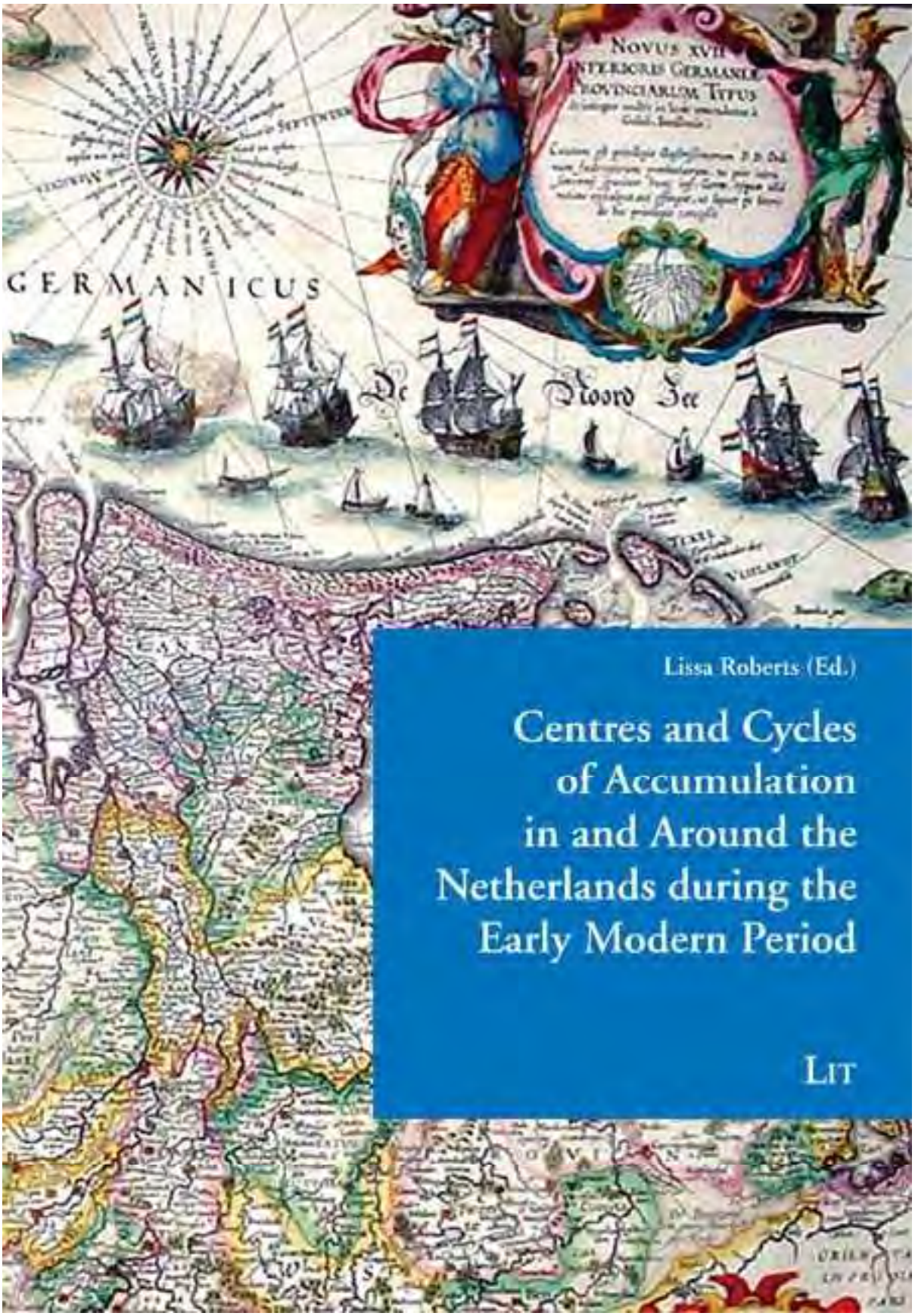

Lissa Roberts (Ed.)

Centres and Cycles of Accumulation in and Around the Netherlands during the Early Modern Period

LIT

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Low Countries Studies on the Circulation of Natural Knowledge

edited by

Sven Dupré and Geert Vanpaemel

volume 2

LIT

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Lissa Roberts

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The initial germ of this volume developed through a series of intriguingly fruitful conversations with Steven Vanden Broecke in preparation for a workshop we organized together on 'Centres of Accumulation' in November of 2008 in Gent. The workshop was fourth in a series on "the circulation of knowledge in early-modern science" which took place under the auspices of a grant from the Research Foundation – Flanders (FWO). Thanks to all the participants, the workshop was an intellectually invigorating experience. One thing it did not accomplish, however, was to provide an unequivocal and clearly bounded definition of our central concept 'accumulation'. Far from this being a bad thing, however, the questions raised by our discussions provided a field of inquiry within which to work inductively toward a meaningful and broad-ranging set of essays, held together by a shared geography, vocabulary and set of concerns

The beauty of proceeding in this way, it turned out, was that sharing geography and conceptual vocabulary did not lead to this volume's authors adhering to a rigid definition of either 'the Netherlands' or 'accumulation'. Instead, they have informed both this project's geographical and conceptual orientation with the insights of their own scholarly expertise. In some cases, this led to situating 'the Netherlands' in a confined space – a single museum or town, for example. In other cases, locating 'the Netherlands' required connecting it to the world writ large. The interpretive flexibility of the concept 'accumulation' proved just as rich, applicable to historical analyses of texts, instruments, exhibitions, ships, maps, knowledge and meanings.

The challenge for me was to channel this wealth of insight and detail into an introductory statement which linked what this volume's authors have to say about early modern Dutch history and the roles played by accumulation in it with reflections on accumulation as a multi-faceted vehicle for understanding the history of science and technology more generally. Conversations with my co-authors, with Augusti Nieto-Galan and other colleagues at the Centre for History of Science, Universitat Autonoma de Barcelona and, as always, Simon Schaffer have been

enormously helpful, for which I offer my thanks. For better or worse, the idiosyncrasies embodied in this volume's introduction are my own.

Lissa Roberts
March 2011

Centres and Cycles of Accumulation

Lissa Roberts

Why Accumulation?

The word 'accumulation' has rather humble beginnings. While its semi-synonym 'collection' is rooted in the important histories of Roman and Church tax collection, religious assembly and worship, accumulation originally meant no more than 'to heap up'. Why, then, dedicate an entire volume to it?

Despite its modest origins, something happened in the Low Countries and the world of which they were a part by the early-modern period that transformed accumulation into an object of interest, aspiration and investigation. International commerce had developed by the sixteenth century to the point that a single port, Antwerp in the Southern Netherlands, came to function as Europe's most important port of trade. And by the seventeenth century, Amsterdam had usurped this position. Tellingly, the Dutch term used to describe Antwerp's and, subsequently, Amsterdam's identity in this context is *stapelmarkt*. Basically defined as a place where goods are temporarily stored (*stapelen* literally means to pile or heap up) before being processed and sent on to customers, the term and the historical situations it describes simultaneously depended on the networks and activities that made such complexes of localized accumulation possible and the impact these centres of accumulation had on the local and global networks to which they were connected.[1]

Responses to Antwerp and Amsterdam's rise as key *stapelmarkten* manifested themselves in various ways throughout the early-modern period: as books and pamphlets, government policies, international competition, demographic movements, productive innovations and bellicose confrontations. By the eighteenth century, a small number of political economists sought to place the analysis of accumulation on a more general footing. While Josiah Child regarded the Dutch

[1] See among others Gelderblom, *Zuid-Nederlandse Kooplieden*; Lesger, *The Rise*.

talent for accumulation and its associated practices with envy in 1668, the Dutch-Anglo doctor Bernard Mandeville scandalized his readers fifty years later by generalizing the not-yet-virtuous cycle of self-interested accumulation and envy as the unintended motor of expansive material comfort and political liberty. Adam Smith found a much more receptive audience in the revolutionary year of 1776 – though, ironically, less so in the Netherlands, where increased competition from foreign centres had awakened the nation's critical conscience – for his formulaic promotion of accumulation as a necessary step in the process of productive economic growth.[2]

In the introduction to book two of *An Inquiry into the Nature and Causes of the Wealth of Nations*, Smith explained:

> As the accumulation of stock must, in the nature of things, be previous to the division of labour, so labour can be more and more subdivided in proportion as stock is previously more and more accumulated. The quantity of materials which the same number of people can work up, increases in a great proportion as labour comes to be more and more subdivided; and as the operations of each workman are gradually reduced to a great degree of simplicity, a variety of new machines come to be invented for facilitating and abridging those operations.[3]

A number of issues worthy of discussion appear in this excerpt, especially the question of whether accumulation is necessarily prior to the division of labour and whether the process Smith presented is indeed 'natural'. First, however, it is crucial to note that Smith indissolubly linked accumulation, which he positioned as both preceding and furthering productivity, with the historical developments he witnessed whereby increasingly technologically-mediated means were driving industrial production and the generation of wealth. For better or worse, accumulation could no longer be seen as historically innocent.

Among those who answered Smith's depiction of the relationship between accumulation and capitalist production was, of course, Karl Marx. In place of Smith's partially idealized story of origins in which accumulation naturally lays the ground for economic growth, Marx was keen to accentuate both the historically and geographically grounded character of these related processes. Accumulation, its conditions and consequences, according to Marx, need to be analyzed in their specific contexts of time and space in order for us to recognize the of-

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2 Child, *Brief Observations*; Mandeville, *The fable*; Smith, *An Inquiry*. On reception of Smith in the Netherlands, Kloek and Mijnhardt, *1800*, 301.

3 Smith, *An Inquiry,* book II, introduction.

ten global networks and cycles which have historically constituted production and distribution.[4]

Some readers might be wondering what this discussion of (capitalist) material accumulation and production has to do with 'the circulation of knowledge' – the general theme of the book series in which this volume is published. By now the case for the intimate connections between commerce and (natural) knowledge during the early modern period has been irrefutably made.[5] But, while trade remains a significant ingredient in the essays that follow, their shared subject takes us beyond this increasingly well-trodden path of historical analysis to examine a broader range of ways in which accumulation can be interpreted and understood to have been a constitutive part of inter-related cycles of material and knowledge production, distribution, consumption and use. To set the stage for a discussion of what this entails, we turn to Bruno Latour's recruitment of the concept of accumulation for his presentation of 'science in action'.

Latour speaks in quasi-Marxist terms of science as involving cycles of accumulation and capitalization. To see how this works, it pays to begin with his oft-quoted definition of knowledge:

> ... 'knowledge' is not something that could be described by itself or in opposition to 'ignorance' or to 'belief', but only by considering a whole cycle of accumulation: how to bring things back to a place for someone to see it for the first time so that others might be sent again to bring other things back. How to be familiar with things, people and events, which are *distant*.

As this quotation implies, the cycles of accumulation that Latour identifies as key to scientific development are not narrowly about the movement and accrual of knowledge in its own right. Rather, he draws our attention to a complex process which cannot be properly understood by distinguishing between commercial, political, technical, social and intellectual activity; (scientific) knowledge is only made possible, he argues, through the seamless and successful coordination of political, commercial, social, technical and natural activities and the centralized accumulation of things, people and events which this coordination affords.

Because it is not always possible or even desirable to hoard a growing mass of things, people and events in a single location, Latour continues, accumulation must be disciplined. In order to be effective, cycles of accumulation must entail processes of translation, both in the sense of movement across space and in the

4 Marx, *Das Kapital*.

5 Zilsel, "Sociological Roots"; Smith and Findlen, *Merchants*; Cook, *Matters*. See also the essays by Karel Davids, Alette Fleischer, Johan de Jong and Benjamin Schmidt in this volume.

sense of substituting one mode of (re-) presentation for another. To render objects of accumulation mobile and potentially profitable, in other words, requires that they also be somehow stabilized and made combinable. It is only then that accumulation can be put in the service of transforming a specific location into a centre which is capable of dominating the network(s) of which it is a part.

This refers, of course, to Latour's well-known discussion of 'immutable mobiles' and their role in reconfiguring centres of accumulation as centres of calculation.[6] While both his concept of 'immutable mobiles' and his larger quasi-historical explanation of science in action as revolving around the construction and maintenance of centres of calculation have been subjected to much praise, critique and modification, this volume grows out of a project which seeks to uncouple accumulation as a topic of interest to the history (as well as philosophy and sociology) of science from the teleological orientation of Latour's depiction. While a critical appreciation of Latour, as found in his *Science in Action* and associated essays, has certainly been helpful to this project (as testified by the number of conversations many of the authors conduct with his work in their essays), it should certainly not be seen as a Latourian one. The goal, rather, is to analyze accumulation's many facets as a way of helping to recover the complex cycles, local idiosyncrasies, mediations and appropriations through which the production, exchange, consumption and use of material goods and knowledge implicated each other during the early-modern period. While Latour depicts the inevitable victory of modern, calculating science – a story of centres and peripheries, we want to focus on the processes and geographies of accumulation as a way to recover moments of historical openness and contingency.

This means crossing a number of conventional boundaries, including those that are often taken to exist between the history of science and the history of technology, between political history and natural history, between labour history and intellectual history, and between economic history and cultural history. Hence, for example, Johan de Jong examines labour practices at the Dutch East Indies Company (VOC) shipyards in concert with an analysis of the historical role of diagrams in ship design. Rina Knoeff investigates the meaning of anatomical preparations from the perspective of recent literature in museum studies. Further, this project involves questioning the centrality of centres and the peripherality of places 'far away', the authority of authors and the proprieterity of owners, the stability of texts and images and the passivity of visitors and observers. A number of essays thus play with the question of geography. Arjen Dijkstra, for example, studies the

6 Latour, "Visualisation".

impact of the production and circulation of a small astronomy text in and around the unjustifiably neglected Frisian university of Franeker. Alette Fleischer moves our attention to the VOC colony at the Cape of Good Hope – a veritable centre on the periphery – where relations between indigenes and colonists hinged at least partly on their representations in maps and VOC documents. Benjamin Schmidt reveals the extent to which early-modern Europe's very notions of global geography, its centres and exotic peripheries, rested on Dutch publishers' productively manipulative accumulations. While this volume's essays are thus relatively circumscribed by the fact that they all treat subjects which are somehow related to the history of science in the Netherlands during the early-modern period, their cumulative reach draws together resources and challenges from a large number of fields. The historical characteristics and roles of accumulation are analytically set in contexts that range from Karel Davids's comparative overview of Spanish and Dutch networks of knowledge circulation to a number of more specific locations ranging from shipyards and printing houses to museums and exotic gardens. Though each essay tells a specific story, the overall goal is to draw readers' attention to the multi-faceted phenomenon of accumulation which, while at the core of virtually all productive activity during this crucial period of Dutch history, has not previously been subject to extended analysis.

An Anatomy of Accumulation

This volume is concerned with centres and cycles of accumulation. As such its essays offer both geographies of intensive concentration and of extensive travel. But what are we talking about when we speak of accumulation? What did the historical actors who inhabit these pages accumulate and what purposes did accumulation serve? To help answer this question, this section begins with a general definition and goes on to offer a brief example meant to illustrate the ways in which a focus on accumulation can shed light on the intimately related contents and contexts of the history of material and knowledge production and circulation in and around the Netherlands during the early-modern period.

This introduction began by drawing an etymological distinction between 'accumulation' and 'collection'. As already indicated, the former word has traditionally been discussed and analyzed by those interested in economics and political economy; of special interest here is the growing focus by economists and economic historians on the role played by the accumulation of knowledge in economic growth.[7] The second term, on the other hand, has attracted the interest of

[7] See the writings of Joseph Schumpeter for pioneering work on the central role of knowledge ac-

scholars with a more cultural bent. Along these lines, two developments have had particular impact on the study of history generally and the history of science particularly: first, a growing interest in collection as a cultural phenomenon of historical import, especially linked to issues of commodification; second, a growing recognition that natural history and the collection of *naturalia* and *artificialia* were central to the pursuit of knowledge and linked it indelibly with both local and global trade during the early-modern period.[8]

For our purposes it is worth noting that, unlike most economically oriented analyses of accumulation, studies of collection have moved easily to the micro-level of analysis and detail, allowing for an in-depth portrayal of local sites and case studies. But it is also true that collecting can be considered as an end in itself – the purpose of collecting might be no more than to amass and display (either privately or publicly) that which is collected. The archaeologist and authority on collecting, Susan M. Pearce, succinctly defines it as "the gathering together and setting aside of selected objects."[9] Accumulation, on the other hand, is historically understood as a step in a more extended process; accumulation stockpiles resources and goods for further productive use and exchange. As such, despite the crude implications of its etymological roots, accumulation can and should be analyzed as situated along a trajectory which involves planning, transformative application and processes of value ascription. By anatomizing historical cases of such situations, then, we might be able to go beyond the broadly structural statements about the role of capital and knowledge accumulation offered by growth analysts, on one hand, and what we have learned from both the fascinatingly detailed case studies of early-modern collections and the theoretical insights offered by scholars such as Krzysztof Pomian on the other.[10] As demonstrated by the essays in this volume, the results promise to open up to a rich understanding of the

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cumulation in spurring economic growth. More recently this has been taken up by practitioners of what is variously called 'innovation economics', 'new growth economics' and 'evolutionary economics'. See Warsh, *Knowledge*. Economic historians have applied this view especially to account for European economic growth during the so-called industrial revolution. See especially Mokyr, *Gifts*.

8 Elsner and Cardinal, eds., *Cultures*; Impey and MacGregor, eds., *Origins*; Findlen, *Possessing Nature*; Schiebinger and Swan, eds., *Colonial Botany*, which actually includes a section entitled "Technologies of Accumulation"; Jardine, Secord and Spary, eds., *Cultures*; Bergvelt and Kistemaker, eds., *De Wereld*.

9 Pearce, *On Collecting*, 3.

10 Pomian defines collection as "an institution which must satisfy the following criteria: a set of natural or artificial objects, kept temporarily or permanently out of the economic circuit, afforded special protection in enclosed places adapted specifically for that purpose and put on display." Pomian "The collection," 162.

complex cycles of production, exchange, consumption and use that constituted and crossed a variety of commercial, cultural and academic sectors. To give an initial flavour of what this entails, a brief example is given here.

Accumulation in an apothecary shop

Like much of early-modern Europe, the Netherlands was home to a large number of apothecary shops, some of which were more successful and impressive than others. A prime example of this last was the shop owned by Albertus Seba (1665-1736), famous as a collector and purveyor of *naturalia* and *curiosa*, especially because one of his most lucrative customers was Peter the Great and because of his *Thesaurus* which translated his collection into a beautifully illustrated series of volumes.[11] Seba's shop was located at 110 Haarlemmerdijk in Amsterdam and served as a centre for his activities as an apothecary, shop-keeper, large-scale wholesaler of medicinal ingredients and compounds, as well as master of some nineteen apprentices. Its situation near the harbour helped him establish profitable relations with sailors and surgeons, which in turn helped him successfully maintain both supply and demand in all aspects of his business. It is interesting to note, along these lines, that Seba's first business contacts with Russia involved supplying bulk quantities of pharmaceutical items to the Russian court and military and serving as middleman for the purchase of Dutch-made scientific instruments by the Czar's personal physician Robert Areskine.

To call Seba's or any other apothecary shop a centre of accumulation invites us to inventory what was accumulated there, organized here in three categories: the accumulation of equipment; the accumulation of material substances (medicinal ingredients, *naturalia* and *curiosa*) which were stored, processed, presented and represented for sale and various modes of consumption; the accumulation of labour and learning.

1. The accumulation of equipment

If contemporary figures from London are a reliable indication (and it can be argued that they are, at least for comparison with urban centres such as Amsterdam, Leiden and Haarlem), apothecary shop owners tended to invest heavily in shop fixtures and equipment – an average of 40% of the shops' value was tied up in the material items needed to produce, store and display apothecaries' wares. Part of this comes as no surprise. Apothecary shops (and their annexes) were generally

[11] Seba, *Locupletissimi*; Driessen-Van het Reve, *De Kunstkamera*.

sites of manufacture as well as sales, necessitating the presence of mortars, stills, ovens, alembics, balances and flasks of various sorts. But as retail outlets operating in a period marked by an increasingly stylized culture of consumption, apothecaries in these urban centres also tended to invest heavily – far more than most other retailers, it would seem – in technologies of display. The first things customers often saw when approaching such shops were enticingly laid out window displays which beckoned them to enter. Once inside they were often greeted by extensive rows of shelves covered with systematically arranged ceramic and glass containers, at once increasingly standardized in size and shape and elaborately decorated in ways that pleased the eye while identifying the content. Though the space was inevitably divided by a counter which kept customers from freely entering the storage and manufacturing areas, the wall and ceiling displays of exotic objects and curiosities which were often present, tended to keep their attention focused on the retail area.[12]

Much can be drawn from this description. While apothecaries depended on a vast array of different ingredients for the medicaments they sold, necessitating attention to storage, the solutions they often chose and the spatial context in which they chose to set them indicate that careful consideration was given to presentation – to creating an atmosphere that exuded stability and attractiveness. Unlike counterparts who hawked their wares in the open market, the message of shops like Seba's was that customers were welcome and safe – such apothecaries could be trusted, in other words, while their clientele showed both good judgment and a sense of fashion by frequenting them. The targeted accumulation of material equipment was thus necessary both for furthering production and commerce, linking apothecaries simultaneously to suppliers of material equipment, knowledge of natural history, chemical practices and the evolving culture of consumption.

