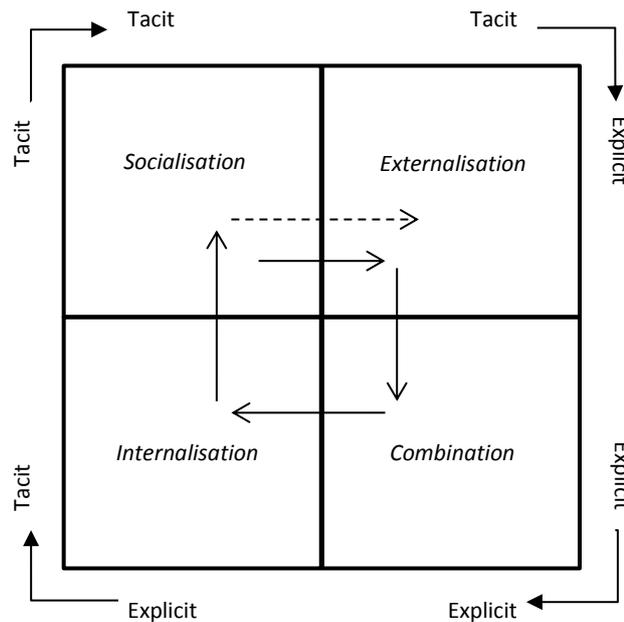
<sup>173</sup> The conventional history of this dichotomous concept goes back to Michael Polanyi in 1958 and would be too extensive to review in much detail detailed. For a good, all-encompassing work on the subject which entails an intellectual correction on common assumptions built into earlier theories, including Nonaka & Takeuchi's, see Collins (2010).

<sup>174</sup> There are of course differences between the theories described by these different authors. Nevertheless, I consider their main ideas consistent enough to discuss here as one single theory.

<sup>175</sup> Gertler (2003), pp.75-85

<sup>176</sup> Nonaka & Takeuchi (1995), pp.74-87

<sup>177</sup> Nonaka et al. (2000), pp.10,11



**Figure 2.2** – The SECI-model of knowledge creation

However, as Collins (2010) has argued, the assumption that tacit knowledge can always unambiguously be externalised is problematic because all explicit knowledge is in turn rooted in tacit knowledge.<sup>178</sup> The things generally understood as tacit knowledge – i.e. personal practices and skills acquired by repeated experience – indeed often remain ‘hidden’ inside individuals or groups but can be externalised by means of verbalisation and standardisation, in order to be replicated on a larger scale. However, this verbalisation itself involves the production of symbolic reference by means of social convention. It is these social convention systems of symbolic meaning that Collins calls ‘collective tacit knowledge’, which is *necessarily tacit* because it cannot exist outside of the collectives themselves. Therefore, although the inscriptions of information that are the product of externalisation, can be transmitted rapidly and be manipulated by computers in intricate ways, their *meaning* remains grounded in this collective tacit knowledge and the effectiveness of their transmission depends on the extent to which sender and receiver share the same tacit background that enables effective interpretation.<sup>179,180</sup> As a result, local tacit knowledge, acquired in specific research practices, can only be externalised, by converting ‘personal tacit knowledge’ into ‘collective tacit knowledge’. This corresponds with Latour’s idea that the formation of consensus about the interpretation of evidence entails the spread and collective acceptance of its entire contextual

<sup>178</sup> Polanyi already made the same point in 1958, stating that “knowledge is either tacit or rooted in tacit knowledge” (Collins, 2010, pp.1,46).

<sup>179</sup> Gertler (2003), pp.75-85

<sup>180</sup> Collins (2010), p.57-65

embedding, including practices, reference frames, purposes and interests, all of which were once the personal and unique property of specific groups or individuals.<sup>181,182</sup>

This explains why meaningful knowledge exchange is tightly embedded in social networks, which are in turn shaped by organisational and institutional structures. Mere physical co-localisation, such as having an office on the same floor or lunch in the same restaurant, is rarely sufficient.<sup>183,184,185</sup> It has been proposed that ‘proximity’, the experienced phenomenon of being ‘close’, should be conceptualised in multiple dimensions.<sup>186,187</sup> Boschma (2005) distinguishes five:<sup>188</sup>

Social proximity: the extent to which individuals or groups are connected to one other. Unlike with viral infections, the nature of ties such as strength, direction and mutuality, matters when transmissions are socially meaningful.<sup>189,190</sup> ‘Contagions’ with complex or controversial content such as changes in behaviour or interpretation need to be fortified by multiple positive affirmations and require strong ties in order to overcome the inhibitive influence from other ‘non-adopters’.<sup>191,192,193,194,195</sup>