2. The accumulation of material substances

Medicaments were not the only thing for sale in apothecary shops. Other goods ranging from exotic substances and specimens to hair pomades and comestibles such as confectionary treats and liquors could also be purchased.[13] While each of these sorts of commodities implicated their own trajectories of accumulation, what follows is a focus on what might be called an apothecary's 'core business'. It can be said that early modern apothecaries dealt in three general categories of

[12] Wallis, "Consumption"; contrast with Jim Bennett's description of visits to instrument makers' shops in his essay, "Shopping."

[13] Matthee, "Exotic substances."

medicaments and pharmaceutical substances: natural simples, natural compounds and chemically produced substances – the last spurred largely by the impact of Paracelsianism. As stated, this translated into the necessity of obtaining and storing large numbers of ingredients, some domestically available – grown, perhaps in an apothecary's own garden, many others of which had to be imported from faraway, exotic sounding locales. Accumulation thus linked apothecaries to global networks of exchange in which foreign encounters had somehow to be translated into conduits for the flow of desired goods and associated knowledge, as well as occasions for the ascription of (potential) value. Value was then further added at the centre of accumulation through the skilled manipulation and chemical transformation of substances, which leads us to the third category of accumulation. (The ways in which the spectacle of apothecary shop display added yet further value to these substances as desirable commodities should, of course, also be recalled here.)

Apothecary shops couldn't run themselves. Rather, proprietor-apothecaries such as Seba were dependent on the accumulation of labour for their success. The contours this took were at least partially shaped by the evolving guild traditions and government regulations which did much to organize the availability, education and mobility of pharmaceutical practitioners and associated labour.[14] In addition to being a site for the accumulation of labour, then, an apothecary shop was also a site for the accumulation of learning – that is, the concentration of education through apprenticeship, experience and reflective study. It is therefore interesting to consider what this owed and added to the relations between early-modern pharmacy and the more learned, academic world of chemistry. For, as historians such as Ursula Klein have taught us, chemistry's realms of commercial practice and natural philosophical reflection increasingly overlapped as the eighteenth century progressed, which had an important impact on the production of chemical knowledge and the formation of chemistry as a discipline, but which has also been obscured by a cultural and historical prejudice that defines science as a body of (theoretical) knowledge rather than as an activity of which knowledge is only one ingredient and product.[15]

Before turning to the question of learning, however, the local geography of labour needs to be sketched. Apothecary shops, often housed in the same build-

[14] There is no general historical study of Dutch apothecaries, perhaps partly because of the highly localized nature of oversight and organization. For an exemplary study, see Bosman-Jelgersma, *Vijf Eeuwen*. For a classic study which surveys developments in a number of European countries (though not the Netherlands), see Kremers and Urdang, *History*.

[15] Klein, "Apothecary Shops"; Klein and Spary, eds., *Materials*.

ing as an apothecary's domicile, were actively populated by the apothecary and his family – that is, his wife and children, as well as by servants (*knechten*) and apprentices. Each played their own role in a context that made no absolute distinctions between the domestic, manufacturing and commercial realms either in terms of architecture or interpersonal relations. Spouses and children were often engaged in many aspects of the business, while apprentices and servants generally lived as well as worked in the same location, often sitting at table with the family.

Unlike the Marxian image of industrial labour as a mechanical function and alienated commodity, the accumulation of labour in and around an early-modern apothecary shop entailed a process of accumulating a spatially and temporally distributed body of knowledge and skill, which was at least partially recognized and rewarded. This can be seen most clearly by examining the institution of apprenticeship. The details of apprenticeship were not regulated on a national scale in the Netherlands before the end of the eighteenth century; neither did guilds seem to play a major role. Instead, individual urban communities governed the process in their own way, often in relation to the establishment of institutions such as a *Collegium Medico-Pharmeuticum* and the publication of an official *pharmacopoeia*.[16] Even within this context, the form that apprenticeships took varied from shop to shop. At one end of the spectrum were cases in which apprentices were hardly distinguishable from servants in terms of the menial tasks they had to perform and the paucity of training they received. In other cases, especially when facilities were available for the production of chemical compounds, apprentices learned by doing – having to read and follow recipes, man the bellows, test the quality of ingredients and outcomes by engaging their senses and so forth. Another layer was added when books and/or willing masters, shop administrators and senior journeymen were available for consultation and discussion.

[16] Davids, "Apprenticeship". Unlike most of Europe, apothecary apprenticeship was regulated during the eighteenth century (in an elementary way) in Prussia by government edicts which stipulated that apprentice-candidates be boys aged 14-15 who had already completed primary school and knew a modicum of Latin. The unguided preparation of medicines for sale was prohibited before apprentices completed their fourth year of apprenticeship, which lasted five to six years, followed by six to eight years as a journeyman. See Klein, "Apothecary-Chemists", 99-100. In Amsterdam, there are well-known cases of apothecaries never having served formal apprenticeships, which did not preclude a successful career. Caspar Georg Carl Reinwardt (1773-1854), who went on to become professor of natural philosophy at the University of Leiden and a highly placed government servant, was one such example. It was also possible to go abroad to serve an apprenticeship (or in Reinwardt's case, to develop a career without formally going through the stage), which would make someone subject to the regulations which governed apprenticeships there. Consequently, drawing such national or regional comparisons should not be seen as mapping directly on to national histories of pharmacy.

Some apothecaries claimed that they learned virtually nothing from their years as an apprentice other than what they taught themselves, though it would be hard to deny the educative impact of practical experience, no matter how mute the accompanying commentary. Others were more fortunate, as this anonymous report from a provincial Prussian apprentice in the 1760s indicates:

> I was not so unlucky to get apprenticed by a man who was totally ignorant and lacked education, as so many are; rather my master, who lived in a mid-sized country town but had become acquainted with no apothecary's shop other than the one in which he was apprenticed and his own, loved the sciences, read a lot, and possessed a nice little library; at least he owned the newest chemical writings, inasmuch as chemistry was advanced at this time. He possessed several very good physical instruments, a small, but for the time very instructive collection of minerals and an impressive collection of stuffed birds... He prepared... several things in a genuine way following good chemical principles... In addition his wife was present in the house, caring for the discipline of the pupils. An older pupil who had almost finished his apprenticeship and myself did the work in the officine by ourselves, but the wife was always there keeping house and urging us to work hard... The older pupil was the dispenser and did the few tasks in the laboratory, where the master was also present. He [the older apprentice] knew exactly how to get rid of the hard and unpleasant work, so that I had to do all the work that a maid or servant should have done. To this belonged in particular the cleaning of vessels... After three years, when the older pupil had finished his apprenticeship, he left, and I replaced him as a dispenser. I knew little about the work in the laboratory, as I never had the opportunity to learn it, but fortunately there was a book of recipes for the preparation of the usual goods so that I learned quickly. Now I also began to learn the scientific part of our art by reading Gottlieb's *The newly founded Apothecary school* (1701), Helwig's *Apothecary treasures* (1709) and Kräutermann's *The well trained Apothecary or Instructions on the Apothecary's art* (1730), which were kept in the apothecary's shop for the older pupils along with the dispensatories of Württemberg and of Brandenburg.[17]

Two particular points in this rich description are worth special attention. First is what it reveals about the distribution of learning, both in terms of who and what embodied the source and process and in terms of where that learning took place: domestic and shop discipline taught by the apothecary's wife, hierarchical privilege and drudgery taught in the shop and at the sink by an older apprentice, laboratory skills and experientially-based knowledge taught in the laboratory by

[17] Klein, "Apothecary-Chemists," 104. Unfortunately, similarly rich testimony from a Dutch apothecary has not yet come to light, but the points made in this quotation are generally applicable. See, however, the autobiographical material left by the apothecaries Conrad Rutger Busken (Nederlands Letterkundig Museum and Municipal Archive Vlissingen) and Harmen Thieden Ament (Haga, ed., "Herinneringen").

the master, pharmaceutical and more theoretical knowledge drawn from books either in the library or shop. Second, and closely associated with this double distribution is the variety of what was learned: some referred to in the literature as 'tacit knowledge', some associated with the education of the senses, some social and commercial, some technical, some informational and some which can be described as theoretical or natural philosophical knowledge.[18] How are we to understand this ensemble? Is it right to refer to it all as 'knowledge' or does this label obscure as much as it reveals?

Another way to pose these questions is to ask whether we should speak of accumulation in terms of processes or products (as accumulated knowledge, goods, substances, etc)? While the essays which follow help to make clear that the answer is both, that processes and products of accumulation are historically inseparable, currently popular phrases such as 'the circulation of knowledge' indicate how easy it is to privilege the latter – to focus on knowledge and its material embodiments as if they possess a kind of agency that is independent of the processes which give them form and substance and which afford their circulation and use. In fact, this isn't only a historiographical issue. In the increasingly secular and commercialized culture which had its birth in early-modern Europe, manufactured objects such as maps and chronometers, or substances such as magnesia alba and laudanum came to be valued as factually-based commodities with the power to organize space and time or protect humans from the disease-bearing onslaughts of nature. As such, attention and value were and are too often given to them and the knowledge they helped to produce and transport rather than the labour, social relations and negotiations which have made and sustained them. But this is precisely what histories of accumulation can help us do: highlight the work, the negotiations and social relationships – be they manifested in political, cultural or economic terms – which have given form and sustenance to the world we too often take to be organized by knowledge and its factual or fact-producing embodiments.

Accumulation and 'Useful Knowledge'

This approach has particular consequences for discussions of the claim that 'useful knowledge' was the prime motivator of innovation and economic growth leading

[18] On tacit knowledge, see Polanyi, *Tacit*; Collins, "Tacit". On the education of the senses in chemistry, see Roberts, "Death". Pamela H. Smith speaks of artisanal epistemology. See Smith, *The Body*.

up to and including the so-called industrial revolution.[19] By examining the globally networked, local accumulation of people, things and practices which might be said to have constructed, embodied or employed the kind of knowledge and know-how that either spurred or resulted from innovation, at least two fundamental questions arise.

Historiographically, we need to ask what kind of history we are led to write by ordering the past in terms of knowledge that can be labelled as 'useful' according to this definition? On one hand, it can have the liberating effect of freeing us from the question of whether particular knowledge claims were true by current standards. From this radically Baconian perspective, what counts is that their embodiment or application somehow had productive effect; "Human knowledge and human power meet in one... that which in contemplation is as the cause is in operation as the rule."[20] On the other hand, it risks distorting our vision of the fabric of the past by privileging (groups of) individuals, institutions and inventions which retrospectively seem most directly associated with either (affording) the production or application of 'useful knowledge'.[21] This view from the present is not only subject to a preoccupation with history's heroes, whose long shadows all too often obscure the activity of countless other participants in the historical market of scientific and technological development. It is sure also to be shaped by methodological convictions regarding the socio-geographical order and distribution of knowledge production. And while few serious historians are any longer willing to voice their allegiance to what has been called the 'linear model' in which science prescribes and technology applies, there remains the tendency to begin with an explanatory grid that distinguishes between the institutions of natural philosophy and their members on one side and the world of material production on the other and then to seek the ways in which these realms interacted. But this is not necessarily how history in fact proceeded.[22]

The second question calls on us to consider the consequences of taking the substantiality of what is usually called 'embodied knowledge' seriously. This point is perhaps best introduced by returning to the economist Simon Kuznets, whose discussion of 'useful knowledge' is often claimed as the direct inspiration

[19] The most programmatic statement to this effect has been made by Mokyr, *Gift*. See also the comparative research programme organized by economic historian Patrick O'Brien, "Useful".

[20] Bacon, *New Organon*, aphorism 1. See Mokyr, *Gifts*, p. 6.

[21] For the Netherlands, see Jacob, *Scientific Culture*, esp. 141-154.

[22] On the linear model, see Edgerton, "Linear Model". For the claimed split between natural philosophy and material production in history, see Roberts et al, *Mindful Hand*.

for the more recent interest shown by economic historians and others in the term.[23] In his words,

> The key feature of an innovation is that it is *new* – and thus a peculiar combination of new *knowledge* sufficiently useful and promising to warrant the attempt to apply it; and of *ignorance* of the full range of possibilities and improvements that can be learned only in extended application.[24]

It is, obviously, a body's substantiality which allows for the embodiment of knowledge and know-how. But it is that same quality which both allows for its mobility and which renders a body's meaning and use polyvalent – to use the term introduced by Rina Knoeff in her essay here – across time and space. Embodiment thus provides a physical bridge between knowledgeable production and (productive) use which simultaneously opens it up to a myriad of local appropriations while limiting appropriation through the body's specificities.[25]

Both the construction process and varied use of VOC ships as they sailed to and from between Asia and the Netherlands, as discussed here by Johan de Jong, illustrate this point, as might any number of other material objects. It might be most useful, however, to focus for a moment on books, such as those which feature in the essays by Arjen Dijkstra, Benjamin Schmidt and Ernst Hamm. Despite the work of historians such as Rogier Chartier, Robert Darnton and Adrian Johns, books too often continue to be examined as no more than transparent vehicles for knowledge.[26] But a book can be mobilized, modified and multiplied with relative ease. Its combined mobility and mutability, that is to say, functions across time and space, potentially allowing for a long and dynamic career. In a culture, however, that privileges 'the author' as hero and proprietor of a book's content – think here both of the traditions of intellectual history and of the term 'intellectual property' – it is not surprising that our attention was long turned to the author's 'intention' and away from the material characteristics of a book, as well as from the consti-

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[23] Mokyr, *Gifts*, p. 2.

[24] Kuznets, *Economic Development*, 10.

[25] By referring to a body's 'substantiality' rather than its materiality, I mean also to take into account human embodiment which involves more than physical presence. When examining the role played by human migration in the circulation of knowledge and know-how, one needs also to consider what we might call socio-cultural embodiment; that is, the interests, expectations, mores, communication skills and so forth possessed by migrants which affect their performance as 'diffusers' of knowledge and know-how. On the various uses and implications of the term 'embodied knowledge', see Roberts, "Interrogating".

[26] See for example, Chartier, *L'ordre*; Cavallo and Chartier, eds., *Histoire*; Darnton, *Business*; Darnton, "What is"; Johns, *Nature*.

tutively productive role played, for example, by illustrators, printers, publishers, book sellers and readers in determining a book's impact and meaning.

Accumulation is thus only a first step. Though often difficult to achieve, the authoritative management and control over material embodiments, their movements and modifications are of crucial importance. This point is most poignantly made here by Alette Fleischer whose essay traces the saga of how South African aborigines lost control over their resources, traditions and outward identities. Unaccustomed to European modes of accumulation, valuation and management techniques which allowed the VOC to gain authority over long distances through the circulation of tools that included maps and chronicles as well as guns and trinkets, the Khoikhoi peoples came to lead increasingly precarious and dependent lives in what had once been their own land. On the other hand, as Benjamin Schmidt argues, the successful management of embodied knowledge and its circulation need not translate into practical hegemony. Dutch printers controlled the international market for atlases, geographic and ethnographic works during much of the early-modern period, as Dutch control over the territories and resources their works described declined.[27]

In sum, examining the historical processes and consequences of accumulation seem to present us with an interesting methodological irony. Marx, arguably the greatest analyst of accumulation cycles, placed them in a context of historical determinism.

> Accumulate, accumulate! . . . what avails lamentation in the face of historical necessity? If to classical economy, the proletarian is but a machine for the production of surplus value; on the other hand, the capitalist is in its eyes only a machine for the conversion of this surplus-value into additional capital.[28]

One might take current proponents of the historical role of 'useful knowledge' to be at risk of making an, albeit softer-core, claim of historical determinism – expressed in terms of Europe (especially Great Britain) having industrialized and having achieved global dominance because it most successfully accumulated and

[27] See also Schmidt, "Inventing,": Schmidt, "Mapping".

[28] Marx, *Capital*, chap. 24, section 3. Some have contrasted Marx and Latour on this point by characterizing Marxist historical analysis as beginning with definitions and structures which determine historical development, and Latour as arguing that supposed structures and categories themselves are what need to be seen as emergent outcomes of practices and exchanges at local levels and across / within dynamic networks. See http://webcache.googleusercontent.com/search?q=cache:vw-mTYzje8AJ:www.shaviro.com/Blog/%3Fp%3D782+accumulation+latour&cd=8&hl=nl&ct=clnk&gl=nl. Accessed 13 February 2011.

applied useful knowledge.[29] By taking various forms and consequences of embodiment seriously and using them to subject accumulation to a kind of critical anatomy, however, the essays in this volume help instead to reveal its historical openness. Locally situated, globally networked accumulation is thus presented as an invitation – sometimes vague and malleable, sometimes carefully articulated and formatively potent – for further valuation, processing, translation, use and appropriation, the outcome of which was not pre-ordained.

Why the Netherlands?

William Temple, English ambassador to The Hague, seems to have been speaking for many visitors (virtual and actual) to the United Provinces, when he described the country in these terms:

> 'Tis evident to those who have read the most, and travell'd farthest, that no country can be found either in this present age, or upon record of any story, where so vast a trade has been manag'd, as in the narrow compass of the four maritime provinces of this commonwealth: Nay, it is generally esteem'd that they have more shipping belongs to them, than there does to all the rest of Europe. Yet they have no native commodities toward the building, or rigging of the smallest vessel, their flax, hemp, pitch, wood, and iron, coming all from abroad, as wool does for cloathing their men, and corn for feeding them... Nor has Holland grown rich by any native commodities, but by force of industry; by improvement and manufacture of all foreign growths; by being the general magazine of Europe, and furnishing all parts with whatever the market wants or invites.[30]

The Dutch were, in other words, masters of accumulation, which they successfully harnessed during their Golden Age to both internal consumption and global trade.

It wasn't always clear which was the cart and which the horse in the relationship between accumulation and trade. We can return to the example of Albertus Seba's apothecary business, which both depended on international trade for its supplies and thrived on the profits made in a number of foreign markets. The point is also elaborated by De Jong's essay in which he traces the circular patterns connecting VOC shipbuilding practices (dependent as they were on the accumulation of capital, supplies and know-how) with international trade (which was simultaneously dependent on ships and the source of both the supplies and profits that

[29] This is the essence of Joel Mokyr's argument, made most forcefully in debate with historians such as Kenneth Pomeranz, who attributes the 'great divergence' between China and Great Britain to the possession of coal and colonies. Pomeranz, *Great Divergence*, 3-24.

[30] Temple, *Observations*, 209-210.

enabled their construction). Partly because such cycles made it virtually impossible to distinguish between cause and effect, concerns about decline as the eighteenth century wore on pointed to various reasons for the Netherlands' perceived fall from grace and offered a variety of solutions. But the most prominent and sustained voices tended to recognize an indelible connection between Dutch society's material, cultural and intellectual circumstances. For at their height, the Dutch had experienced not only storehouses overflowing with imported substances, many of which underwent knowledgeably informed, transformative processes before being sent back out into the world, but also foreign students scrambling to fill their universities and foreign authors eager to have their words (and images) published by Dutch presses. The Netherlands, that is to say, also served as Europe's cultural and intellectual entrepôt for a time. As described by Pete Langman's essay on what we might call Francis Bacon's philosophy of accumulation, the Netherlands – even without the wise coordination of a centralized government or institutionalized 'House of Salomon' – might have temporarily been seen by some as a kind of 'New Atlantis'.

Much of this is, of course, already known – certainly in its broad outlines. But by reconsidering this history through the lens of accumulation, the essays which follow can help us grapple with the ways in which accumulation, its causes and consequences provided productive intersections for the recognized realms of material, cultural and intellectual activity in the Netherlands. So too do they affirm a historical geography and cultural history of the early-modern period in which the Dutch occupied the world and the world (pre-) occupied the Netherlands. Finally, they caution us against viewing the Netherlands as a homogeneous entity; we are reminded of the kinds of regional, sectoral, social and cultural differences which both added to and challenged the dynamism which characterized the United Provinces.

This Volume as a Centre of Accumulation

The essays that follow are bound together by their joint interrogation of Dutch centres and cycles of accumulation in the early-modern period. While this introduction is intended to enunciate the value and significance of their accumulated wisdom, each essay has a story of its own to tell which merits consideration as well. Karel Davids sets the stage for the volume's other essays by offering a comparative analysis of what he terms the 'global networks of knowledge' which had their respective hubs in Spain and the Dutch Republic during the early modern period. By examining the ways in which these two centres and the various par-

ties associated with them sought to manage both the accumulation and exchange of knowledge in local sites around the globe and the long-distance translation of knowledge within the networks connecting these sites, Davids considers how these two networks ought to be characterized. Is it true that the Spanish network was dominated – for better or worse – by the dictates of a centralized royal government, its attendant institutions and colonial representatives, while the Dutch network was essentially driven by commerce and commercial values?

By stressing the various challenges which both local interests and long-distance transmission placed on the various forms of management exerted by metropolitan governments, religious orders and trading companies, Davids answers this question with a more nuanced historical presentation of these networks and the relations between them. Of special interest is the increasingly important role played by Spanish colonial groups and institutions in directing the production and circulation of knowledge during the early-modern period, in contrast to the paucity of a counterpart development in overseas outposts which were governed by the VOC. Despite the presence of enterprising merchants and settlers as well as of colonially managed initiatives in the Spanish world, however, Davids concludes that the Spanish network must indeed be seen as dominated by the 'visible hand' which reached out from Seville. Regarding the Dutch, he suggests that their network was subject to a kind of *de facto* centralization, precisely because matters of global exchange were left to such a large extent in the hands of trading companies; Davids speaks here of a combination of 'visible' and 'invisible' hands.

Moving from a comparison between Iberian and Dutch networks to a focus on the paths of circulation that linked the Dutch and the English, Pete Langman begins his essay by presenting Francis Bacon's *New Atlantis* as a manifesto for the managed accumulation, processing and application of knowledge. Rather than content himself with analysing the central role of accumulation in Bacon's work from a strictly philosophical perspective, though, Langman follows its textual afterlife as well – for a very good reason. Recognizing that his call for the establishment of Salomon's House on English shores would not be heeded by his erstwhile royal patron, Bacon had the fictive ruler of his utopian island proclaim publishing as an alternative vehicle for the encouragement of natural historical accumulation, experimentation and application "for the good of other nations."[31] But early-modern publishing was itself a hybrid activity which relied on the ac-

[31] *New Atlantis* as found in Bacon, *Sylva sylvarum*, g2^{r} (*SEH*, III, 166). See Bacon, *New Atlantis*, 55.

cumulation of a variety of material, social, intellectual and practical resources. And given that both Bacon's former chaplain, secretary and amanuensis William Rawley and the Dutch scholar Isaac Gruter endeavoured to establish a new centre through which Bacon's words would be processed, bound and distributed, the route through which Bacon's programme might be propagated remained an open question in the years following his death. The ultimate solution grew out of the competition and periodic cooperation between these two men, which meant that the path along which Bacon's philosophy made its way into the world as a hybrid product of intellectual, social and material accumulation passed through the Dutch Republic with important implications for its subsequent career.

Publication and textual circulation also play an important role in Arjen Dijkstra's essay, in which he seeks to account for how Johannes Phocylides Holwarda, a young scholar at the University of Franeker in the northern Netherlands, was able to establish a European-wide reputation as a philosophical astronomer following his 'discovery' of a new star in 1638. Dijkstra portrays Franeker (the university and surrounding community) as a centre of accumulation which provided both a context for Holwarda's successes and the means to achieve them. The political and intellectual ambitions, scholarly community, mathematical instruments and publishing capabilities gathered there linked Franeker to a hybrid network of supportive possibilities, ranging from the court of the Frisian Stadtholder to Tycho Brahe's astronomical empire centred in Hven. Simultaneously they offered a rich setting whose resources Holwarda used to forge a successful career. In order to demonstrate his worth, however, Holwarda had both to find a way to manage local resources and to send carefully crafted news of his discovery and its meaning travelling along the paths which linked Franeker to other centres of astronomical activity. By following the trajectory traced by Holwarda's "wonderful little book," Dijkstra reconstructs the route which led to Holwarda's success. Along the way, he draws on the insights of book historians such as Adrian Johns to remind us of the challenges that attended reliance on texts for the circulation of claims, given the destabilizing impact of interpretation and use to which they were (and remain) subject.[32]

A number of historians have considered the role played by the Dutch East Indies Company (VOC) in furthering the production and circulation of natural knowledge. The usual approach is to consider the activities undertaken by individual governors or employees of the company in their spare time, with the company acting as '*een onwillige mecenas*' (a reluctant patron) in the words of Klaas

[32] Johns, *Nature*, 6-20.

van Berkel, or providing the commercial space within which exchanges with foreign contacts afforded the circulation of natural facts.[33] Alette Fleischer chooses a different approach with which to frame her examination of accumulation at the Company's garden at the Cape of Good Hope – the primary source of sustenance for ships travelling between Europe and Asia – during the second half of the seventeenth century. Beginning with the view that the production of natural knowledge and the VOC's commercial interests actually depended on each other, she interrogates the historical process whereby company representatives transformed the Cape into a centre of accumulation which served the interdependent material and knowledge interests of the Company. Fleischer enlists a number of concepts to help her make sense of this process. Her first move involves extending the notion of cultivation from its obvious application to the Company's garden to the Cape as a whole. She shows, that is, how VOC representatives claimed the Cape's land as ripe for settlement and cultivation by ignoring indigenous practices of nomadic occupation in favour of European definitions of land tenure and use. The realization of this transformative claim required the coordination of local negotiations and long-distance exchanges with centres of commerce and calculation in the Dutch Republic. Fleischer describes the first as involving the activities of go-betweens who served as intermediaries between VOC representatives and indigenous peoples in a space which, based on the work of historian Richard White, she terms a 'middle ground'.[34] To make sense of the circulations which linked the Cape with the Netherlands, she turns to Bruno Latour's depiction of the construction and use of immutable mobiles and recounts how locally gathered information was shipped to the Netherlands where it was transformed into maps, charts and natural history texts which returned to further the Cape's transformation from its indigenous existence to a cultivated garden whose fruits could be harvested for the VOC's further profit.

Commerce and knowledge of the world could certainly be linked in other ways and for other purposes, as demonstrated by Benjamin Schmidt, both here and in a number of other publications.[35] For the very processes of constructing 'the global' as an early-modern field of knowledge and distributing its products were commercially dominated by the Dutch through at least the 1730s. This realization invites an inquiry into the ways in which material and knowledge resources were accumulated in Dutch printing ateliers as a crucial element in the cycles that linked local exchanges between Europeans and their non-European counterparts in var-

[33] Berkel, "Maecenas"; Cook, *Matters*.

[34] White, *Middle Ground*. For go-betweens, see Schaffer *et al*, *Brokered World*.

[35] See footnote 27.

ious corners of the world (as described here by Fleischer) with a growing European market of consumers who purchased the exoticized representations of these encounters and the 'knowledge' to which they gave rise. Dutch printers such as Pieter van der Aa masterfully managed this accumulation, directing it and shaping its textual and iconographical products through a complex process which Schmidt quite deliberately calls 'compilation'. With an etymology as old as that of 'accumulation', compilation stems from the latin *compilare*, to plunder or pillage. And this, as Schmidt relates, is precisely what took place in and around Dutch (and other) ateliers. Words and images were freely 'borrowed' from other works, leading to the canonization of certain geographical and ethnographic representations of the world. Schmidt makes a compelling case for the need to recover these mediating practices, despite their elusiveness, if we want to assess the early modern sources of geographic and ethnographic knowledge.

Though his primary focus is on the mediatively constructive practices of Dutch printing ateliers, Schmidt echoes Dijkstra's view that we need also to attend to the instability of textual meaning, dependent as it is on the interpretations and appropriations of users. Rina Knoeff makes it her goal to highlight the interpretive work of users along with the mediative nature of embodiment more generally in her essay by developing what she calls the 'polyvalence' of objects.[36] Knoeff situates her analyis historically in an investigation of anatomical exhibits which were accumulated in a variety of Leiden sites during the late seventeenth and early eighteenth century. Internationally known for its university, Leiden was also an important tourist destination at this time – especially for those in search of cultural gratification. In keeping with this inseparably double identity as an intellectual and cultural centre, the objects displayed in various sites were simultaneously used and interpreted in various ways. While anatomical exhibits might thus have been enlisted to serve a scientifically pedagogical purpose, their significance and use refused to be bound by such ends. Instead, they were invariably accompanied by and interwoven with a parallel accumulation of narratives – some of which were enunciated by tour guides who sought to manage the 'visitability' of the collections under their charge, some of which were explicitly depicted by the objects themselves and others of which were introduced by visitors who entered these sites of accumulation with their own storehouse of cultural associations and information.[37] Because anatomical knowledge was, in Knoeff's words "a complex phenomenon that linked physical or material attributes to a broader

[36] For the role of users in relation to technology, see Oudshoorn and Pinch, eds., *Users*.
[37] For the concept of 'visitability' see Dicks, *Culture*.

cultural (moral, aesthetic, geographical, exotic) context... the visitor's view and with it the irreducible polyvalence of exhibits must take centre stage in any study of early modern (anatomical) collections."[38]

Discussions of circulation generally distinguish between local sites and the routes of translation that connected them. Johan de Jong problematizes this distinction by considering VOC shipbuilding practices and its shipping operations as a complex web of accumulation. Unlike the English East Indies Company, the VOC built the majority of its own ships and did so at its own shipyards. What made this possible was a carefully managed accumulation of supplies, equipment, standardized parts, labour, knowledge and know-how, brought from both far and near. If the drawings and models which guided the shipbuilding process might be seen as examples of Latourian immutable mobiles, De Jong describes the ships themselves as mutable mobiles. Once they were built according to well-orchestrated specifications and practices, they were sent out as floating centres of accumulation in their own right, laden with ballast, commodities for trade and manpower *en route* to the VOC's Asian factories. On their return trip, however, they manifested a rather different character, in keeping with their rather different inventory of accumulation and the different sea routes they traversed. Now the human load was at a minimum, partly because of the insalubrity of VOC service in Asia and partly to make room for a maximum of commodities brought back to grease further cycles of accumulation and trade by which the VOC and its shareholders profited.

De Jong is keen to demonstrate the hybrid character of both VOC shipyards and ships as centres of accumulation. This is a rather straightforward issue for the yards, where shipbuilding was directed by a knowledgeably skilful amalgam of human and non-human actors such as diagrams, models and moulds. De Jong portrays VOC ships, however, as doubly hybrid, both as designed embodiments of the collaboration among human and non-human actors and in terms of the hybrid activities in which the ships engaged. At one and the same time, they and their crews negotiated with nature, as they made their way across often forbidding seas, and served the commercial interests of their owners. These ships were neither brute objects nor social constructions, then. Rather they embodied inseparable webs of physical and social attributes, making them examples of what Latour calls 'quasi-objects'.[39]

The Dutch Republic was and is often praised for having been a land of toleration, which led it also to serve as a site for the accumulation of various minority

[38] Knoeff, "The visitors view,"p. 156
[39] Latour, *Never*, 55.

communities and immigrant groups. Toleration, however, needs to be appreciated as a relative term which, in fact, was not universally extended to all in the same manner. Hence, Dutch Mennonites, the focus of Ernst Hamm's essay, found themselves shut out of certain cultural activities and barred from holding public office before the 1790s. A number nonetheless managed to flourish as manufacturers and traders, as well as contributors to Dutch cultural and intellectual life. The most famous example is no doubt Pieter Teyler van der Hulst, who grew rich from manufacturing silk, trade and banking, and who used his fortune to fund a museum, two societies and a number of charities.[40]

Teylers Museum stands today as a tribute to Mennonite-sponsored accumulation, especially interesting because of its collection's emphasis on scientific instruments, models and natural historical specimens. But even before Teyler endowed the institution which bears his name, an accumulation of instruments was sponsored by members of the Mennonite community. Hamm seeks to understand why this physics cabinet – one of the largest instrument collections in the Netherlands during the eighteenth century – was placed in the service of educating Mennonite seminarians. What did it have to do with training them to serve a religious community? And why were its contents sold off in the early nineteenth century without being replaced? To help make sense of his answers, Hamm contrasts this story of temporary accumulation and use with that of a longer-standing and still existent Mennonite accumulation – the textually bound history of martyrs, entitled *The Martyrs' Mirror*. Together they have much to tell us, not only about the accumulation practices of a culturally engaged religious minority in the Netherlands, but also about the moral concerns that Mennonites and other Dutch had about accumulation in general.

Volumes such as this often end with a reflective epilogue written by a senior member of the field. Rather than follow this pattern, the final essay of this volume, by historian and museum curator Tim Huisman, leads us from an analysis of the past through to a discussion of the future. It does so by examining the layered accumulation of display modes and meanings attached to the instruments which form the core of the collection held by Leiden's history of science museum, Museum Boerhaave. Starting with their origins in the physics cabinet used by Leiden professors such as Willem Jacob's Gravesande, Huisman describes the changing purposes they were made to serve, especially as twentieth-century conservators projectively transformed them from neglected, left-over tools into valuable relics of a brilliant national past. For most of the twentieth century, this past was charac-

[40] Evers, ed., *De Idealen*.

terised narrowly as one inhabited by great scientists and skilful instrument makers. Only recently have curators sought to present the museum's instruments as cultural artefacts, whereby instrument-making and use are placed in a broader setting of cultural significance.

For most of the museum's history, the accumulating layers of meaning attached to its instruments were attributed by its conservators and curators. Whatever their visions and goals, however, each new attribute was not fully able to shut out the past. Just as with the anatomical exhibits discussed by Knoeff, Museum Boerhaave's instruments are multivalent, able to bear more than one meaning and purpose at the same time. And with the advent of a new generation of museum curators, new interactive technologies and changing expectations by the visiting public, they stand to become even more so as visitors increasingly engage with curators and exhibited objects to construct new layers of accumulated experience and meaning. If, as has been argued in this introduction, examining the centres and cycles of accumulation opens up into a richly complex and un-preordained history, so too is the future of museums open in keeping with the dynamic web of actors, culture and technologies with which their accumulated artefacts will interact. As 'houses of history' institutions such as Museum Boerhaave are bound to be sites in which the accumulated objects of historical interest and inquiry take on layers of significance that reflect the visions, desires and capabilities of the surrounding culture.

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Visitors to the Netherlands throughout the early-modern period remarked extensively on its visible wealth, which was so clearly borne of global trade. In an attempt to capture the atmosphere of Amsterdam, for example, the eighteenth-century diarist and traveller Margaret Calderwood drew on the biblical description of Tyre, "here all the riches of both east and west are dayly [sic] pouring in."[41] But beyond comparison for Calderwood and countless other travellers was the way in which the Dutch had transformed their domestic landscape to support accumulation and distribution, on one hand, and thanks to the accumulating profits of international trade on the other. Harbours and canals were dredged and maintained with advice from the country's greatest minds, while the construction of polders and idyllic country estates was financed by wealthy merchants and investors. As the popular saying had it, "god created the world, but the Dutch created the Netherlands."

[41] Steuart Denham, Steuart Calderwood and Kippis, *The Coltness*, 159.

What made this all possible from a domestic standpoint – what allowed accumulation to feed on itself – was the concentration and orchestrated management of knowledge and material goods and related practices. As represented by the essays in this volume, this process took many forms: the stockpiling of building supplies gathered from distant places and the carefully managed division of labour at the VOC shipyards; the commodification of geographical and ethnographic representation by Amsterdam printers; the controlled freedom allowed religious minorities such as the Mennonites, who not only excelled in significant branches of manufacture and trade, but invested their profits to build centres of cultural and knowledge production. The consequences of accumulation could be quite dramatic, as in the case of the discovery of a new star or the domination of world trade. But accumulation itself was generally quite mundane and unspectacular – a basic, yet crucial, element of everyday life. Its historical centres and cycles are thus surely worthy of attention.

Dutch and Spanish Global Networks of Knowledge in the Early Modern Period: Structures, Connections, Changes

Karel Davids

From the end of the sixteenth century onwards, the Dutch Republic became a hub in a global network of knowledge. A knowledge hub is a nodal point or crossroad in regular, long- and short-distance flows of knowledge where knowledge is being supplied, assessed, exchanged, stored or disseminated. I conceive 'knowledge' both in the meaning of *kennen* – knowledge by acquaintance of objects, namely from the senses, by taste and experience – and in the meaning of *weten* - knowledge of causal explanation by reasoning.[1] Knowledge can flow through a variety of carriers, notably via the mobility of people or by means of the transmission of texts, natural objects or artefacts. The knowledge hub that emerged in the Dutch Republic at the end of the sixteenth century was spatially situated in a limited number of locations, notably the cities of Amsterdam and Leiden as well as some smaller towns like Enkhuizen, Middelburg, Rotterdam and The Hague. The Dutch Republic was of course not the first area in Europe to become a site of a nodal point in a global network of knowledge. Among its immediate predecessors were the Southern Netherlands and the Iberian Peninsula. Antwerp, Louvain, Lisbon, Seville and Madrid preceded Amsterdam, Leiden and The Hague.

This essay aims to compare the Dutch and Spanish global networks of knowledge. This comparison may be fruitful as a case-study of a larger issue: the relation between the 'local' and the 'universal' in the accumulation and exchange of knowledge. Knowledge is created in a local setting but it can move beyond its original context to become a universally shared good. Knowledge shared among different cultures and social groups, on the other hand, can be adapted, reshaped or reconfigured for local settings. While locally produced knowledge can be transformed into standard prescriptions or can be acknowledged as universally valid propositions, general knowledge stored in a intercultural or 'global' space can be

[1] For this distinction see Cook, *Matters of Exchange*, 15, 20.

translated into particular, practical, localized forms. Analyzing the relation between 'local' and 'global' contexts can help us to a get a better understanding of changes and continuities in the evolution of knowledge as such.

What is especially interesting about comparing the Dutch and Spanish global networks, is the question of the role of commerce and territorial states as factors in the circulation of knowledge between the 'universal' and 'local' contexts. Harold Cook has forcefully argued that values instilled by commerce between the late sixteenth and early eighteenth centuries became the prime factor stimulating the accumulation and exchange of natural knowledge, and that the Dutch, as key actors in the emerging global economy, played a leading part in this process.[2] In the case of Spain, by contrast, scholars such as José María López Piñero, Nicolas García Tapia and David Goodman, have laid stress on the pivotal role of the royal governments in the production and circulation of scientific and technical knowledge in the sixteenth and the seventeenth centuries. López Piñero labelled the Crown, together with the municipalities, the 'modern' component of the organisation of science in Spain, as opposed to the 'traditional forces' represented by the Church and the nobility.[3]

Taking a more American perspective of the Spanish empire, however, Jorge Cañizares-Esguerra recently qualified this state-centred picture in two important respects. Besides calling attention to the contributions by religious orders to local botanical research and writings, he also made a case for the revaluation of initiatives by 'enterprising settlers and merchants' in overseas colonies in the collection and marketing of natural knowledge.[4] One wonders whether the Dutch and Spanish global networks were that different after all.

Trade in the Spanish empire indeed was never as completely controlled by the Crown and interest groups in Seville as the strict regulations introduced in the early sixteenth century intended. The monopoly system created in 1503, when the *Casa de la Contratación* (House of Trade) was founded to supervise all sailings to the Indies, knew in fact all sorts of loopholes, which were eagerly exploited by Iberian and foreign merchants. Daviken Studnicki-Gizbert and other historians have documented how and to what extent merchants outside the in-crowd of Seville, especially the Portuguese, managed to build their own networks, spanning both sides of the Atlantic, which produced benefits for their own families as well as for the Crown by means of trade in goods, tax farming and lending to the gov-

2 Cook, *Matters of Exchange*, 42-81, 411-416.
3 López Piñero, *Ciencia*, 89-96, García Tapia, *Tecnica y poder*, Goodman, *Power and Penury*.
4 Cañizares-Esguerra, *Nature*, 9, 19.

ernment.[5] But if the relationship between the state and its monopolist allies on the one hand and free-floating merchants on the other hand was less unequal than it appeared on paper, what did this actually mean for the circulation of knowledge? Did 'enterprising settlers and merchants' or more abstractly, commercial values, really make a difference in the accumulation and exchange of natural knowledge in the Spanish orbit?

This essay first compares the role of commerce, states and religious organizations in the Dutch and Spanish global networks of knowledge from a structural point of view, then examines how and to what extent these networks became connected in the course of time and finally analyzes how and to what extent they changed. Areas of knowledge that will be discussed in this essay are in particular natural history, medicine, geography, cartography and navigation. The conclusion assesses the different theses, discussed above, about the role of merchants, territorial states and religious organizations in the global circulation of knowledge.