Cognitive proximity: the extent to which there is overlap in the existing ‘knowledge bases’, pools with unique compositions of specific expertise and skills, of different individuals or groups.<sup>196,197</sup> This knowledge background shapes the way in which individuals and groups interpret and internalise new information. As a result, the extent to which a new piece of information is perceived as complex or controversial depends on the cognitive distance between source and recipient.<sup>198</sup>

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<sup>181</sup> Latour (1987), pp.63-144

<sup>182</sup> Latour (1983), pp.159-169

<sup>183</sup> Torre & Gilly (2000), pp.173-176

<sup>184</sup> Gertler (2003), pp.90,91

<sup>185</sup> Moodysson (2008), pp.451,452,463

<sup>186</sup> This approach was first developed by the French school of ‘Proximity Dynamics’, e.g. Torre & Gilly (2000).

<sup>187</sup> Boschma (2005), pp.65-68

<sup>188</sup> Although it is helpful to separate these five dimensions analytically, the line between them is not always easy to draw. Scholars have described formal organisations as stable, cohesive social networks (E.g. White et al., 2004, pp.97,98) but also as institutional arrangements (E.g. Meyer & Rowan, 1977, pp.343,346; Meyer, 2006, pp.789,790). Institutions, being ‘models for agency and scripts for activity’, can in turn be regarded as a form of knowledge (Ibid., pp.792,798).

<sup>189</sup> E.g. Watts & Strogatz (1998)

<sup>190</sup> Strang & Meyer (1993), p.488

<sup>191</sup> However, strong ties tend to stabilise themselves into a situation where every member of the community is equally strongly and mutually connected to any other member. As a result, knowledge in closely-knit communities becomes homogenised and trapped (‘lock-in’). The community’s remaining weak connections to the outside world become the only bridges for new information (Granovetter, 1973, pp.1361-1364).

<sup>192</sup> Centola & Macy (2007), p.706-708

<sup>193</sup> Hansen (1999), pp.82-87

<sup>194</sup> Krackhardt (1992), pp.217-218

<sup>195</sup> Boschma (2005), pp.66,67

<sup>196</sup> Ibid., p.63

<sup>197</sup> N.B. knowledge bases are built up over time. Since new tacit knowledge is continuously built on top of existing knowledge by new experiences or new ‘internalisation’, cognitive differences between individuals, teams, organisations and even nations and cultures are amplified over time and develop divergently in a contingent, historically path-dependent way (Bathelt et al., 2004, pp.34,35).

<sup>198</sup> N.B. Importantly, the idea of cognitive ‘proximity’ seems to overlook the possibility that independently developed solutions for similar problems will not only be *different* but may also be *conflicting* or even logically ‘incommensurable’. In such case the complexity or controversial character of a contagion is not really a matter of cognitive ‘distance’ but rather one of cognitive ‘dissonance’.

Organisational proximity: the extent to which individuals or groups are part of a shared organisational arrangement. These arrangements, which occur in different varieties and on different levels,<sup>199,200</sup> involve a common set of formal and informal rules, routines and identities which together create an environment that structures and encourages the kind of social ties and interactions necessary for knowledge sharing.

Physical proximity: spatial distance, defined either in the 'absolute' sense of spatial distance measures, in the semi-relative sense of the time and costs of travel, or as the relative constraint on actors' behaviour as a result of travel time and costs.<sup>201,202,203</sup>

Institutional proximity: the extent to which individuals or groups share a background of similar institutions. Institutions, which often conjoin large groups of people without specific social, organisational or physical ties,<sup>204</sup> are formal and informal sets of mutual expectations between people that have become more or less enduring. By prescribing roles, identities, inclusion criteria and codes of conduct in for different types of situations, institutions structure individual and collective behaviour.<sup>205,206</sup> Together institutions form an interdependent dynamic climate in which some arrangements remain stable over long periods of time whereas others may change very fast.<sup>207,208</sup>

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<sup>199</sup> E.g. permanent official institutes or loose, temporary constructions

<sup>200</sup> Boschma (2005), p.65

<sup>201</sup> Torre & Rallet (2005), p.49

<sup>202</sup> Boschma (2005), p.69

<sup>203</sup> Boschma (2005) uses the term 'geographical proximity'. However, following Frenken et al. (2009), I prefer the term physical proximity for the purpose of avoiding confusion (Frenken et al., 2009, p.222).