Circulation of knowledge has become a key concept in the history of technology and the history of science. Circulation is said to take place once knowledge ceases to be the exclusive property of a single individual or group and becomes part of the taken-for-granted understanding of much wider groups of people.[6] Kapil Raj has observed that circulation comes into play at two moments: "firstly, in the collection and centralization of information or data from the outside world in some fixed place" and "secondly, in the dissemination of the knowledge produced in this setting."[7] Circulation of knowledge encompasses all the various aspects of the 'social history of knowledge' distinguished by Peter Burke (although his conception of knowledge primarily refers to 'academic', not technical knowledge): professing, establishing, locating, classifying, controlling, selling and acquiring knowledge.[8] Circulation of knowledge has both social and spatial dimensions and it can occur in many forms and ways and through many different carriers: people, goods, images, sounds or texts.[9]

5 Studnicki-Gizbert, *A Nation upon the Ocean Sea*, 30-39, 108-109, 114-120, 153, Elliott, *Empires*, 108-111.

6 Secord, "Knowledge in Transit".

7 Raj, *Relocating Knowledge*, 225.

8 Burke, *Social History*, esp. 11-14.

9 Hilaire-Pérez and Verna, "Les circulations techniques", Belfanti, "Guilds,", Raj, *Relocating Knowledge*, 20-21, 226.

Structures

The structural comparison of the Dutch and Spanish global networks of knowledge in this section relates to four different aspects: the nature of knowledge infrastructures, the forms of remuneration, the criteria of access and the degree of openness or secrecy of knowledge. These four aspects admittedly do not exhaust the full range of possible angles to the subject, but they cover a fairly broad spectrum. Guiding questions are: what institutions or clusters of experts supported the supply, assessment, exchange, storage or dissemination of knowledge? How were new contributions to the supply of knowledge rewarded? To what extent could people freely participate in networks of knowledge? To what degree was access to knowledge itself open or closed? As the Spanish network in reality emerged earlier than the Dutch one, I will, for each of the four aspects, discuss the Spanish case first.

1. The nature of knowledge infrastructures

López Piñero, García Tapia and Goodman were right in a way. Knowledge infrastructures in Spain and the Dutch Republic differed in the relative weight of state-controlled institutions. In the Spanish global network, all key institutions supporting the production and circulation of knowledge since the sixteenth century were agencies of the central state, notably the House of Trade, the Council of the Indies and the Royal Court. Most of the functions and facilities that sustained the creation and transmission of knowledge were directly or indirectly linked to these agencies: pilot-majors, cosmographer-majors, chronicler-majors, chairs of navigation and cosmography, chairs of mathematics, medical gardens, royal hospitals and the Royal Academy of Mathematics.[10] The leading centres of teaching of modern scientific and technical knowledge established in Bourbon Spain after 1715, namely the naval and military academies, were likewise creations of the central state. The same held for the institution that in 1755 took over the task of the chronicler for the Indies, the Royal Academy of History.[11]

The principal parts of the knowledge infrastructure that did *not* operate under the aegis of the central state were monasteries, hospitals and colleges managed by religious orders, such as the Franciscans and the Jesuits. But these organizations

[10] Goodman, "Science, Medicine, and Technology," 12-24, Portuondo, "Cosmography," 57-77, Barrera-Osorio, "Knowledge and Empiricism," 219-232, Vicente Maroto, "Los cosmógrafos españoles," 351, Esteban Piñero, "Institucionalización," 427-442, Goodman, *Power and Penury.* chapters 2 and 5.

[11] Cañizares-Esguerra, *How to Write the History*, 160-169.

still sometimes acted in support of the knowledge infrastructure created by the state. In 1625, the mission of the Royal Mathematical Academy was incorporated into the *Colegio Imperial de San Isidro*, staffed by Jesuit teachers.[12] Religious orders were not purely national organizations, however. They could also manage trans-national networks of their own. These trans-national aspects of their activities will be discussed below.

And what about the 'enterprising settlers and merchants'? There are a few tantalizing indications that they were at least to *some* degree active in the circulation of knowledge. Lutgardo García Fuentes reports for instance that in the second half of the seventeenth century, 6,636 chests with books were sent from Spain to markets in America, 77 % of them from Seville and 23 % from Cádiz. The bulk of these shipments were destined for the Spanish Main. The actual numbers may have been higher, as these figures only related to legal exports. The shipments partly consisted of books printed in other European countries, part of books produced in Spain itself. Seville was at the time an important centre of printing in its own right.[13] Some merchants in Cádiz at the end of the eighteenth century possessed libraries which reveal an intimate acquaintance with the state of the art of scholarship in their time. Sebastián Martínez' collection in Cádiz (he had another one in Madrid) contained 844 titles, more than half of them in other languages than Spanish; the share of the books in French (40 %) was almost as large as that in Spanish (47 %). The collection covered a wide range of subjects: history, geography, literature, arts, religion, philosophy, law, political economics, mathematics, physics and natural history. Books by George Louis Leclerc de Buffon and René Antoine Ferchault de Reaumur stood side by side with works by Pedro Rodríguez de Campomanes and Gaspar Melchor de Jovellanos. Vicente Pulciani's library, with 904 titles, was equally multi-lingual, varied and up to date. Both merchants also possessed a fine collection of periodicals.[14] 'Enterprising settlers' in the Indies, in their turn, are known to have sometimes sent specimens of plants with supposed curative powers to Europe in order to explore their commercial possibilities on metropolitan markets.[15] Pedro Franco Dávila, a Creole merchant from Guayaquil in the Viceroyalty of Peru, assembled a huge collection of natural curiosities and antiquities, which he eventually transferred to the Spanish Crown.[16]

Yet, all these examples together hardly add up to a strong case for an impor-

[12] Portuondo, *Secret Science*, 86.
[13] García Fuentes, *El comercio español*, 309-311.
[14] Bustos Rodríguez, *Cádiz en el sistema atlántico*, 332-334
[15] Barrera Osorio, "Local Herbs," 165-175, De Vos, "An Herbal El Dorado," 120.
[16] Pimentel, "Across Nations and Ages".

tant role of merchants, or commercial values, in the accumulation and exchange of knowledge in the Spanish orbit. The sparse evidence of shipments of *naturalia* from the Americas to Europe in fact either dates from the early decades of Spanish Atlantic expansion, when supervision by the House of Trade began to take shape, or from the 1780s and 1790s, when the transatlantic trading system had been reformed by the proclamation of 'free trade' in 1778. Dávila assembled his collection after he had settled in Paris in 1745. And the flow of indigenous plants from the Americas to Europe at the end of the eighteenth century largely came about in response to 'order after order' of the Council of the Indies to administrators in Spanish America requesting them to send to Madrid 'medicinal herbs, roots and seeds,... and descriptions of their uses.' Expectations about the potential of 'miracle' drugs to cure major epidemic diseases as a new source of wealth from the Indies then had risen to fever pitch.[17] Whichever way one looks at it, during most of the early modern period the Crown and its agencies in Spain and overseas were far more weighty actors in the Spanish global network of knowledge than merchants or 'enterprising settlers' in the Americas.

At the end of the day, it was the state that called the tune in the governance of the empire. The Crown could extend or curb the opportunities for private merchants at will. The Portuguese Nation in fact lost its wealth and power in a crackdown by the government and the Inquisition in the 1640s, after its protector, Gaspar Guzmán y Pimentel, count-duke of Olivares, had fallen out of favour with the King. The network of Portuguese merchants in the Spanish empire was rapidly dismantled.[18] In the 1770s and 1780s, it was the royal government, notably the Secretary of the Indies, which launched a wholesale reform of the transatlantic commercial system ushering in the introduction of free trade.[19]

The knowledge infrastructure in the Dutch Republic was more diverse than in Spain. Positions like those of the pilot-majors, cosmographers-majors, chairs of navigation, cosmography and mathematics in Spain existed in the Dutch Republic, too, but in contrast with Spain many of these functions did not come within the jurisdiction of agencies of the central state. They were scattered over many different places instead. They could be found in semi-public chartered companies, like the Dutch East-India Company (VOC) and the West-India Company and at universities and other institutes of higher learning sponsored and controlled by cities and provincial governments since the late sixteenth century. There were also lectureships sustained by funds provided by urban governments. Botanical gardens

[17] De Vos, "An Herbal El Dorado," 119-120, Pimentel, "Across Nations and Ages".
[18] Studnicki-Gizbert, *A Nation upon the Ocean Sea*, 156-174.
[19] Elliott, *Empires*, 306-307.

and professorships of botany in the Netherlands were created by cities or universities, not by agencies of the central state. The Dutch counterpart of the Royal Academy of Mathematics in Madrid, the *Duytsche Mathematicque*, which offered courses on surveying and fortification, formed part of the University of Leiden.[20] However, a few institutions supporting the circulation of knowledge *did* form part of the apparatus of the central state. Examples are the offices of examiners of pilots and naval officers created by several Admiralties in the eighteenth century, the nautical schools in Amsterdam and Rotterdam founded jointly by the Admiralties, the East-India Company and city governments about 1750 and the Committee on the Determination of Longitude and Improvement of Charts established by the Admiralty of Amsterdam in 1787.[21]

Furthermore, although the Dutch Republic lacked educational institutions or collections supported by religious organizations, there were plenty of people, especially in port cities and inland towns in the maritime provinces, who regarded the production and distribution of knowledge as a promising commercial venture.[22] These 'entrepreneurs in knowledge' included great numbers of publishers, book sellers, surveyors, map makers, instrument makers, medical practitioners and teachers of navigation and mathematics.[23] The knowledge infrastructure in the Dutch Republic thus was characterized by a great variety of facilities, a high degree of decentralization, a low measure of coordination by state institutions and a relatively important role of market mechanisms. It was not merely based on 'values instilled by commerce' but operated thanks to a combination of 'visible' and 'invisible hands.'

Spanish and Dutch global networks of knowledge were not entirely unlike in their functioning, however. They *did* show some similarities in the way knowledge was locally 'tapped' and then transformed while flowing from place to place in the networks. Both networks drew upon a rich store of knowledge accumulated by local groups of people. Naturalists and physicians living in Spanish or Dutch settlements in the Americas, the Philippines, South-East Asia or India learned much about botany, zoology, agriculture, medicine or geography from people on the spot.[24] And the flows of knowledge in the Spanish and Dutch networks were

[20] Davids, "Amsterdam as a Centre of Learning", Egmond, "Clusius and Friends".

[21] Davids, *Zeewezen en wetenschap*.

[22] For a partial exception, see Ernst Hamm's essay in this volume which discusses Mennonite education.

[23] Davids, 'Ondernemers in kennis", Davids, "Een huis vol handboeken", De Clercq, *At the Sign of the Oriental Lamp*, Van Selm, *Een menighte treffelijcke boecken.*

[24] Anagnostou, "International Transfer," 299-302, Barrera-Osorio, "Local Herbs", 167-168, Boomgaard, "Making and Unmaking," 194-195, Fleischer, "Company's garden", Cañizares-

not restricted to movements of bits of information from locality to locality via the mobility of craftsmen, shipments of plants and medicines or the spread of printed materials. In the process of circulation, knowledge often underwent a transformation, too, from a particular, localized shape to the form of a general, propositional statement, or a collection of statements, such as botanical classification system, reports on the properties of medicines or sailing directions containing information on patterns of winds and currents. Whatever the differences in the nature of the knowledge infrastructure, in this respect the Spanish and Dutch networks essentially did the same thing: turning local knowledge into the taken-for-granted understanding of much wider groups of people.

2. Forms of remuneration

Why did people take pains to make new contributions to the supply of knowledge? What were the incentives for trying to discover or create new knowledge? Incentives came in all shapes and sizes. Remuneration in networks of knowledge in the early modern period, like today, could assume both a material and an immaterial nature. Examples of the former were patents, rewards and prizes, sponsorship by public or semi-public institutions or patronage. These forms of remuneration normally involved an element of material recompense. Remuneration also could take a less tangible, immaterial form, such as the prospect of a service in return, an increase in reputation, a gain in power or an enhanced chance of salvation of one's soul.

Among the material forms of remuneration, patents for invention emerged earlier in Spain – or more precisely in Castile – than in the Low Countries. Patents appeared in Castile at the end of the fifteenth century and became more frequent after the task of examining inventions and granting patents in the kingdom was entrusted to the Council of Castile. The first patent granted by this Council dates from 1522. The Council of the Indies soon began to grant patents as well. Nicolás Garcia Tapia has found that between 1478 and 1650 some 240 patent applications were submitted by Spanish and foreign inventors to the king or to the Councils of Castile and the Indies, of which 152 were actually approved. The number of applications submitted to the Council of Castile between 1522 and 1622 amounted to 140.[25] However, Castilian patents were seldom accepted in Aragon and the number of patents granted by the Council of Aragon remained dismally low until the early eighteenth century. The validity of patents granted by the Council of

Esguerra, *Nature*, 8, Reyes, "Botany", 265, 272.

[25] Mateos Royo, "State Policy," 149-150, García Tapia, *Tecnica y poder*, 195-201.

Castile was not extended to the entire territory of Spain until after the abolition of the Council of Aragon in 1716.[26]

In the Low Countries, patents for invention were issued regularly from the 1550s onwards. Granting patents was originally a prerogative of the sovereign lords of the Netherlands, Charles V and Philip II, who also happened to be Kings of Spain. After the Revolt, the power to award these privileges in the newly-established Dutch Republic became more widely diffused. Patents were actually granted at three levels of authority: the central governing body of the Republic (the States General), the estates of the separate provinces (Holland, Zeeland etc.) and town governments. Between c.1590 and the 1650s the largest number of patents was issued by the States General. After that, the States of Holland succeeded the States General as the principal patent-granting institution. This shift of primacy occurred shortly after the States General introduced the rule that a patent was only valid in a particular province of the Republic, if it had been confirmed by the estates of the province concerned. The formal barriers for transfer between provinces were much lower than between Castile and Aragon, however. In contrast with Castile, the total number of patent applications in the Dutch Republic is not known. We *do* know, however, that most of the patents granted by the States General and the States of Holland date from the period between c. 1580 and 1720: 553 and 224, respectively (which, understandably, partly concerned the same inventions). Another fourteen and fifty eight, respectively, were granted between 1720 and 1795.[27] The procedure followed by these agencies to validate the merits of a new invention was not unlike that in Castile: it normally involved an assessment by officials, sometimes assisted by a group of experts.[28]

Both the Castilian and the Dutch patent systems acted as poles of attraction for knowledge flows from a much wider area than the state territory itself. The key difference was that in the Dutch case natives formed a much larger proportion of the would-be inventors than in the case of Castile. Whereas in the Dutch Republic between 1580 and 1720 some 65-80 % of all patentees originated from the country itself, in Castile between 1478 and 1650 only 56 % of the patentees were Spaniards, while 17 % hailed from Spanish America and some 25 % from other countries in Europe.[29]

Beside patents, rewards and prizes, sponsorship by public or semi-public institutions or patronage could offer powerful attractions, too. All of these forms of

[26] Mateos Royo, "State Policy," 147-148.
[27] Davids, *Rise and Decline*, 401-404.
[28] Davids, "Patents and Patentees," 267, Barrera-Osorio, 'Knowledge and Empiricism," 221-227.
[29] Davids, "Patents and Patentees," 268, Mateos Royo, "State Policy," 152.

material remuneration could be found both in the Spanish and the Dutch networks of knowledge. In both cases, the major institutions charged with the regulation of trade and shipping between the home country and the overseas world, the House of Trade and the VOC, respectively, played a pivotal part in providing material support for the production and circulation of 'useful' knowledge.[30] The chief differences between the Spanish and Dutch cases appear to be that in the Netherlands in the sixteenth and seventeenth centuries the production and circulation of 'useful' knowledge was also very actively promoted by city governments and that in the later eighteenth century the number of patents granted by state agencies was dwarfed by the number of rewards and premiums for innovations granted by a private society (the Economic Branch of the Holland Society of Sciences): 376 between 1778 and 1797 by the latter, against less than forty by the States General and the States of Holland.[31]

The most lavish rewards in Spain and the Netherlands were earmarked for solving a problem in navigation. In 1598, the King of Spain offered a reward for anyone who would come up with a practical and reliable solution for the problem of finding longitude at sea. This reward, the first specifically offered on this subject in a European state, consisted of a sum of 6,000 ducats plus a life annuity of 2,000 ducats and 1,000 ducats more for expenses. The task of assessing the merits of the proposals was entrusted to the House of Trade. Most of the applicants of the ten proposals submitted until 1634 were Spaniards, but two of them came from abroad: a globe maker and mathematician from Flanders, Michel Florent van Langren and an astronomer from Tuscany, Galileo Galileï. None of the applicants ever received the prize. The only payments made were in the category of expenses.[32] Interest in the Spanish prize declined after the mid-1630s.

Hardly had the Spanish Crown offered its longitude prize than authorities in the Dutch Republic did the same. On April 1, 1600, the States General of the United Provinces offered a sum of 5,000 guilders plus a life annuity of 1,000 pounds for anyone who would present an adequate solution for the problem of finding what the Dutch called 'the East and West'. A year later, the States of Holland likewise offered a longitude prize. This prize could be earned in stages: an applicant would receive 150 pounds if he had submitted an explanation of his method and was prepared to have it tested at sea, and a sum of 3000 pounds plus a annuity of 1000 pounds if six to eight skippers would attest that method was com-

30 Cf. for instance Barrera-Osorio, "Knowledge and Empiricism" and Davids, *Zeewezen en wetenschap*, chapters 11 and 12.

31 Davids, *Rise and Decline*, 410-416, 478-482.

32 Jonkers, "Rewards and Prizes," 434.

pletely reliable. The reward offered by the States General was raised to 15,000 guilders in 1611 and to 25,000 guilders in 1660. The States of Holland were in 1738 prepared to pay as much as 50,000 guilders. Applications for a longitude reward continued steadily to arrive until about 1775. The total number of proposals submitted in the Dutch Republic amounted by then to almost forty. While the majority of the applicants came from the United Provinces itself, a substantial number hailed from abroad, especially from the Holy Roman Empire and the Kingdom of France.[33]

In contrast with Spain, the assessment of the proposals was not always entrusted to the same agency. The most common procedure was that States General of the States of Holland first asked ad-hoc committees of experts in the theory of navigation (*theoristen*) to assess the correctness of the underlying principles of a proposed solution and then, if a proposal had survived this theoretical scrutiny, called on experienced seamen (*practisijns*) to attest whether the suggested solution would work in practice. Ad-hoc committees of *theoristen* requested to advise on the merits of longitude proposals included scholars, teachers and surveyors such as Joseph Scaliger, Willebrord Snellius, Simon Stevin, Burchard de Volder and Petrus van Musschenbroek. Between about 1650 and 1730, the States General more than once referred an applicant to the VOC, which employed several in-house experts in navigation, the examiners of pilots.[34] Although neither the States General nor the States of Holland ever awarded the longitude prize in full, they nevertheless more than once paid (or ordered other institutions to pay) considerable sums of money to would-be longitude-finders by way of expense allowances. The most successful claimant from this point of view was doubtless Jan Hendricksz Jarichs van der Ley, a former receiver-general of the Admiralty of Friesland, who in 1625 secured an annuity which up to its cancellation in 1655 generated for himself and his heirs a total income of 19,000 guilders.[35]

Immaterial forms of remuneration are of course harder to measure than material ones. Still, we have various clues that suggest that these forms of remuneration actually must have exerted an influence. Many Catholic missionaries in the Iberian empires or Asia worked untiringly to gather and transmit data on the natural world without ever receiving a visible material reward. All those Franciscans or Jesuits collecting specimens, drawing maps and writing books and reports can hardly have been motivated by the prospect of improving their own income or wealth. Spiritual autobiographies and questionnaires composed by Jesuits in

[33] Davids, *Zeewezen en wetenschap*, 69-74, 129-141, 178-182.
[34] Davids, *Zeewezen en wetenschap*, 73, 81-83, 132, 180, Vanpaemel, "Science Disdained".
[35] Davids,'"Weest EenDERLEY sins," 135-136.

the sixteenth century studied by Luke Clossey and others rather suggest that the desire of salvation must have a powerful incentive.[36] Considering the fact that religious organizations like the Society of Jesus put a premium on the systematic acquisition, assessment, storage and dissemination of data on the overseas world it is not at all unlikely that missionaries active in global networks of knowledge were further driven by the expectation of other inner-worldly immaterial rewards such as an increase in reputation, the prospect of services in return and perhaps, a gain in power.

Immaterial rewards were probably not absent in the Dutch case either. Why else, for example, should scholars such as Isaac Beeckman or Christiaan Huygens have preoccupied themselves with the problem of finding longitude at sea, whereas they never applied for a longitude prize and were hardly in need of patronage either?[37] If there *was* any difference in the operation or relative importance of immaterial remuneration in the Spanish and Dutch networks, this difference, I would guess, first and foremost resided in a higher degree of institutionalization of immaterial rewards within the context of religious organizations in the case of Spain. The Dutch Reformed Church was in this respect no match for the Society of Jesus, or for any other Catholic religious order for that matter.

3. Criteria of access

Access to global networks of knowledge was in the Spanish case, on paper at least, less open than in the Dutch one. Spain appeared in this respect to maintain a much higher degree of exclusiveness than the Dutch Republic. Religion and national background were used as criteria to exclude particular groups from professions or positions where they could have participated in the accumulation and exchange of knowledge. Jews and Muslims were forbidden to enter the Indies. A decree of 1552, which ruled that potential emigrants must provide proof from their hometowns or villages of their *limpieza de sangre*, made it almost impossible to evade this prohibition.[38] The statutes of *limpieza de sangre* also effectively barred converted Moors from entering the universities and the medical profession.[39] In 1609, the Moriscos, like the Jews more than a century before, were expelled from Spain altogether. Fear of spying led to a prohibition on the employment of Portuguese pilots in the India trade as early as 1515. Although the King relaxed the regula-

[36] Clossey, *Salvation and Globalization*, 114-135.
[37] Davids, *Zeewezen en wetenschap*, 72, 135-137.
[38] Elliott, *Empires*, 51.
[39] Goodman, *Power and Penury*, 37.

tion on the admission of foreign pilots in the early 1580s, he strictly forbade the employment of English pilots since 1589 and of French and 'rebel Dutch' after 1595.[40] Yet, such restrictions do not imply that the Spanish network knowledge hardly attracted any expertise from abroad. Foreign interest in longitude prizes was not an isolated example. Engineers are also a telling case in point. Even if, as García Tapia rightly has stressed, the vast majority of engineers in sixteenth-century Spain were Spanish, some 15 % of all engineers hailed from Italy and another 10 % were German, Flemish, French or English.[41]

Restrictions on access to knowledge networks on the basis of 'purity of blood' or national background were unknown in the Dutch Republic. The barriers that *did* exist, rested on religious criteria. The practice of confessions other than that of the Dutch Reformed Church was formally prohibited. The Dutch Reformed Church was the only recognized, public church. The most severe restrictions applied to Catholics, who made up a third or more of the population of the United Provinces. Being Catholic was not against the law, but "it was quite illegal to live and worship like one."[42] Membership of the Reformed Church was mandatory for professors, though not for students, at the newly-founded institutes of higher learning in the United Provinces, such as the Universities of Leiden, Groningen and Utrecht and the Athenaeum Illustre in Amsterdam. Many Catholics preferred to study at Catholic universities across the border, like Louvain or Cologne, instead.[43] Religious organizations that played a leading part in the accumulation and exchange of knowledge in Catholic Europe, such as the Jesuits, the Dominicans or the Oratorians, were not allowed to have a public presence in the Dutch Republic. A Jesuit college or Oratorian school in Amsterdam or The Hague could not exist. Yet, religion-based restrictions that were valid *inside* the Republic did not preclude exchange of knowledge with members of Catholic organizations in the world at large, as we shall see shortly.

4. Secrecy and openness

Moving from the access criteria to the knowledge itself we can observe that the degree of openness of knowledge in the Spanish network was de facto lower than in the Dutch case. Or to put it the other way around: knowledge in the Spanish network more often remained secret, or at least moved less widely, than in the

[40] Goodman, *Power and Penury,* 80-81.
[41] García Tapia, *Ingeniera y arquitectura*, 41.
[42] Parker, *Faith on the Margins*, 10.
[43] Frijhoff and Spies, *1650 Bevochten eendracht*, 247-248.

Dutch network. Research of the past thirty years has uncovered the sheer profusion and originality of activities in science and technology carried out in the Spanish empire especially during the sixteenth and eighteenth centuries, in particular in such areas as natural history, medicine, mining, hydraulic engineering, geography, cartography and navigation technology. The insights reached by this recent scholarship, one hopes, should put the Black Legend about the obscurity and backwardness of Spain finally to rest.[44]

But this new research has also brought to light that important contributions to the advancement of knowledge often did not appear in print, or at best only in an incomplete version, and that the circulation of new knowledge frequently remained limited to a small audience. Many treatises by official teachers of mathematics in the late sixteenth and early seventeenth century were never published, for example, and the voluminous survey by Francisco Hernández on the flora of New Spain, completed in the 1570s, only appeared in a truncated version many decades later.[45] Part of the explanation of this 'underachievement' in the circulation of knowledge lies in the deliberate policy of secrecy conducted by the Crown in areas like geography, cartography, and navigation technology. Secrecy, however, was not consistently maintained. Whereas the policy was quite strictly enforced during the reigns of Philip II (1555-1598) and Philip IV (1621-1665), it was significantly relaxed during the reign of Philip III (1598-1621). Even when the Crown attached less importance to the maintenance of secrecy, financial constraints could seriously hamper efforts to distribute the fruits of knowledge. Shortage of money became a nagging problem for the Spanish government after 1600.[46] The crucial point was, again, that the circulation of knowledge in the Spanish orbit depended so heavily on the presence, or absence, of political and financial support from the state.

In the Dutch Republic, openness of knowledge was de facto the rule until about 1750. Foreign travellers normally had no problem at all in collecting the information they wanted. They were pleasantly surprised that the Dutch were not as distrustful or secretive as people in other European countries. It was not until the second half of the eighteenth century that foreigners more frequently reported

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44 See especially *Más allá de la Leyenda Negra*, ed. Navarro Brotóns and Eamon and *Science in the Spanish and Portuguese Empires*, ed. Bleichmar, De Vos, Huffine and Sheehan.

45 Álvarez Peláez,"Un Nuevo Mundo," 151, Vicente Maroto, "Los cosmógrafos españoles," 351, Esteban Piñero, "Institucionalización," 430, Goodman, *Power and Penury*, 234-236.

46 Sandman, "Controlling knowledge," 33-41, Esteban Piñero, "Institucionalización," 430, Goodman, *Power and penury*, 262, Kagan, "Arcana Imperii", 57-70, Portuondo, *Secret Science*, 7-9, 103-107, 258.

about obstacles being encountered when they attempted to get access to sites of technological interest and that, at last, prohibition orders on the export of technology appeared on the statute-books of the States General, the States of Holland and individual cities.

The persistence of this regime of openness until about 1750 was not the result of some high-minded principle about the value of the free flow of knowledge. The Dutch Republic never proclaimed open access to knowledge an official goal of policy. Openness simply existed as a matter-of-fact.[47] A few exceptions to the rule can be found before 1750, but most of them were of minor consequence. The principal exception for a while concerned the Dutch East-India Company. In 1619, the VOC obtained a privilege from the States General to the effect that no one would be permitted, without the express consent of the Directors, to publish or copy maps or descriptions concerning the area exclusively reserved for trade by the company. In reality, however, this policy of secrecy was abandoned less than twenty years later. Charts, maps and descriptions based on data gathered by the VOC circulated widely inside and outside the Netherlands in the later seventeenth and eighteenth century.[48]

Connections

Up to this point, I have treated the Dutch and Spanish global networks of knowledge as if they were entirely separate entities. In the studies by Cook and López Piñero linkages between these networks hardly figure at all. In reality, however, the Dutch and Spanish networks have been much more interrelated than either of these accounts suggest. Knowledge circulating in the Spanish and Dutch networks was, by origin, not always 'Spanish' or 'Dutch', nor did its circulation remain exclusively restricted to the Spanish or Dutch orbits. Knowledge could flow between networks, thanks to merchants, state agencies or other sorts of actors, and the degree of connectedness or disconnectedness changed over the course of time. The connections between the Spanish and Dutch networks in the early modern period seem to have been more intense at the end of sixteenth century, the second half of the seventeenth century and the final decades of the eighteenth century than in the periods in between and the ways in which the connections came about were different each time.

At the end of the sixteenth century, knowledge on botany and navigation technology flowed directly from the Iberian Peninsula to the Netherlands. The princi-

[47] Davids, "Openness or Secrecy?," Davids, *Rise and Decline*, 388-400, 472-480.
[48] Zandvliet, *Mapping for Money*, 94-98, 128-130.

pal hubs for these flows of knowledge were all located in Europe: Seville, Lisbon, Antwerp, Amsterdam. Carolus Clusius, who in 1593 became *praefectus* of the newly-founded botanical garden at the university of Leiden, managed to obtain all sorts of *naturalia* from the Americas through his contacts with botanists in Spain (especially Seville) and the Spanish Netherlands.[49] Manuals on ocean navigation by Pedro de Medina and Rodrigo Zamorano were translated into Dutch in Antwerp and Amsterdam in the 1580s and 1590s. De Medina's book was the standard guide on the first Dutch voyages to Asia.[50] Manuscript Portuguese sailing directions for routes in the Atlantic and the Indian Ocean were eagerly collected by Dutch 'spies' in Lisbon. The first tentative method for finding longitude at sea used on Dutch ships – finding longitude with the aid of data on magnetic declination, as explained by Petrus Plancius and Simon Stevin – was essentially based on path-breaking work by Portuguese and Spanish authors, such as João de Lisboa, Francisco Faleiro and Alonso de Santa Cruz.[51]

Yet, the importance of the Spanish network as a source of knowledge declined for some time after 1600. For the first Dutch general survey of the Americas, which, among other things, included a fair amount of information on the Continent's natural history, Johannes de Laet in 1625 drew, tellingly, mainly on non-Spanish sources. Among the thirty seven publications which de Laet mentioned as the principal sources for his work were eleven writings in English and seven each in Spanish, French and Dutch.[52] Spanish guides on navigation lost their status as state-of-the-art models among Dutch publishers, too. The most consummate manual to appear in Spain after 1600, the *Regimiento de navegación e hydrografia* (1606) written by "a uniquely qualified cosmographer," Andrés García de Céspedes, which according to María Portuondo "set a new and ambitious standard for the navigation manual,"[53] was in contrast with the older books by De Medina and Zamorano never translated into Dutch. Dutch publishers preferred to market manuals written by Dutch authors instead. On the Spanish side, most scholars in the later seventeenth century only kept their direct contacts with peers in other territories under Spanish rule, especially in Italy and the Spanish Netherlands, and with France.[54]

When the Dutch and Spanish networks of knowledge in the second half of

[49] Barona, "Clusius'exchange,", Mason, "*Americana*,", Egmond, "Clusius and Friends".
[50] Davids, "Dutch Contributions", 60-63.
[51] Davids, *Zeewezen en wetenschap*, 70-71, 75, Jonkers, *North by Northwest*, 304-314.
[52] De Laet, *Nieuwe werelt*, Preface.
[53] Portuondo, *Secret Science*, 271, 282.
[54] López Piñero, *Ciencia*, 400.

the seventeenth century once again became interconnected, the flows of knowledge ran to a greater extent than before via hubs outside Europe, like Batavia and Manila, and for a large part under the aegis of what Steven Harris has called 'long-distance corporations', namely the Society of Jesus and the Dutch East-India Company.[55] Harris has argued that a religious organization like the Society of Jesus and a trading company such as the VOC, despite all their obvious differences, still can be fruitfully compared from the point of view of the problems they faced with regard to 'personnel management' and the methods they developed to cope with these challenges. As long-distance corporations, both the Society of Jesus and the VOC had to devise ways "to keep their members healthy, motivated, and loyal when stationed in remote and often hostile environments."[56] The Society of Jesus at the time held a unique position in the global circulation of knowledge by virtue of the fact that it was 'plugged in' in many different networks at the same time. Aside from maintaining a smoothly running worldwide network of communication of its own, the Society also on a regular basis connected with the Spanish and Portuguese networks as well as with the Dutch, the French and the English ones. Thanks to this strategic position, it could mediate in the transmission of knowledge between far-flung parts of the globe, whether in the Americas, the Philippines, China, India or Europe.[57]

Exchange of knowledge between the Jesuits and the Dutch East-India Company was especially evident in the areas of geography, cartography and botany. When the Jesuit Martino Martini, for instance, *en route* from Macao to Europe, arrived in Batavia in 1652, he provided the governor-general and council of the VOC with precise information on the commercial and political conditions in China and showed them a description and atlas of the empire which he had recently completed.[58] Having travelled to Amsterdam aboard a Dutch East-Indiaman, he brought out this *magnum opus* as part six (*Novus atlas sinensis*) of the world atlas published by the firm of Joan Blaeu, who also served as hydrographer and examiner of pilots of the Chamber of Amsterdam of the VOC.[59] Jacob Golius, professor of mathematics and Oriental languages at the university of Leiden eagerly grasped

55 Harris, "Long-Distance Corporations," 272, 279, 285-286.

56 Harris, "Long-Distance Corporations," 285-300.

57 See e.g. Clossey, *Salvation and globalisation*, Harris, "Jesuit Scientific Activity", esp. 75-76, Anagnostou, "International Transfer," 299, 312, Mazumbar, *Sugar and Society*, 152-157 (on the diffusion of the double-roller vertical sugar mill from the Americas via the Philippines to China).

58 *Generale missiven*, ed. Coolhaas, vol. II., 606-607, letter Gouverneur Generaal en Raden to Heren XVII, December 24,1652.

59 Barten, "Hollandse kooplieden," 86-87, Szczésniak, "Seventeenth-Century Maps of China".

the opportunity to talk with Martini, when he changed barges in the city, and later called on him for a longer conversation in Antwerp, a Jesuit bulwark in the Spanish Netherlands.[60] Books by Johan Nieuhof and Olfert Dapper on the activities of the VOC in China, published in 1665 and 1670, were partly based on publications by Jesuits such as Martini and Athanasius Kircher (whose *China illustrata* appeared in Amsterdam as well).[61] Nicolaes Witsen, director of the Dutch East-India Company, owed the new maps of China and Manchuria and notes on the population of the Chinese Empire included in his *magnum opus Noord- en Oost Tartarye* to the Jesuit Philip Couplet, born in the Spanish Netherlands, who lived in China from 1658 till 1681 and then returned to Europe aboard a ship of the VOC.[62]

In botany, which for medicinal reasons interested Jesuits and the VOC alike, circulation of knowledge between Dutch, Jesuit and Spanish networks took place in many different ways.[63] Works of Clusius, partly based on information gathered from Spanish America before 1600, were in the seventeenth and early eighteenth centuries used in Jesuit pharmacies in Spanish America and the Philippines as an aid in the study and preparation of drugs.[64] Botanists in the Society of Jesus and the VOC also contacted each other directly. Georg Josef Camel, founder of the pharmacy of the Jesuit College in Manila, corresponded in the late 1690s with Willem ten Rhijne, physician of the VOC in Batavia, about their common interests in botany and medicine. Ten Rhijne prized Camel's descriptions and drawings of plants in the Philippines, acquainted him with recent botanical research by employees of the VOC in Batavia and Ceylon and shared with him his contacts in the scholarly world in Europe.[65]

After the exchange of knowledge between the Company and the Jesuits overseas had decreased in the early decades of the eighteenth century, it took until the 1780s before the connections between the Dutch and Spanish global networks were somewhat restored. Knowledge once again flowed from Spain to the Netherlands. Like in the days of Clusius, botanists in Spain – viz. the Royal Botanical Garden in Madrid under the direction of Casimiro Gómez Ortega – began on a

60 Duyvendak, "Early Chinese Studies in Holland".
61 Van Kley, "Qing Dynasty China," 220-221.
62 Peters, '*Mercator sapiens*', 154-161. Compare these exchanges and cases of the reliance on other sources for publications with the those described by Benjamin Schmidt in this volume.
63 Harris, "Long- Distance Corporations," 285-294.
64 Anagnostou, "International Transfer," 295, 297-299.
65 Reyes, "Botany, " 265-266.

regular basis to send seeds of 'exotic' plants to gardens in other places in Europe, including Amsterdam, The Hague and Leiden.[66]

Changes

In the first section of this essay I compared the Spanish and Dutch global networks of knowledge from various structural perspectives: nature of infrastructures, forms of remuneration, criteria of access and degree of openness or secrecy of knowledge. This comparison showed that in the Spanish case the circulation of knowledge was to a high extent managed by 'visible hands' of public institutions and religious organizations whereas in the Dutch case the management rather took place by a combination of 'invisible' and 'visible hands.'[67] In other words, in the Dutch case the management was realized by a mix of market and non-market mechanisms. In the Spanish network, material forms of remuneration such as patents and prizes became less attractive to inventors after the middle of the seventeenth century. The Iberian network was more restrictive in its rules of admission and displayed less openness in the circulation of knowledge than the Dutch one.

The Spanish and Dutch networks were not entirely separate, as we have seen in section two. These networks were in the course of time connected to varying degrees. The agencies that temporarily brought them most closely together were organizations specialized in managing long-distance operations themselves, the Society of Jesus and the VOC, which both operated networks of their own. But the dynamics of the Spanish and Dutch networks were determined neither by such intermittent connections, nor by the religious and mercantile organizations that acted as go-betweens. Changes and continuities were determined by forces inside the networks themselves, both in the metropolis and in settlements overseas.

With regard to the Spanish network, Antonio Barrera-Osorio has argued that the changing economic, financial and political circumstances in the first half of the seventeenth century led to a sharp decline of institutional support for the quest for natural knowledge – at least among institutions in Spain itself. "Regarding the New World, activities such as natural history, cosmography, and technology were no longer necessary as they had been during the sixteenth century for the establishment of economic activities and political jurisdictions," Barrera-Osorio observed. In Spanish America, however, the empirical and collaborative practices which

66 De Vos, "An Herbal El Dorado," 119.

67 To borrow the well-known distinction coined by Adam Smith and Alfred Chandler, cf. Chandler, *Visible Hand*.

had emerged during the empire-building in the sixteenth century were continued throughout the early modern period, albeit with a different purpose. The communities that had arisen in the American colonies, according to Barrera-Osorio, had developed their own interests and activities in regard to the study and understanding of the New World, namely to use natural history and cosmography to create their own territorial and cultural identities.[68]

Still, a reversal in the development of the Spanish network appears to have taken place in the last decades of the eighteenth century. Like its Habsburg predecessor before 1600, the Bourbon central government assumed a leading role in the collection and transmission of knowledge about nature in the overseas world. The rationale behind this state-sponsorship of research was to some extent similar to that of the Habsburg era. Knowledge of natural history, specifically, was regarded as a potential source of wealth. Plants could be valuable items because of their uses as 'miracle' drugs to cure to epidemic diseases in the colonies and in Europe. But the motives were also political: a reduction of diseases could lead to an increase of population and a growth in power, and the promotion of utilitarian learning could further advance the grand project of reform of Spanish culture and society. Astronomical and geographical inquiries could help to exploit botanical and mineral resources and to improve the Crown's control over its far-flung territories.[69] Between 1760 and 1808 the Spanish government sponsored no less than fifty seven scientific expeditions to its colonies. During these expeditions, travellers systematically collected all sorts of data on natural history. Besides, they made astronomical observations, carried out geographical explorations and produced all sorts of maps and charts.[70] The cabinet of curiosities of Franco Dávila, which the Spanish Crown acquired in 1771, served as the nucleus of a newly-founded Royal Cabinet of Natural History in Madrid.[71] The role of religious organizations, meanwhile, was substantially curtailed. The network of the Society of Jesus that between the mid-sixteenth and mid-eighteenth centuries had spanned a large part of the globe, both inside and outside the Spanish empire, was after about 1770 completely dismantled.

These internal changes in Spain explain why the partner of the Dutch in the 1780 was no longer the Jesuits, but a royal institution – the Botanical Garden in Madrid. Yet, change was less radical than it may seem at first blush. Like in the Habsburg era, government-sponsored efforts at the end of the day led to few tangi-

68 Barrera-Osorio, *Experiencing Nature*, 133.
69 De Vos, "An Herbal El Dorado," 118-120, Cañizares-Esguerra, *Nature,* 56-58.
70 Bleichmar, "A Visible and Useful Empire, " 297-280.
71 Pimentel, "Across Nations and Ages".

ble results. The institutions established in the colonies to exploit natural resources, like botanical gardens, were after 1800 left to wither, "leaving Spain with little to show after some thirty years of unparalleled official patronage of naturalists," according to Cañizares-Esguerra. Medical reform did not lead to a visible improvement in public health. Production of minerals was not significantly enhanced by technological change. And the "taxonomies, travel accounts, maps, and thousands of botanical and anthropological illustrations accumulated by dozens of scientific expeditions – remained, by and large, unpublished."[72]

Developments in the Dutch network differed from the Spanish developments in several respects. In contrast with the slowdown in seventeenth-century Spain, the circulation of knowledge centred on the hub in the Dutch Republic showed no signs of slackening in the seventeenth and eighteenth centuries. The existing infrastructure of knowledge in the Dutch Republic was able to sustain the process of collection, assessment, exchange, storage and dissemination of knowledge over a prolonged period of time. The rise of commercial values, detected by Harold Cook, plus the persistent rivalry between cities and provinces, were powerful forces that kept circulation of knowledge in the Dutch network continuously in motion.

Viewed as a whole, however, the Dutch network appears for a long time to have remained more 'centred' than the Spanish one. New centres of knowledge accumulation in the overseas colonies did not emerge until at a very late stage. Outside the home country, the knowledge infrastructure in the Dutch seaborne empire long remained fairly underdeveloped. While Spanish America, for example, boasted the foundation of thirty universities between 1538 and 1810 along with numerous colleges, monasteries and hospitals[73], the Dutch settlements only managed to sustain a few institutions that served more or less continuously as centres for the collection and circulation of knowledge, namely, the hydrographical office, the hospital and the apothecaries' shop in Batavia and the Company's garden in Cape Town.[74]

This underdevelopment of the overseas knowledge infrastructure may well be explained by the fact that the administration of the Dutch overseas settlements was entirely left to trading companies, without any significant interference by the central government or by religious organizations. In this regard, differences in goals

[72] De Vos, "An Herbal El Dorado," 121, Cañizares-Esguerra, *Nature*, 58-59

[73] Goodman, 'Science, Medicine, and Technology," 26.