<sup>204</sup> Boschma (2005), pp.67,68

<sup>205</sup> Van Waarden, 2009, pp.247-281

<sup>206</sup> E.g. legislation or professional identities

<sup>207</sup> N.B. strategic adaptations or replacements of institutional arrangements may (intentionally or unintentionally) alter their 'reach' and thus change 'institutional proximity'.

<sup>208</sup> N.B. sociologists of the 'neo-evolutionary institutional' school have compared the whole of dynamic interactions of institutions to the workings of a biological ecosystem (e.g. Abrutyn, 2010). Elaborating on this in detail exceeds the scope of this thesis. Yet, I regard my approach as sympathetic to this analogy.

## Appendix 2: Interview Questions

### **Topic 1 – Knowledge creation**

The survey has examined basic features about the structure of knowledge creation and the degree of consensus and hierarchy in the field. Do you consider yourself part of a specific 'school/paradigm/thought-style' and why (not)?

- ➔ Do 'schools' in your field tend to be concentrated in specific structures like the same institutes, universities, countries etc. and/or do they correlate with 'social divides' within the scholarly community?
- ➔ How would you describe the degree of consensus and differences concerning 'matters of paradigm' between you and the other researchers whom you consider your closest colleagues?
- ➔ How are different 'schools' or approaches within one field reflected in the way students receive their research training in your institute/department? Are they expected to assimilate to the dominant view in the institute (if there is any)? Particularly, what is your role as a teacher in educating students in doing their own research?
- ➔ How do you in your own research relate to knowledge created other research in terms of how you use or discuss that knowledge? Does this depend on differences between 'schools' (either 'your own' or 'other ones')?
- ➔ In which ways is the knowledge produced in your own research usually used or discussed by other researchers in the community? And again, does this depend on differences between 'schools' (either 'your own' or 'other ones')?
- ➔ Do you see more 'paradigmatic' consensus as desirable in your field and why (not)?
- ➔ Do you think 'paradigmatic' consensus is likely to grow in your field in the near future and why (not)?
- ➔ In the survey I have asked whether your research practice is mainly a collective or a solitary affair. Is this related to the place where you prefer to do your academic work (particularly: in a study-room at home or in an office at your institute)?
- ➔ Do conferences in your field primarily have a social or an intellectual function? In other words: do people in your field substantially learn things from conferences or are they rather means to get to know (important) people in the field? And is there a difference in this respect at different scale levels of organisation (e.g. local, national, international)?

- ➔ Have you ever been on a temporary residency at another institute or in another country? What were (in general) your main motivations and what have been the main benefits? Particularly, were these benefits mostly social or intellectual?
- ➔ Has your institute or department ever received a residential fellow? (Idem) what were the main motivations and what were the main benefits for the institute/department? And where these mostly social or intellectual?
- ➔ How does knowledge in your field get disseminated to the outside world? Who outside the professional community (directly or indirectly) uses/consumes or in any other way benefits from the knowledge and in what way does this happen?
- ➔ Do you think the professional community in your field manages well enough to defend the 'value' of the knowledge it produces and legitimise research in the area?
- ➔ Do you think the 'market value' of the knowledge produced in your field and the legitimisation of research in your research area should improve and why (not)? (And... how do you experience the 'economistic' approach to knowledge creation in general?)

### **Topic 2 – Interdisciplinarity and disciplinary identity**

The survey has touched upon interdisciplinary conferences and in fact, the organisational history combination of historians and philosophers of science creates an interdisciplinary setting. Is there (or has there been), in your experience any actual interdisciplinary research combining history *and* philosophy of science in some complementary manner?

- ➔ What are the disciplines to which your field is most closely related? How are your own intellectual and social relationships with researchers in those fields and how have these changed over time?
- ➔ Are you happy with the organisational structure as it is now (e.g. the history and philosophy of science pooled together, formally part of the faculty of beta-sciences and the Descartes Centre as a network of 'weak ties' connecting all the other related activities)?

### **Topic 3 – Change and historical context**

In the survey you have characterised how knowledge creation in your branch of research is structured, but only for the current situation. What are the main aspects in which research in your field has changed over the years (in terms of organisation and social practices as well as intellectually)?

- ➔ In what aspect has that changed your own daily research practice?

- ➔ Are these changes, in your experience, mostly due to external (e.g. financial) factors or do they also benefit the actual research itself?
- ➔ And are these changes, in your experience, mostly due to the vision, work and strategy of specific individuals or rather the outcome of circumstances?
- ➔ What changes do you expect *will* happen in the future and why?
- ➔ And how do you think your field *should* change (or rather stay the same)?