[74] On the Company's garden at the Cape of Good Hope, see Fleischer, "[Exchanging] knowledge and nature" as well as her essay in this volume. Note that Fleischer offers a different interpretive view of the VOC's history of knowledge accumulation and circulation than developed here.

between the Society of Jesus and the VOC, despite their obvious similarities as long-distance corporations, *did* matter: the VOC was more interested in making profit, the Jesuits more in saving souls.[75] The VOC's care for its garden at the Cape was the exception rather than the rule: the Cape after all had a special importance as a refreshment station for ships en route to Asia.[76] For the Jesuits, accumulation of knowledge on nature was a means to this overarching end and thus a legitimate pursuit, even if it did not immediately result in the discovery of new drugs, or the VOC accumulation of knowledge on nature that went beyond the practical was a luxury that the company was only intermittently prepared to support. Employees and directors of the Dutch East-India Company who in the seventeenth century conducted scholarly research (and sometimes entered into contact with Jesuits), did so on their own accord.[77] The decline of exchange of knowledge with Jesuits after 1700 must largely be ascribed to the disappearance of such dedicated scholars among the personnel of the VOC.

It was not until the very last decades of the eighteenth century that groups of people in Dutch settlements overseas finally became as interested and active in understanding their natural environment as communities in Spanish America had started to do long before. Citizens of Batavia and Paramaribo after c. 1780 began to found their own learned societies, conduct their own inquiries in natural history, agriculture or astronomy, publish their own journals and develop their own networks of correspondents abroad. The newly-founded scientific society in Batavia even received some material support from the VOC.[78] Thus, the knowledge infrastructure in Dutch settlements overseas finally assumed a more institutionalized form.

Support from government agencies for the expansion of knowledge infrastructures only grew to a limited extent, however. Although the Dutch state in the second half of the eighteenth century *did* create more provisions in the field of navigation technology, as we saw above, it was, in contrast with the Spanish government (or the English, French and Russian ones for that matter), not prepared to take an active part in the systematic collection and circulation of natural knowledge about the overseas world by organizing natural history expeditions or voyages of discovery. A Dutch equivalent for the fifty seven scientific expeditions to the colonies supported by the government of Spain did not exist. In the world of

[75] Clossey, *Salvation and Globalization*.

[76] Cf. Fleischer, "Company's Garden", in this volume.

[77] Boomgaard, "Making and Unmaking," 193-195.

[78] Boomgaard, "Making and Unmaking," 195-198, Davids, "Sources of Technological Change," 669-670.

state-sponsored global travelling in the late eighteenth century, the Dutch Republic was conspicuous by its absence. Thus, although the Dutch network was able to keep the circulation of knowledge continuously in motion, it did not significantly step up the process in the way other European states did by the end of the early modern period.

Conclusion

The Dutch and Spanish global networks of knowledge in the early modern period thus showed a more mixed character than the stylized accounts of Harold Cook or Jose María López Piñero suggest. Accumulation and exchange of knowledge in the Dutch network, on the one hand, was not entirely dominated by values instilled by commerce. The infrastructure that kept this process going was partly created and maintained by government institutions at a local, regional or central level. The management of the Dutch network took place by a mix of market and non-market mechanisms – a combination of 'invisible' and 'visible hands'. Accumulation and exchange of knowledge in the Spanish network, on the other hand, did not exclusively depend on sponsorship by the state or municipal governments. Religious organizations were a far less conservative, restrictive force than López Piñero assumed. Initiatives by 'enterprising settlers and merchants' in overseas colonies, however, did not carry as much weight in the collection and marketing of natural knowledge as Jorge Cañizares-Esguerra supposed. Whichever way one looks at it, the Spanish network was to a large extent managed by a 'visible hand'.

What is often overlooked in accounts on the accumulation and exchange in the Spanish empire or the Dutch Republic, are the connections between the two networks. These connections were, admittedly, of an intermittent nature, but they exemplify circulation of knowledge of the highest order: they demonstrate how knowledge created in a local setting could transcend political, religious and cultural boundaries, could become an almost universally shared good and eventually, at particular places, could be turned into some special, practical form for local use. The agencies that brought the Spanish and Dutch networks most closely together were organizations specialized in managing long-distance operations themselves, the Society of Jesus and the VOC. Yet, the dynamics of the networks were not determined by these intermittent connections, nor by the religious and mercantile organizations that acted as go-betweens. Changes and continuities were ultimately determined by forces inside the networks themselves, both in the metropolis and in settlements overseas.

Each network in the early modern period *did* show some capacity for change. In the Spanish network, communities in the American colonies began to use natural history and cosmography to create their own territorial and cultural identities from an early date, as Barrera-Osorio observed, while in the later eighteenth century the share of religious organizations substantially decreased and the Crown took a more energetic posture in the collection and transmission of knowledge than before. In the Dutch network, citizens in settlements overseas became more active at the end of the eighteenth century in building their own infrastructures for the accumulation and exchange of knowledge. At the end of the day, however, neither the Spanish nor the Dutch network cast off the structural features acquired in the early stages of growth, which ultimately put limits on the possibilities for further development in the circulation of knowledge within these global networks. The Spanish network throughout the early modern period remained heavily dominated by the 'visible hand' of the state, while the Dutch one remained essentially characterized by a combination of 'invisible' and 'visible hands.' But the Spanish state was thwarted time and again in its ambitions in the sphere of knowledge by economic, financial and political constraints, while the Dutch mixture of a high degree of decentralization, a low measure of coordination by state institutions and a relatively important role of market mechanisms was not able to generate an acceleration and expansion of knowledge circulation in the later eighteenth century. Perhaps the circulation of knowledge within, and between, both these networks might have benefitted greatly, if religious organizations had persistently been allowed to take a larger part in the process.

"I Giue Thee Leave to Publish"
New Atlantis and Francis Bacon's Republic of Knowledge

Pete Langman

G O D Blesse thee, my Sonne; And GOD blesse this Relation, which I haue made. I giue thee leaue to Publish it; for the Good of other Nations; For wee here are in G O D S Bosome, a Land vnknowne.[1]

So ends Francis Bacon's 'utopian' fiction, *New Atlantis*, a short work published late in 1626 by his one-time chaplain, secretary and amanuensis William Rawley alongside the rather more substantial work of natural history *Sylva sylvarum*. This short line, delivered by one of the fathers of Salomons House, the 'scientific' research institution that dominates both the text and its critical appreciation, is invariably overlooked in favour of the far more exciting terminal editorial insertion "The rest was not perfected". Overlooked or not, however, it clearly demonstrates the importance the text placed on publication, and as the narrator insists that the Bensalemites command "in forme of Courtesie", this "leaue to Publish" may be considered more of an order than an invitation.[2]

Bacon had lobbied hard for the establishment of a state-funded institution such as Salomons House throughout his career, from his first major philosophical work, the *Advancement of Learning* (1605), through to his magnum opus, the *Instauratio magna* (1620), arguing that it was the key to advancing man's knowledge. After his impeachment in 1621 on charges of accepting bribes effectively destroyed any hopes he had of establishing such an institute, Bacon devoted himself to textual matters, writing several new works, notably natural histories, as well as beginning the task of translating his extant output into Latin. While the exact date of composition is unknown – it is likely that *New Atlantis* was written during this period, though scholarly opinion ranges from 1605 to 1625[3] – *New Atlantis*

1 *New Atlantis* as found in Bacon, *Sylva sylvarum*, g2^{r} (*SEH*, III, 166).

2 *New Atlantis*, b2^{r} (*SEH*, III, 134).

3 Spedding mentions 1624 (*SEH*, III, 121), Renaker suggests that it was planned in 1616 ("A

shares an obsession with temporal placement with the works Bacon produced between his impeachment and his death in 1626. Bacon dedicated these final works in pointed fashion, favouring Prince Charles over the king; that is, favouring the future over the present. The text which the narrator of *New Atlantis* brings back from Bensalem, an island situated "beyond, both the Old World, and the New", is indicative of this, and it works alongside Bacon's translations and his natural histories in urging his readers to actively engage and improve natural philosophy.[4] Denied a state-funded institution, Bacon seemingly switched his attention to putting in place a bibliographical superstructure designed to help encourage the future formation of a loose coalition of like-minded individuals throughout Europe who would work in concert to advance the cause of knowledge.

As a work concerned with discovery, *New Atlantis* seems to serve as a neat example of the model of scientific advance Bruno Latour presents in his seminal *Science in Action*, especially his concepts of the immutable mobile and the centre of accumulation, both of which he delivers tightly wrapped within a seafaring metaphor. Bacon's text also complicates it, however, as while *New Atlantis* initially follows the same pattern of discovery as that of Latour's seafarer Lapérouse, it soon diverges as it becomes plain that the sailors at no point enter into a position of dominance. The Bensalemites not only dominate the sailors' present, but their past and future, too, as they demonstrate their superior knowledge of European history and deliver a vision of the future. Finally, while the text which the narrator returns to Europe clutching is a sort of immutable mobile, it is not one made by the explorers or the culture from which they hail. It is in many ways a revelatory text, delivered into his hands to allow the Europeans to reproduce the advances made on the island – the Bensalemites thus potentially dominate the future. It is the island of Bensalem, and particularly Salomons House, which best fits Latour's description of a centre of accumulation.

Primarily a document about the accumulation of knowledge, *New Atlantis* is a summation of Bacon's ideas of natural philosophy and the importance of natural history – it is, in effect, a map explaining how 'science' was to be done. For Bacon, natural history was necessarily a collaborative work, but in the final years of his life he realised that this collaboration had to take place not in an institution, but textually. Through engagement and adjustment of natural historical texts the

miracle," 188), while Matar puts its creation as between 1613 and spring 1621 ("The sources," 780), Bierman between 1605 and 1623, ("*New Atlantis* revisited," 127), Sharon Achinstein is happy with 1624 ("How to be a progressive," 250), while Jardine and Stewart suggest that it was written in the last few months of 1625 (Jardine and Stewart, *Hostage to Fortune*, 499-500).

4 *New Atlantis*, b2^{r} (*SEH*, III, 134).

text effectively becomes the centre of accumulation: a Salomons House in bibliographical form. In this way, Bacon seems to have supported the creation of a republic of knowledge predicated on the widespread and accurate dissemination of texts.

The problems this second attempt at the creation of a research institute ran into are perhaps best illustrated by the relationship between William Rawley and the Dutch scholar Isaac Gruter, and how they looked to publish Bacon's works after his death. Both could lay claim to some authority in matters Baconian. Rawley was not only intimately acquainted with both Bacon and his works, but came into possession of much of the extant Baconiana following his master's death and was methodically, if slowly, preparing it for publication according, as he put it, to Bacon's instructions.[5] Isaac Gruter had acquired several Baconian manuscripts from William Boswell which he was keen to publish alongside the Latin translation of Bacon's *Sylva sylvarum* prepared by his brother Jacob. Gruter wrote to Rawley several times, asking for editorial input with the revision of *Sylva* as well as access to some of the more important manuscripts he held. Gruter's letters seem to have re-ignited Rawley's own campaign of dissemination, the dissemination of Bacon's works in Latin, "for the benefit of other nations," and it is as if Gruter instinctively understood Bacon's call to publish at the end of *New Atlantis*.[6] In the collaboration and conflict we see between Rawley and Gruter we find the gradual unfolding of the process Bacon had instigated with the exhortation of the father of Salomons House, an unfolding illuminated by Latour's model.

Salomons House as a Textual Institution

Critical thinking on *New Atlantis* has been guided if not dominated by the first lines of Rawley's letter To The Reader:

> This *Fable* my *Lord* deuised, to the end that He might exhibite therein, a *Modell* or *Description* of a *Colledge*, instituted for the *Interpreting* of *Nature*, and the Producing of *Great* and *Marueilous Works* for the *Benefit* of *Men*; Vnder the Name of *Salomons House*, or the *Colledge of the Sixe Dayes Works*. And euen so farre his *Lordship* hath proceeded, as to finish that Part. Certainely, the *Modell* is more Vast, and High, then can possibly

[5] See dedicatory letter to *Operum moralium*, A3^{r}, in which Rawley wrote "E*A quæ* Honoratissimus Dominus, *mihi olim in Mandatis dedit*, Lectori *ut exponerem*, *hæc sunt* [These are the things which the most honourable Master gave to me once in his orders, and in what manner I was to set them before the reader]."

[6] *SEH*, I, pp. 9-10. From Rawley, *Resuscitatio.*

be imitated in all things; Notwithstanding most Things therin are within Mens Power to effect.[7]

Several contemporaries also took these words literally. Thomas Bushell, for example, announced his intention to finish "*SOLOMONS* House in all its dimensions, and with all the accommodations and endowments thereof, according to his Lordships own Heroick *Idea*," inviting Samuel Hartlib to Lambeth Marsh to view its progress,[8] while Joseph Glanvil perhaps saw the work a little more clearly, calling it a "*Prophetick Scheam* of the ROYAL SOCIETY."[9]

New Atlantis is primarily a text of discovery, one whose narrator is part of a ship's company that, lost in the South Seas and fast running short of food, water and hope, stumble upon an unknown island called Bensalem, which appears out of the empty sea in answer to their prayers that God might "now discouer Land to vs, that we mought not perish."[10] Upon arrival, they are treated in a rather business-like manner, the natives demonstrating in all manner of subtle ways their utter superiority. The sailors are quarantined – in the House of Strangers, the institution that serves as a guest-house-cum-quarantine-cum-hospital – where they experience the rather unusual feeling, for European explorers, of slowly realising that it is they who belong to the inferior culture. Gradually, however, the island's culture, society, history and most importantly its 'scientific' research institute become open to them, primarily through the intellectual largesse of the Governor of the House of Strangers. Overwhelmed by the richness and advanced nature of the society they have encountered, the sailors accept an invitation to remain upon the island, though the narrator himself is encouraged to return to his home country with invaluable riches. These riches do not take the form of gold, jewels, exotic goods or even the knowledge achieved in this advanced society, but an account of how the islanders have achieved all that they have. *New Atlantis* is, in many ways, the culmination of Bacon's philosophy as he had expressed it over the past thirty years – it is a text that aims, amongst other things, to tie together the disparate strands of Bacon's thoughts, religious, philosophical, social, and temporal.

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7 *New Atlantis*, a2^{r} (*SEH*, III, 127).

8 Bushell, M^{r}*Bushell's Abridgement*, A3^{r} [second set of sigs]; Hartlib wrote to Robert Boyle on May 8th, 1654, that "Yesterday I was invited by the famous *Thomas Bushel* (for I suppose you have seen his *Mineral Overtures* in print) to *Lambeth-Marsh*, to see part of that foundation or building, which is designed for the execution of my lord *Verulam*'s *New Atlantis.*" (Boyle, *Works*, VI, 88)

9 Glanvill, *Scepsis scientifica*, c1^{v}.

10 *New Atlantis*, a3^{r} (*SEH*, III, 129).

Bacon recommended greater co-operation between institutions, and the establishment of well-funded positions in universities to advance the sciences since the *Advancement of Learning* (1605), where he argues that "it is necessary to the progression of Scyences, that Readers be of the most able and sufficient men; as those which are ordained for generating, and propagating of Scyences, and not for transitorie use."[11] More telling than his plea for funding such that their endowments might "content the ablest man, to appropriate his whole labour, and continue his whole age in that function and attendance," is the emphasis on time, however.[12] Time, for Bacon, was not only mutable, but was a vital component in the discovery of new knowledge: "let great Authors haue their due, as time which is the Author of Authors be not depriued of his due, which is furder and furder to discouer truth."[13]

His most eloquent and extended plea for the establishment of a state-funded institution, the dedicatory letter that accompanied Bacon's magnum opus, the *Instauratio magna* of 1620, was qualified by a private, hand-written letter delivered with King James's presentation copy. In it, Bacon suggests that his ideas would be accepted in time, but that the endowment of a dedicated institution would bring this date closer:

> And to tell your Ma. trewly what I think; I accownt your
> fauor may be to this woork, as much as an hundreth
> years tyme. for I am perswaded, the woork will
> gayne upon mens myndes in Ages; but your gracing
> it may make it take hold more swiftly;[14]

His pleas fell on deaf ears, however, and within a year, his ambitions had taken another blow: impeached on charges of accepting bribes, Bacon was unceremoniously prised out of office, and found himself a disgraced former Lord Chancellor. He was not only ruined financially and briefly imprisoned, but also banished from the verge of the court, denying him access to the ear of the king, and thus to the funds necessary to realise his plans.[15] His plans now dashed, Bacon reacted in a

[11] *OFB*, IV, 58.

[12] *OFB*, IV, 58

[13] *OFB*, IV, 28.

[14] NLS, Adv. MS, 33.1.7, ll. 30-5. For more on this letter, see Langman, "private revision of public negotiations."

[15] In a letter to father Fulgentio in 1625, Bacon noted the financial ramifications of his proposals: "As for the third part, namely, the 'Natural History,' that is plainly a work for a King or Pope, or some college or order: and cannot be done as it should be by a man's private industry."

very interesting fashion, no longer dedicating his philosophical works to James, but increasingly appealing to a new benefactor: the future. The dedicatory letter for *Historia vitae et mortis* begins with the line "To the present and future ages, greeting," while in the *Abecedarium novuum naturae* Bacon writes "because I have little faith in the genius of our times, [. . .] I deal out work for ages to come."[16] *New Atlantis* is itself the text the narrator brings back from Bensalem to publish, but it isn't brought back from a *place* so much as a *time*: for Bacon, Bensalem was one of Europe's possible futures.[17]

As well as his appeals to the future, the final five years of his life saw Bacon particularly concerned with producing exemplary natural histories and with making his works available throughout Europe, ordering that several of his works be translated into Latin "for the benefit of other nations."[18] If this sounds familiar, it is because it is rather close to the suggestion of the father of Salomons House that the narrator publish "*for the Good of other Nations*." As we shall see, Bacon's death did not have an adverse impact on this European dissemination, as Rawley not only continued translating Bacon's works, publishing the collection *Operum moralium et civilium tomus* in 1638, but was also involved with their dissemination in Continental Europe.

That *New Atlantis* sees a sailor turned natural philosophical evangelical and publisher is perhaps inevitable, as Bacon had long relied on seafaring metaphors to help the gradual unveiling of his philosophy, writing that *Novum organum* was

(*LL*, VII, p. 533n; cf. Bacon's *Parasceve* (*OFB*, XI, 451)). René Descartes, too, noted the vast quantities of cash Bacon's natural historical plans would require, writing in the 1648 edition of his *Passions de L'Ame* that the *Instauratio magna* and *New Atlantis* contain "the best thoughts touching the method to drive physics to its perfection," before noting that "all the revenue of two or three kings, the most powerful on earth, would not be sufficient to put in place all the things which it requires to have its effect." [I'ay vu aussi l'Instauratio magna & le Novus Atlas du Chancelier bacon, qui me semble estre, de tous ceux qui ont escrit avant vous, celuy qui a eu les meilleures pensees, touchant la methode qu'on doit tenir pour conduire la physique a sa perfection; mais tout la revenu de deux ou trois Roys, des plus puissans de la terre, ne sussiroit pas pour mettre en execution toutes les choses qu'il requert a cet effect] (Descartes, *Passions*, ***3v, my translation).

16 *OFB*, XIII,173; *SEH*, V, 215 (*SEH*, II, 103), Bacon, *Baconiana*, O3r.

17 For more on *New Atlantis* and its relation to a possible future, my essay "The Future Now," 142-58.

18 *SEH*, I, 9-10, from *Resuscitatio*. In a letter to King James on the subject of *De augmentis scientiarum*, the 'translation' of the *Advancement of Learning* into Latin, he wrote that "It is a translation, but enlarged almost to a new work. I had good helps for the language. I have also been mine own *Index Expurgatorius*, that it may be read in all places. For since my end of putting it into Latin was to have it read everywhere, it had been an absurd contradiction to free it in the language and to pen it up in the matter." (*LL*, VII, 436)

designed to "make the human intellect ready to take to the high seas."[19] Bacon explicitly compares ship-borne trade and especially discovery with bibliographical communication in the *Advancement of Learning*:

> ... if the inuention of the Shippe was thought so noble, which carryeth riches, and commodities from place to place, and consociateth the most remote regions in participation of their fruits: how much more are letters to bee magnified, which as Shippes, passe through vast Seas of time, and make ages so distant, to participate of the wisedome, illuminations, and inuentions the one of the other?[20]

Later in the same work he extends the metaphor further, connecting knowledge and cartography in one neat image:

> Thus haue I made as it were a small Globe of the Intellectuall World, as truly and faithfully as I coulde discouer, with a note and description of those parts which seeme to me, not constantly occupate, or not well conuerted by the labour of Man.[21]

Bacon, Latour, and the Domination of Nature

Bacon's use of seafaring metaphors with regards the acquisition of knowledge is echoed in Bruno Latour's seminal work on the nature of scientific progress and its manifestation, *Science in Action*. Latour borrows much Baconian rhetoric and explains two key concepts, the immutable mobile and the centre of accumulation, through reference to a journey of discovery undertaken by Lapérouse in 1787, noting his experience in encountering the uncharted Sakhalin, and the effect of subsequent mapping of the area.[22] Latour uses the word domination for the acquisition of knowledge, echoing Bacon's words that "nature is not conquered save by obeying it":

> ... the cartographer *dominates* the world that dominated [...] The balance of forces between the scientists and the earth has been reversed; cartography has entered the sure path of science; a centre (Europe) has been constituted that begins to make the rest of the world turn around itself.[23]

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19 *OFB*, XI, 29.

20 *OFB*, IV, 53.

21 *OFB*, IV, 192. See also *The Praise of Knowledge*, delivered as part of a device entitled *Of Tribute; or, giving that which is due* (*Francis Bacon: The Major Works,* 22-51). For the engraved title of *Novum organum*, see *OFB* XI, and Corbett and Lightbown, *The Comely Frontispiece*, 184-89. *New Atlantis* begins with the words "WEE sayled from *Peru*, (wher wee had continued by the space of one whole yeare,) for *China* and *Iapan*, by the South Sea." (*New Atlantis*, a3r)

22 Latour, *Science in Action*, 215.

23 Reference to *OFB* XI, 65; quotation from Latour, 224.

It is in the creation of stable and transportable knowledge that the discoverer not only comes to dominate the world around him but allows for this domination to occur at a distance, at the centre of accumulation, where the packets of stabilised knowledge are accumulated and allowed to affect one another. In this sense, Latour is reiterating Bacon's most famous utterance, *Scientia potestas est*: knowledge is power. While this statement is invariably taken out of context – Bacon here discusses the relationship between God's foreknowledge and his active control over events – it does illustrate both Bacon's attitude to the acquisition of knowledge and Latour's description of its creation.

It is through the translation of the natural world into a representation that can be easily transported and assimilated by distant observers that the world can be understood at one remove.[24] This is what Latour means by the immutable mobile: a knowledge packet that takes the form of maps, graphs, equations and so forth, which must be both stable and mobile. Bacon, too, advocated something similar, the aphorism, which as the basic unit of knowledge both complements and complicates Latour's ideas. Firstly, it is designed, like the immutable mobile, to present the phenomena in question in an unadorned, instantaneous fashion.

> But that other delivery by aphorisms has many excellent virtues whereto the methodical delivery does not attain. First it tries the writer, whether he be light and superficial in his knowledge, or solid. For aphorisms, not to be ridiculous, must be made out of the pith and heart of sciences. For illustration and excursion are cut off; variety of examples is cut off; deduction and connexion are cut off: descriptions of practice are cut off; so there is nothing left to make the aphorisms of but some good quantity of observation.[25]

Secondly, and perhaps most importantly, the aphorism is designed to encourage further discovery.

> Lastly, aphorisms, representing only portions, and as it were fragments of knowledge, invite others to contribute and add something in their turn; whereas methodical delivery, carrying the show of a total, makes men careless, as if they were already at the end.[26]

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[24] In this sense, Bacon and Latour both consider the problem of witnessing, that is, how one can communicate the reliability of a source of information through textual means. Bacon considered this in the *Parasceve* in some detail, suggesting that information be accompanied by a note indicating "whether he [the author] has it from hearsay or reading (which is what *C. Pliny* gives you), or from his own direct knowledge [...] and anything else like that which affects one's estimate of reliability." (*OFB*, XI, 467) This problem is also addressed by the Royal Society, for which see Shapin and Schaffer, *Leviathan*, and Shapin, *A Social History of Truth.*

[25] *SEH,* IV, 450-51.

[26] *SEH*, IV, 451.

Latour's explication of the centre of accumulation relies heavily on the transference of knowledge from one place to another in the form of a map, and a map is exactly what *New Atlantis* is – a conceptual map of an island culture dedicated to discovering the secrets of nature. Its textual stability (which resembles that of the Bensalemite scriptures, as it is dictated directly from the mouth of a 'prophet' of natural philosophy, one of the fathers of Salomons House) and mobility means that in many ways it, too, is an 'immutable mobile'. But it is not merely Salomons House that presents the Baconian way of 'doing natural philosophy', but the entire island culture. The island of Bensalem possesses the ideal conditions for the accumulation of masses of natural-historical data. In this sense, *New Atlantis* presents a different knowledge to that of Latour's maps, and this knowledge has a different purpose.

The Revelation that is New Atlantis

New Atlantis contains many things, but simple answers are not amongst them – there are no new axioms or great revelations here to excite the reader. What it does contain, however, is a virtual map that charts the best way in which knowledge can be acquired, namely Bacon's 'method' based on the accumulation of vast quantities of natural historical data. The narrator's task, therefore, is to disseminate not specific knowledge, but the message of how to do natural philosophy, as well as the true nature of knowledge, and this 'how-to' revolved around accumulation. Latour, too, understands that the way in which knowledge is gained is at least as important as the knowledge itself.

> ...what is called 'knowledge' cannot be defined without understanding what *gaining* knowledge means. In other words, 'knowledge' is not something that could be described by itself or by opposition to 'ignorance' or to 'belief', but only by considering a whole cycle of accumulation: how to bring things back to a place for someone else to see it for the first time so that others might be sent again to bring other things back. How to be familiar with things, people and events, which are *distant*.[27]

We have already seen how *New Atlantis* as a text is representative of something 'brought back', but we are perhaps lacking a true sense of where this 'something' is being brought back from, and thus where, in Latour's schema, the next set of travellers might travel in search of more knowledge. Bensalem does not, however, exist in a geographical sense, and *New Atlantis* is a text that maps the cultural and philosophical state of Bensalem, not its position. The knowledge as brought back

[27] Latour, 220.

with the narrator is, therefore, able to offer only temporal access to Bensalem. It presents itself as a dialogue not with another country, but with another time – the text represents the possible physical state of Europe should its methods (that is, Bacon's natural philosophical prescriptions) be adopted. *New Atlantis* represents, therefore, a sort of communication with the future.

For Latour, the ideal laboratory functions as a centre of calculation, a place that because of its reputation and its track record with regards to the production of knowledge, becomes the "obligatory passage point" for both people and knowledge, somewhere "strategically placed between anyone's goal and the fulfilment of that goal."[28] We have seen how Bacon felt that his philosophy required a state-funded research institute for it to reach its potential, and that this institute was made textually concrete within *New Atlantis*. Salomons House is not only a 'working model' of the ideal Baconian research institute, the ultimate centre of calculation that acts as the hub of the world's knowledge, but also one whose temporal history is extensive enough to allow for the accumulation of the natural historical data necessary for the production of knowledge.

In his explication of the workings of Salomons House, the father clearly presents the institution as the hub of knowledge, as knowledge is not only created on-site, through the large numbers of experiments being undertaken at any one time, but is gathered from around the world and brought back to be analysed. The account of Salomons House taken away from Bensalem by the narrator is a mixture of the institute's achievements, methods and hierarchy, and begins with an indication of the length of time taken by some of the experiments:

> The Preparations and Instruments are these. We haue large and deepe Caues of seuerall Depths: The deepest are sunke 600. Fathome: And some of them are digged and made vnder great Hills and Mountaines: So that if you reckon together the Depth of the Hill, and the Depth of the Caue, they are (some of them) aboue three Miles deepe. For wee finde, that the Depth of a Hill, and the Depth of a Caue from the Flat, is the same Thing; Both remote alike, from the Sunn and Heauens Beames, and from the Open Aire. These Caues we call the Lower Region; We vse them likewise for the Imitation of Naturall Mines; And the Producing also of New Artificiall Mettalls, by Compositions and Materialls which we vse, and lay ther for many yeares. Wee vse them also sometimes, (which may seeme strange,) for Curing of some Diseases, and for Prolongation of Life, in some Hermits that choose to liue ther, well accommodated of all things necessarie, and indeed liue very long.[29]

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[28] Latour, 151-52.

[29] *New Atlantis*, e2^{r-v} (*SEH*, III, 156-57).

The father then lists the various accomplishments of Salomons House, providing the narrator with a basic understanding of both the Bensalemite method and its ultimate success. The message of this account is not merely based around the continuous and progressive accumulation of data, but also the collaborative nature of the institute. The length of time covered here also shows how these discoveries are not the result of individual genius but of a succession of individuals, a succession that cannot succeed without the dedicated record-keeping prevalent throughout Bensalemite culture as well as in Salomons House, and that Bacon promotes throughout his works, such as in *De sapientia veterum*: "the perfection of the sciences is to be looked for not from the swiftness or ability of any one inquirer, but from a succession."[30]

Salomons House, with its "Merchants of Light" who collect "*the* Bookes, *and* Abstracts, *and* Patternes *of* Experiments *of all other* Parts," and the experiments taking place in the various laboratories over time, is a fictionalised literary representation of the process Bacon described in the *Parasceve ad historiam naturalem*, or *Preparative to a Natural History*, which was designed to be

> . . . a description and delineation of a natural and experimental history which may serve for the building up of philosophy, and embrace material tested, abundant, and properly arranged for the work of interpretation which will follow it.[31]

But it is not merely the institute that is geared towards the progressive accumulation and collection of data necessary for the production of knowledge. *New Atlantis* presents the whole culture of Bensalem as possessing the temporal reach to undertake the sort of work Bacon talked about dealing out "for ages to come." Bensalem has been a functioning civilisation, powerful yet eirenic, for several thousand years, and temporally it is, as the narrator suggests, "*beyond*, *both the Old World*, *and the New.*"[32] It has escaped the seemingly inevitable rise and fall of empires, something Bacon considered a major hindrance to learning.

> For of the twenty-five centuries that men's memory and learning run to, scarcely six which were productive of sciences and helpful to their advancement can be set aside and picked out. Now times no less than places have their desert wastes. For we can properly count

[30] *SEH*, VI, 753, 675.

[31] For short quotation see *New Atlantis*, f4^{v} (*SEH*, III, 164). In the *Parasceve*, Bacon writes that "the materials for the intellect are so widely spread out that they ought to be sought out and gathered in (as if by agents and merchants) from all sides" (*OFB*, XI, 451). For block quotation, see *OFB* XI, 451, 473.

[32] *New Atlantis*, b2^{r} (*SEH*, III, 134).

only three revolutions or periods of learning: the first with the Greeks; the second with the Romans; and the third with us.[33]

While Europe had only seen six centuries in the previous twenty-five that have contributed to mankind's knowledge, Bacon not only presented Bensalem's history as continuous and continuously fruitful, but also as faithfully *recorded*. In his narrative, the governor tells the sailors how the state of navigation has decayed in the past three thousand years, nonchalantly pointing out that the island "had then fifteene hundred strong Ships, of great content. Of all this, there is with you sparing Memory, or none; But we haue large Knowledge thereof," this knowledge coming from "faithfull Registers of those times."[34] The governor thus simultaneously asserts not only Bensalem's longevity, but also the reliability of this information; in Bacon's timescheme, the knowledge in Bensalem that is backed up by records stretches back to before the time of Solomon.[35]

The conditions on Bensalem are diametrically opposed to those in Europe, where time "seemeth to be of the nature of a Riuer, or streame, which carryeth downe to vs that which is light and blowne vp; and sinketh and drowneth that which is weightie and solide."[36] On Bensalem, however, the keeping of accurate and continuous records that cover the island's history in its entirety mirrors the workings of Salomons House.

The knowledge contained in *New Atlantis* is an explanation of the conditions under which Baconian natural philosophy may be fruitfully undertaken, and as such it is not merely the workings of Salomons House that are of importance, but the text as a whole. But the knowledge delivered in *New Atlantis* is not the knowledge that Latour describes as allowing the centre to dominate from afar – that is, knowledge of things or places, but the way of acquiring and coding this knowledge. *New Atlantis* is not Bacon's plea for a *physical* centre of calculation so much as it is the beginning of a textual and atemporal centre in which *texts* act as the locus around which knowledge circulates.

In the publishing of his natural histories in the years before his death, Bacon was explicit in his hope that it would inspire others to action, writing in the dedicatory letter to the *Historia naturalis* that "perhaps others will be moved by my example, especially when they have appreciated what I am up to," giving "directions for new experiments," while including explanations of each experiment "in

[33] *OFB*, XI, 123.

[34] *New Atlantis*, c1^{v} (*SEH*, III, 141).

[35] See *OFB*, XI, 123.

[36] *OFB*, IV, 29. Cf. *SEH*, III, 227; Farrington, *The Philosophy of Francis Bacon*, 80; *SEH*, III, 599.

case it is flawed, and also so as to prompt others to work out better ways."[37] In the *Parasceve*, Bacon wrote that his natural histories are not end points, but merely posts along the way; he was particularly keen that anyone who sees a better way of carrying out the experiments ought to set it down.

> For my own part, if I have wrongly given credit to anything, or grown sleepy or inattentive, or become weary on my way and left the investigation unfinished, I nevertheless make the things plain for all to see, so that my mistakes can be spotted and separated out before the body of science is further infected by them, and also so that my labours can be carried on easily and expeditiously.[38]

This exhortation was certainly followed by several readers, as can be seen in the relentless re-writing of *New Atlantis*, and the marginalia found in one copy of *Sylva sylvarum*, published in 1627, and acquired by one James Clitherow in 1638, for example.[39] In this book, at least five different hands scribbled various comments including such incisive remarks as the "what's this!" which we find alongside Experiment 286. More insightful and indicative of the reader's acceptance of Bacon's challenge to consider how the knowledge set down might be built upon, is the annotation to Experiment 238. The Experiment itself is an aphorism concerning the imitation of the human voice.

> No beast can imitate the speech of man, but birds only; for the ape itself, that is so ready to imitate otherwise, attaineth not any degree of imitation of speech. It is true that I have known a dog, that if one howled in his ear, he should fall howling a great while.[40]

Next to it, the annotator has written the following:

> I hav tried this
> expt, but the dogg
> must love him
> who doth it[41]

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37 *OFB*, XII, 5, 15

38 *OFB*, XI, 21.

39 *New Atlantis* was rewritten in 1660 by one R.H., and an edited version also appeared in John Heydon's *The Holy Guide*. The marginalia is found in Francis Bacon, *Sylva sylvarum*, BL shelfmark 982.f.14. The title *Sylva sylvarum* translates as 'a forest of forests' or 'a forest of materials', and its centuriate organisation seems to accord with Bacon's prescription in the *Parasceve*: "...make sure that everything which is adopted is set down briefly and concisely, so that they are not exceeded by the words that report them. For no one collecting and storing materials for shipbuilding or the like bothers (as shops do) about arranging them nicely and displaying them attractively; rather his sole concern is that they are serviceable and good, and take up as little space as possible." (*OFB*, XI, 457).

40 *Sylva sylvarum*, BL 928.f.14, I2^{r}.

41 *Sylva sylvarum*, BL 928.f.14, I2^{r}.

What is happening here is textual collaboration – by commenting on experiments, seeing them as works in progress rather than the finished article, the readers become collaborators, members of what is effectively a Baconian republic of knowledge. This republic, which can be inferred from Bacon's writings, did not rely on the efforts of its instigator because, as with the final words of *New Atlantis*, the implications of his works were designed to outlast their writer. The relationship between William Rawley and Isaac Gruter is a good example of how this 'republic' relied on the dissemination of Bacon's works, and particularly his natural histories, in order for it to begin to take shape. Gruter, it seems, effectively took up the challenge laid down at the end of *New Atlantis*, and attempted to act in the place of the narrator, publishing the Baconian message "*for the Good of other Nations*": in this case the Dutch Republic. His communication with William Rawley shows how difficult he found this task, though his efforts were not in vain – it seems as if his failure inspired Rawley to act.

Publishing the Republic of Knowledge in the Dutch Republic

It is in the rather fractured relationship between William Rawley and Isaac Gruter that we find a locus of tension between Bacon's apparent desire for a situation in which his *texts* might become the de facto centre of calculation, and the necessity or otherwise for a geographical centre to this process. Rawley and Gruter tussled over the revision and publication of several pieces, notably Bacon's *Sylva sylvarum*, a tussle that in many ways was over the issue of textual authority.[42]

Isaac Gruter (1610-1680) was a Dutch scholar and schoolmaster, conrector of the Latin school in Middleburg, and later Rector of the Latin schools of Maastricht and Zeeland, finally taking up the post of Rector of Rotterdam's Erasmus school of Latin. As a scholar he built up an impressive library of some 4,000 volumes, and counted John Selden, William Boswell, Constantijn Huygens, Isaac Beeckman, Pierre Gassendi, Nicholas Hensius and William Rawley amongst his intellectual network. His association with Bacon's works is easiest to date from the introductory letter he penned for his brother Jacob's 1648 Latin translation of *Sylva sylvarum*, an edition he evidently considered flawed, as Jacob began work revising almost as soon as it was published, with Isaac asking his English contacts,

[42] The centre of calculation for Latour, we recall, becomes the "obligatory passage point" for both people and knowledge, somewhere "strategically placed between anyone's goal and the fulfilment of that goal." (Latour, 151-52) It is this function that *Sylva* and Bacon's other works fulfil, as we have seen.

notably Browne and Rawley, for advice and information. Jacob's death meant the project took almost a decade to complete, and during this time Gruter published a manuscript he seems to have acquired from William Boswell, the *Scripta in natvrali et vniuersali philosophia* (1653), and planned the publication of a Baconian *Opera omnia* with printer Lodewijk Elzevier.[43]

William Rawley is perhaps the single most important figure with regards to Bacon studies, as much of what is accepted wisdom regarding Bacon comes directly from Rawley's pen. Closely involved in the production of Bacon's later works, with the majority of the surviving manuscript notes for *Sylva sylvarum*, for example, being in his hand,[44] Rawley was adamant with regards his authority over Bacon's legacy.

> Having been employed, as an *Amanuensis*, or dayly instrument, to this *Honourable Authour*; And acquainted with his *Lordships* Conceits, in the composing, of his *Works*, for many years together; Especially, in his writing Time; I conceived, that no Man, could pretend a better Interest, or Claim, to the ordering of them, after his Death, then my self.[45]

How exactly he laid his hands on Bacon's textual remains is something of a mystery, as Bacon's will contains the following instructions:

> I desire my executors, especially my brother Constable, and also Mr. Bosvile, presently after my decease, to take into their hands all my papers whatsoever, which are either at cabinets, boxes or presses, and them to seal up until they may at their leisure peruse them.[46]

Having acquired them, however, Rawley began to publish, beginning with *Sylva sylvarum* and *New Atlantis*, moving onto the collection of Latin translations *Operum moralium et civilium tomus* in 1638 before producing the *Resuscitatio* of 1659, which included his authoritative *Life of the Right Honourable Francis Bacon*.[47]

Both Rawley and Gruter therefore had not unreasonable pretensions to act in the manner of the narrator of *New Atlantis*, and publish Bacon's works "for

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[43] As Graham Rees has pointed out, the letter to the *Scripta* alludes to Gruter's possession of other works which were "elaborated in the political and moral kind given into my safekeeping by the deceased [William Boswell] and not yet ready for publication." (fr. *Scripta* (1653), qu. In *OFB*, VI, lxxxii) For a fuller discussion of Gruter and the Baconiana he possessed, see *OFB*, VI, lxxv-xcv.

[44] See BL Add MS 38693.

[45] *Resuscitatio,* A4^{r}.

[46] *LL*, VII, 540. The will was dated 19 December, 1625.

[47] See also *SEH*, I, 3-18.

the good of other nations," though Gruter recognised the importance of Rawley's blessing for any project, due to both his holdings of Baconiana and his direct relationship with Bacon. Rawley, for his part, understood that there was no small appetite for Bacon's works abroad, writing that:

> His fame is greater and sounds louder in foreign parts abroad, than at home in his own nation; thereby verifying that divine sentence, *A prophet is not without honour, save in his own country, and in his own house*.[48]

Indeed, there was a great deal of Bacon published in continental Europe in the decades following his death. In the Netherlands alone, the years 1626 to 1667 (the terminal dates of Bacon and Rawley respectively), saw the publication of twenty seven Baconian editions.[49] While these editions were spread over ten different printers, several of them had Isaac Gruter in common. Isaac's brother Jacob had translated *Sylva sylvarum* into Latin, a translation published in 1648, but had died in January 1652, before he had finished his revision, a work that finally saw the light of day in 1661.[50] Isaac, for his part, translated Bacon's *Descriptio globi intellectualis* and *Thema coeli* into Latin, and provided the *Lectori S* (letter To The Reader) to Elzevier's 1653 edition of *Scripta* and his brother's *Sylva*. In 1651 he wrote to Thomas Browne on the subject, mentioning how Jacob's new translation of *Sylva sylvarum* into Latin was coming along nicely, and how he had not only come into possession of Boswell's Baconiana, but was intending to publish "at any time now if the author's fame carry matters forward speedily."[51] Gruter's communications with Rawley not only show his keenness and willingness to be the Continental agent of Bacon's philosophy, but also how Rawley's apparent defensiveness frustrated, annoyed and finally defeated him. The fate of Isaac Gruter's ambition neatly illustrates not only the hunger in the Low Countries for natural philosophical works, but also just how difficult a task Bacon had left in his wake.