## Appendix 3: Complete lists of personnel, dissertations and journals

	<b>Period</b>
Snelders	1978 - 1995
Palm	1978 -
De Pater	1978 -
Van Berkel	1978 - 1988
Hakfoort	1980 - 1985
Van Hoorn	1983 - 1988
Van Lunteren	1984 -
Leegwater	1985 - 1986
Vermij	1987 - 1991
Heijmans	1989 - 1993
Röell	1989 - 1992
Van der Schoor	1992 - 1996
Somsen	1992 - 1996
Roberts	1994
Faasse	1995 - 1997
Allart	1996 - 2001
Porter	1999
Van Helden	2001 -
Baneke	2003 -
<b>Total</b>	
Heniger	1988 - 1990
Sanders	1988
Theunissen	1988 -
Visser	1988 -
<b>Total</b>	
Bos	1985 - 2002
Van Maanen	1985 - 1989
Hogendijk	1986 -
Van Dalen	1987 - 1993
Atzema	1988 - 1992
Hesseling	1995 - 1999
De Wreede	1999 -
<b>Total</b>	
Van Brakel	1986 - 1991
Dieks	1986 -
Hoekzema	1986 - 1990
Slooten	1986
Hilgevoord	1987 - 1992
De Regt	1987 - 1989 + 1996 - 2000
Uffink	1988 -
Hauschildt	1989 - 1990
Muller	1990 - 1994 + 2000 -
Vermaas	1993 - 1997
Budden	1994 - 1997
Van Lith-Van Dis	1996 - 2001
Van der Meer	1998 - 1999
Anandan	1998
Holman	1999 -
Seevinck	2002 -
Muis	2003 -

	PhD Studer	First Prom	Second Pr	Co-promo	Referent'	First Supe	Second Su	University
1978	Glas	Van Melsen		Snelders				RU Gronin
1979	De Pater	Hooykaas						RU Utrech
1983	Van Berke	Snelders		Waterboll	Boogman			RU Utrech
1985	Vanpaem	Bockstael	Snelders					KU Leuver
1986	Hakfoort	Snelders						TU Eindho
1989	Stamhuis	Snelders	Bos					VU Amste
1990	Koetsier	Kirschenn	Maurice		Bos			VU Amste
1991	Vermij	Snelders	Van Berkel					RU Utrech
	Van Lunte	Snelders	Dieks					RU Utrech
1993	Atzema	Bos		Hakfoort				RU Utrech
	Hoekzema	Hilgevoord						RU Utrech
	Van Dalen	Bos		Hogendijk				RU Utrech
1994	Heijmans	Snelders		Visser				RU Utrech
	Maffioli	Snelders	Pancaldi					RU Utrech
1996	Röell	Snelders						RU Utrech
1998	Muller	Dieks						RU Utrech
	Somsen	Snelders		Visser				RU Utrech
	Vermaas	Dieks						RU Utrech
1999	Hesseling	Bos	Van Dalen					RU Utrech
	Zuidevaar	Snelders		Visser				RU Utrech
2001	Van Lith-V	Dieks				Uffink		RU Utrech
	Stomphor	Schaafsma			Uffink			Wagening
2003	Allart	Visser				Van Lunte	Theunisse	RU Utrech
2008	Baneke	Theunisse	Van Lunteren					RU Utrech
	Seevinck	Dieks		Uffink				RU Utrech
2009	Wegener	Theunisse	Van Lunteren					RU Utrech
2011	De Ronde	Dieks	Aerts					RU Utrech
2012	Van der S	Theunisse	Visser					RU Utrech

	1978 - 1989	1990 - 2000	2001 -	Total	Citation Indexed
TGGNWT/	30	26	7	63	n
Studies in the History		8	19	27	y
Wissensch	15	1		16	n
Synthese	2	3	6	11	y
Foundatic	2	3	5	10	y
British Journal for the		2	6	8	y
Janus	8			8	n
American	1	4	2	7	y
Centaurus	3	3	1	7	y
Philosoph	1	3	3	7	y
Physical Review A		1	6	7	y
Algemeer	1		5	6	n
Annals of	4	1	1	6	y
De Gids			6	6	n
Document	4	1	1	6	n
Historia M	3	2	1	6	y
Nederlan	1	1	4	6	n
Physics Le	4		2	6	y
Zeitschrift	1	3	2	6	n
Biografisc	2	1	2	5	n
Foudation	1	2	2	5	y
Bijdragen	1	1	2	4	y
De Negen	4			4	n
Journal fo	1		3	4	y
Journal of the History		1	3	4	y
Kennis & I	4			4	n
Nieuw Archief voor W		3	1	4	n
Spiegel Hi	4			4	n
Stanford Encyclopedia of Philosop			4	4	n
Astronomy & Astrophysics			3	3	y
De Zevent	2	1		3	n
British Jou	1	1	1	3	y
Metascience			3	3	n
Erkenntni	1		2	3	y
Foundations of Scienc		3		3	y
Theoretisi	3			3	n
Tijdschrift	1	1	1	3	y
Tractrix	1	2		3	n
Physical R	1		2	3	y
Virtual Journal of Quantum Inform			3	3	n
A.A.G. Bijc	2			2	n
Alma Mat	1	1		2	n
Ambix	1		1	2	y
Archive fo	1		1	2	y
ArXiv			2	2	n
Congrespe	2			2	n
Communication and C		2		2	n
Foundations of Chemistry			2	2	n
Historical Studies in the Physical a			2	2	n
International Journal c		2		2	y
Isis			2	2	y
Journal for the General Philosoph			2	2	y
Landbouw	2			2	n
Mededeli	2			2	n
Methodology and Scie		2		2	n
New Journal of Physics			2	2	y
Pharmace	2			2	y
Notes and	2			2	y
Physics in Perspective			2	2	y
Quantum Information Processing			2	2	y
Studies in the History		2		2	y
Studia Lei	2			2	y
Virtual Journal of Nanoscale Scien			2	2	n
Wijsgerig Perspectief		1	1	2	n

Acta Botanica Neerlan	1			1	n
Acta IMEK	1			1	n
Algemene	1			1	n
Amsterdams Sociologi	1			1	n
Analysis				1	y
Annalen d	1			1	y
Archives International	1			1	n
Archives c	1			1	y
Archives c	1			1	n
Argos				1	n
Ars Disputandi – The Online Journ				1	n
Belgisch Tijdschrift voor Filologie				1	n
Berichte zur Wissensch	1			1	y
Bolletino	1			1	y
Cahiers Spinoza	1			1	n
Chechoslc	1			1	n
Civis Mundi				1	n
Collegium	1			1	y
Conceptu:	1			1	n
Cultural D	1			1	n
De Vrije F	1			1	n
Dictionary of Medical Biography				1	n
Dictionary of Scientific	1			1	n
Diversity				1	n
Early Science and Medicine				1	y
Educational Studies in	1			1	y
Euclides	1			1	n
European Journal of Analytic Philc				1	n
European Journal of Pl	1			1	y
European Physical Journal B				1	y
Expositior	1			1	y
General Journal for the Philosophy				1	n
Helvetica Physica Acta	1			1	n
Historia Scientiarum	1			1	n
History of Universities				1	y
Hypothese – NWO Blad voor de W				1	n
International Studies in the Philos				1	y
Intersections				1	n
Journal fo	1			1	y
Journal for the History	1			1	n
Journal of Humanistic Mathematic				1	n
Journal of the Japan-N	1			1	n
Journal of Modern Optics				1	y
Kroniek v	1			1	n
Lias	1			1	y
LMPS	1			1	n
Mathematical Intellige	1			1	y
Nature, Cognition and	1			1	n
Nederlan	1			1	y
Nieuwe Verhandeling	1			1	n
Nieuwe Wiskrant				1	n
NTM – Internationale	1			1	n
Nuclear Physics A	1			1	y
Nuclear Pl	1			1	y
NVOX				1	n
Osiris	1			1	y
Perspectives on Science				1	y
Philosophica	1			1	n
Philosophical Quarterl	1			1	y
Physica	1			1	y
Physics World				1	y
Proceedin	1			1	n
Proceedin	1			1	n
Rendicont	1			1	n
Review of	1			1	n
Romantik	1			1	n
Rostocker Wissensch	1			1	n
Routledge Encyclopedia of Philos				1	n
Séminaire Poincaré				1	n
SCIAMVS				1	n
Science				1	y
Scientiarum Historia	1			1	n
School Science Review				1	n
Scoop				1	n
Sepentrio	1			1	n
Studia i m	1			1	n
Studia Logica				1	y
Studies in the History	1			1	y
Utrecht Re	1			1	n
Wijsgerig	1			1	n
Wissenschaftliche Zei	1			1	n