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48 *SEH*, I, 15.

49 According to Gibson, the 1630s saw seven editions, with two of *De sapientia veterum* (1633/34), two of *Historia vitae et mortis*, (1636/37), and *Historia ventis* (1638). The 1640s saw twelve, with five *Essays* (1640/44/46/47/49), two of the *History of Henry VII* (1642/47), *Novum organum* and *De augmentis* (1645), *De ventis* and two *Sylva sylvarums* (1648). The 1650s saw *Scripta in naturali et universali philosophia* (1653) and *Essays* (1659). The 1660s saw *Novum organum* (1660), *Sylva et nova atlantis* (1661), the *Essays*, *Henry VII*, and *De augmentis* (1662), and *Opuscula* (1663), see R. Gibson, *Francis Bacon, A Bibliography*, and *Supplement*.

50 Jacob's Latin *Sylva* was published in 1648 by F. Hackius and L. Elzevier (Gibson nos. 185a and 185b), and Isaac's revised translation by Elzevier in 1661 (Gibson no. 186).

51 Quoted in *OFB*, VI, lxxvii.

As we have seen, Bacon's message regarding both dissemination and accumulation was shown *and* told throughout his works, though most notably shown in *Sylva sylvarum* and its companion piece *New Atlantis*, and told in the *Historia naturalis* and the *Parasceve.* Gruter's letters suggest that, whether wittingly or no, he understood Bacon's exhortations in the *Parasceve* not only to publish, but also to amend and adjust as appropriate. Writing in 1652, Gruter discusses Rawley's (now lost) comments on Jacob's Latin translation of *Sylva sylvarum*.

For your Observations on those Places, either not rightly understood, or not accurately turned out of the *English* by you published, (which, from one not a Native, in his first Essay, and growing in Knowledge together with his Years, if they be many, no man needs wonder at it, who understands the Psychological variety of an Argument of such extent, and rendred difficult by such an heap of things of which it consists, and for the expressing of which there is not a supply of words from the Ancients, *but some of a new stamp*, *and such as may serve for present use*, are required) I intreat you not to deny me the sight of them: That so I may compare them with the Corrections which my Brother (now with God) did make with a very great deal of pains. But, whether the *truth* of them answers his diligence, will be best understood by your self, and those few others by whom such Elegancies can be rightly judged of.[52]

Gruter is plainly very keen to disseminate Bacon's words with the utmost accuracy, while simultaneously showing Rawley that he has some authority for doing so, sending him

. . . a Catalogue of those writings (a) which I had, in *MS*. Out of the study of Sir *William Boswel*, and which I now have by me, either written by the *Lord Bacon* himself, or by some *English Amanuensis*, but by himself revised; as the same *William Boswel* (who was pleased to admit to me a most intimate familiarity with him) did himself tell me.[53]

Gruter repeatedly assured Rawley that he not only had the wherewithal to publish, but also reputation and respect enough to be called upon to assist other publishers. In many ways, it seems as if Gruter was telling Rawley what Bacon told James in the letter sent alongside the *Instauratio magna*, that this would happen with or without Rawley's blessing, but it would be all the better for having it.

For the Book of *Dense and Rare Bodies*, which you have by you, perfected by the Author's last Hand, as likewise the *Fragments* which are an *Appendix* to it, I could wish that they might be here published in *Holland*, together with those hitherto unpublish'd *Philo-*

[52] *Baconiana*, Q1v-Q2r. Isaac Gruter to William Rawley, May 29, 1652.

[53] *Baconiana*, Q2r. (a) reads "*These were the Papers which* J. Gruter, *afterwards publish*' d, *under the title of* Scripta Philosophica".

sophical Papers copied by me, out of M.S.S. Of Sir *William Boswel*; seeing, if they come out together, they will set off, and commend one another.

I have begun to deal with a *Printer*, who is a Man of great Diligence and Curiosity. I will so order the matter, that you shall have no reason to complain of my Fidelity and Candor, if you leave that Edition to me, care shall be taken by me, that it not be done without honourable mention of your self. But it shall abate nothing of the offices of our Friendship, which, from this beginning of it, shall still further be promoted upon all occasions.

Lewis Elzevir, wrote me word lately, from *Amsterdam*, that he was designed to begin shortly, an *Edition in Quarto*, of all the Works of the *Lord Bacon*, in *Latine*, or *English*: but not of the *English*, without the *Translation* of them into *Latine*. And he desir'd my advice, and any assistance I could give him by *Manuscripts*, or *Translations*; to the end that, as far as possible, those *Works* might come abroad with advantage, which have been long received with the kindest *Elogies*, and with the most attested Applause of the *Learned World*. If you have any thing in your *Mind*, or your *Hands*, whence we may hope for assistance in so famous a Design, and conducing so much to the Honour of those who are Instrumental in it, pray let me know it, and reckon me henceforth amongst the devout honourers of the name of the *Lord Bacon*, and of your own Vertues. *Farewel*.[54]

Gruter soon became despondent, however, writing from Maastricht in 1655 that "[i]t is not just to complain of the slowness of your Answer, seeing that the difficulty of your Passage, in the season in which you wrote, which was towards Winter, might easily cause it to come no faster."[55] Gruter was plainly being somewhat disingenuous, as Rawley's attitude seems to have disillusioned Gruter to such an extent that he gave up his crusade.

Though I thought that I had already, sufficiently shew'd, what Veneration I had in the *Illustrious Lord Verulam*, yet I shall take such care for the future, that it may not possibly be deny'd, that I endeavour'd most zealously to make this thing known to the learned World.

But neither shall this Design, of setting forth in one Volume, all the *Lord Bacon's* Works, proceed without consulting you, and without inviting you to cast in your symbol, worthy such an excellent Edition: That so the Appetite of the Reader, provoked already by his publish'd Works, may be further gratifi'd by the pure novelty of so considerable an Appendage.[56]

Finally, Rawley trumped Gruter, apparently showing him through the simple expedient of publication that those papers he was so keen to publish (the identity of which is in question) were, in fact, already in the public sphere.

[54] *Baconiana*, Q2v-Q3r.
[55] *Baconiana*, Q5v.
[56] *Baconiana*, Q6r.

How much I hold my self honour'd by your Present of the Lord *Bacon*'*s Posthumous Works*, published lately by you in *Latine*, my thanks immediately return'd, had let you understand, if ill fortune in the Passage (which is, for divers causes, uncertain) had not deluded the care of a Friend, who did here with much readiness, undertake the Conveyance of them.

Now, the Gift is by so much the greater, by how much more the benefit I reap'd by diligent reading of those Papers, and by comparing them with some of the Lord *Bacon*'s Works, which I my self had formerly published. For to you we owe the more enlarged *History de Denso & Raro*, as also many other things, contain'ed in that volume, which saw not the Light before. One Paper I wonder I saw not amongst them, the *Epistle* of the Lord *Bacon* to Sir *Henry Savil*, *about the Helps of the Intellectual Powers*, spoken of long ago in you Letters, under that, or some such Title, if my Memory does not deceive me. If it was not forgotten, and remains among your private Papers, I should be glad to see a *Copy* of it, in the use of which, my faithfulness shall not be wanting. But, perhaps, it is written in the *English Tongue*, and is a part of that greater *Volume*, which contains only his *English Works*. If you will please to let me understand so much, and likewise give me assurance of obtaining that Book, in which the *Speeches*, and it may be the *Letters* of the Lord *Bacon*, written by him in *English*, are digested; you will render your memory sacred in my Mind, in the veneration of which, the chearfulness of a most devoted affection shall never be weary. *Farewel*.[57]

While Rawley seems in one sense to have taken up the gauntlet metaphorically laid down to him by Bacon in *New Atlantis*, working hard to disseminate his dead patron's thoughts and works, just as the narrator of *New Atlantis* was exhorted to, his rather 'proprietorial' attitude seems to have worked against the ambitions of potential 'agents' such as Gruter. According to Graham Rees, Elzevier was effectively Gruter's publisher, having published the 1648 *Sylva* and also editions of Savile, Gilbert and Grotius for him. Gruter had already published some Baconian natural-philosophical texts, presumably those he had acquired from Boswell in 1653, under the title *Scripta in naturali et universali philosophia,* and the pair also planned a Baconian *Opera Omnia*, for which Gruter requested that Rawley send him various texts. Rawley's refusal, or perhaps recalcitrance, on this issue effectively killed the project stone dead. Considering Gruter's apparent, though non-explicit, desire to emulate the narrator of *New Atlantis* and Rawley, it is perhaps ironic that in his correspondence with Rawley, Gruter suggested that the revision of his brother's Latin *Sylva* (eventually published in 1661 by Elzevier), would dispense with *New Atlantis*.

[57] *Baconiana*, Q8v-R1r.

That *Edition* of my Brother's, of which you write, that you read it with a great deal of Pleasure, shall shortly be set forth with his Amendments, together with some *Additions* of the like Argument to be substituted in the place of the *New Atlantis*, which shall be there omitted.[58]

If Gruter desired the wider dissemination of Bacon's works, and in doing so wished to be the man behind such dissemination, he was, perhaps, at least partially successful, as Graham Rees suggests.

The Gruter-Rawley correspondence may have had one substantial consequence. For twenty-five years Rawley had been sitting on the manuscripts eventually published in the *Resuscitatio* (1657) and *Opuscula* (1658) (Gibson, no. 230). Only after the letters of 1652-3 and the appearance of the *Scripta* did Rawley get on with the job.[59]

Isaac Gruter may have failed in his personal ambition to orchestrate the publication of previously unseen Baconiana, but it does seem as if his activities at the very least influenced Rawley to publish works he had long kept under wraps. In his later works, Bacon preached a mixture of accretive natural history, collaborative research and interactive engagement, a combination forced on him by James's recalcitrance when it came to funding his great project, the *Instauratio magna*. His 'final' work, *New Atlantis*, culminated in an exhortation to disseminate Baconian principles "for the Good of other Nations." William Rawley, the man to whom no-one, in his own words, "could pretend a better Interest, or Claim" to Bacon's works, seems to have been stung into action after Bacon's death by the activities and requests of Isaac Gruter, leading him to kick-start his efforts in following Bacon's exhortation to publish.[60]

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58 *Baconiana*, Q1^{v}. For more on the Gruters and their publication of Bacon's works, see *OFB*, VI, lxxv-lxxxv;*OFB*, XIII, lxxxi-lxxxiii.

59 *OFB*, VI, lxxix n.

60 *Resuscitatio*, A4^{r}.

A Wonderful Little Book. *The Dissertatio Astronomica* by Johannes Phocylides Holwarda (1618-1651)

Arjen Dijkstra

Introduction

While looking at the moon in the early winter of 1638 the Dutch philosopher Johannes Phocylides Holwarda (1618-1651) 'by chance' saw a 'disturbing light'. The young Phocylides Holwarda was observing the skies to collect data for a book on the motion of the moon. He was ambitious and hoped to further his career at the University of Franeker by attacking some of the best known Dutch astronomers of the day. For this he needed his own lunar observations to be precise and extensive. But the disturbing light offered him new opportunities; it would seem that he had accidentally discovered a whole new star. Holwarda completed his studies on the moon and had these printed in a nice little book. While this book was still in print, however, he decided to add a second part in which he claimed his discovery and explained at length what it was he had discovered. [1]

[1] I want to thank Lissa Roberts for inviting me to participate in the workshop in Ghent of which this volume is the result. I want to thank her as well for the numerous suggestions for improvement she made afterwards. All the other participants in that workshop also contributed to several ideas for which I owe my gratitude. My colleagues Tim Nicolaije and Fokko Jan Dijksterhuis, as well as my other colleague historians from the University of Twente contributed with their enthusiastic ideas and comments. An earlier version of this essay was discussed in a workgroup of the Dutch Huizinga Institute, I want to thank participants of that group and especially Robin Buning of Utrecht University for their critique. I am also indebted to Rienk Vermij of the University of Oklahoma who provided me with some essential details and useful comments.

For my use of the treatise by Holwarda I lean heavily on an unpublished translation that I found in the personal archives of H.K. Schippers (1893-1971), which are kept at Tresoar in Leeuwarden, The Netherlands. The translation is from the hand of Jacob Cohen (1911-1972). Liesbert Bonnema and Jelle Krol made these documents accessible to me. Holwarda describes his first sighting of the 'star' with the following words 'profectum errorum' and 'me perturbatum [. . .] faculam' see: Holwarda, *Dissertatio*, 189.

Ever since Holwarda reported on what he saw that winter night, he became viewed as one of Franeker's brightest lights. The booklet in which he claimed his discovery is one of the most discussed treatises in the history of astronomy to come from that university. In this essay I trace the conditions that made Holwarda's sighting possible and enabled him successfully to claim a discovery as he transformed his observation into a complete new astronomical phenomenon. Rather than celebrating Holwarda's work as a heroically individual achievement, however, this essay shows how the accumulated resources of the University of Franeker – some resulting from the political strategies responsible for the university's establishment and governing policies, some more specifically the fruits of Holwarda's predecessors at the university – and the community that grew up around it provided both a context for his successes and the means to achieve them. By giving a thorough historical analysis of the events that led up to Holwarda writing and publishing his book, I give insight into the production of natural facts at universities in the early modern period. I argue that the accumulation of knowledge was not enough for such a fact to be established. New explanations of the subject of study, the tools by which they were shaped and the vehicles by which they were presented were equally important.[2]

An interesting ambiguity rests at the core of this essay's narrative. For while Holwarda seems to have been at least partially motivated by the desire for local career advancement, success required him to craft a publication which, once produced, circulated with effects that extended far beyond Franeker. The University of Franeker might thus be thought of as a centre of accumulation and calculation in relation to this story and Holwarda's 'wonderful little book' might seem a candidate for what Bruno Latour defines as an 'immutable mobile'. The historian Adrian Johns, however, has shown how problematic it is to consider print in the early modern period in terms of 'immutable mobiles'. In a brief exposé of Latour's (and Elizabeth Eisenstein's) paradigmatic discussion of Tycho Brahe, Johns accentuates both the historical challenges of achieving textual mobility during the early modern period and the inherent instability of texts. Not only were authors – even those as authoritative as Tycho – hostage to the availability of a reliable press, distribution channels and patronage, texts themselves were and remain subject to the destabilizing impact of interpretation and use. By tracing the production and

[2] On the University of Franeker the best starting point of research is still Jensma, *Universiteit te Franeker*. The oldest reference I know of Holwarda as the 'Frisiae Lumen' is in his *Philosophia Naturalis* by the editor of this posthumously published book see: Holwarda, *Philosophia Naturalis*, 400. The complete title to the second part of the *Dissertatio Astronomica* is: *Pars Secunda de Novis Phaenomenis, sive Stellis*, Holwarda, *Dissertatio Astronomica*, 185.

subsequent travels of an astronomy book from Franeker in the middle of the seventeenth century I take up Johns' historiographical call to re-situate print culture in the concrete specifics of time and space as a corrective means of understanding how knowledge was historically constructed.[3]

In this essay I begin my analysis with an earlier sighting of exactly the same phenomenon Holwarda saw in 1639. I explain who sighted it and why it was hardly discussed in the European astronomical world of the day. This gives clues to the reasons why Holwarda's claim to a discovery was much more successful. With these pointers in mind I give background information on the academic/intellectual culture of the United Provinces and specifically on the province of Friesland where Holwarda was born and educated. I then introduce Holwarda and show how he was part of an academic society and how he functioned in this context. From there I move on to the star Holwarda sighted and how it was understood by him and his contemporaries. I explain how Holwarda was able to discover the star and show how he used the infrastructure provided by his university to make his claim. This leads to a short *Wirkungsgeschichte* of Holwarda's discovery. With this approach I show that Holwarda wrote the second part of his small booklet for a local market, but that it nonetheless appealed to a broader world. He tried to exploit his discovery to gain local status and success, which he gained, alongside international fame and recognition.

The Connections with Tycho Brahe and Johannes Kepler

What was it that brought Holwarda his success? Many histories of astronomy hail him for being one of the first to note a variable star. In the neck of the star sign Cetus (the Whale) he observed the 'wonderful' star that astronomers call Mira Ceti. This star appears in the sky every eleven months, but after coming to a sort of climax after five months, it disappears from sight for about half a year. Mira reaches a different maximum strength in each cycle; sometimes it is as bright as a second class star (clearly visible with the naked eye), but more often it does not pass a fourth class rating (barely visible with the naked eye). Precisely because of its whimsical nature, the star has been the subject of many astronomers' study. As recently as 2007 NASA proudly presented news that research had shown the star has a tail, much like a comet.[4]

[3] Adrian Johns, *The Nature*, 6-20.

[4] On the recent study of Mira Ceti by Nasa see for example: http://www.nasa.gov/mission_pages/galex/galex-20070815.html (retrieved December 3 2008).

This divergent and, to a certain extent, unpredictable nature of Mira Ceti led to it being 'discovered' more than once. The first well documented 'discovery' of Holwarda's star is closely connected to the Danish astronomer Tycho Brahe and his many assistants. At the end of the sixteenth century Tycho founded the foremost observatory of his time in Hven, Denmark. This observatory has been labelled a typical example of a centre of calculation by Bruno Latour. It was in Hven that Tycho was visited by many young scholars from all over Europe. These astronomers and scholars often acted as agents for Tycho, but just as often established outposts of Hven in their native countries. In numerous places all over Europe, Tycho's instruments were used and his methods were adopted by these students.[5]

The first discoverer of Mira Ceti was one of these assistants. David Fabricius, a clergyman from East-Frisia (Northern-Germany), was an avid astronomer even before he came into contact with Tycho. In 1596 he visited Hven and assisted Tycho for a short period. We know little of this visit, other than that he discussed how to build instruments with the Danish astronomer. Tycho was a prolific builder of new instruments to observe, measure and ultimately chart the heavens. These new instruments had to be precise and useable, essential (but not sufficient) conditions to make new knowledge trustworthy.[6]

These instruments and the way in which data was collected and interpreted were the keys to Tycho's way of observing the skies. It was the instruments that provided a vehicle for other astronomers to understand Tycho's observations and to reproduce them. It was his manuals and his training that, next to the instruments, made his students and assistants become actual disciples of Tycho. When they were able to observe on their own, they could share new collected data with Hven. It is important to note that Tycho operated as a model for other astronomers. He was not a typical example, but he and his observatory provided an ideal – an ideal he found himself impossible to achieve. Hven never actually was a centre of calculation; Tycho's prints never were both mobile and immutable. His books and prints thus can be viewed in the same way his instruments are perceived. They helped establish a European network of correspondence, in which astronomy was discussed.[7]

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5 On Hven as a centre of calculation, see Latour, *Science in action*, 132-144. How the network of Tycho functioned, see Mosley, *Bearing the heavens*, 50-90.

6 On Fabricius see Folkerts, "Der Astronom"; on Fabricius and his time with Tycho, see: Christiansen, *On Tycho's Island*, 264-266. Frabricius is often characterized as an 'amateur' astronomer. This was not the case, he can be seen as one of the first professional astronomers of the early modern period.

7 Much has been published recently on instruments and philosophy; a good starting point is pro-

After his visit to Hven, Fabricius was a member of this network. Armed with Tycho's knowledge on instruments he observed and recorded Mira Ceti shortly thereafter in 1596. He sent word of these observations to Tycho. For this celestial find to be recognized by other astronomers, Fabricius needed the coordinates he circulated to be measurable for all other astronomers. Otherwise it would be impossible to distinguish stars from each other. It seems that Fabricius did a splendid job; his coordinates of the new star were spot on. However success depends on a second condition that is as important as accuracy: other astronomers need to have access to the new knowledge. In this case, they needed access to the coordinates.[8]

In 1596 Fabricius wrote about his new star to Tycho and at the beginning of the seventennth century he shared his observations with Tycho's successor Johannes Kepler. Subsequently Kepler advocated these observations in his own work. In the footnotes to his *Ad Vitellionem Paralipomena* (1604) he gave an account of Fabricius' findings, but without including the coordinates. Around that same time Johannes Bayer added the star to his star atlas, but with very vague information on the exact position and it never became part of the mainstream discussion among astronomers. In 1609 Fabricius noted to his amazement that the star he observed in 1596, which had vanished afterwards, was back! He corresponded this immediately to Kepler. But Kepler, busily engaged in other things, never answered. Whatever Fabricius tried, he could not get Kepler's attention. At his wits end, Fabricius started vehemently attacking Kepler in his locally published prognostications. When Kepler finally responded, Fabricius had already died. The distribution of these smaller works by Fabricius and Kepler's reply never matched the range of Kepler's *Ad Vitellionem Paralipomena*. Neither ever became part of the larger European scholarly world. All in all one can conclude that Fabricius' sighting was published and talked about, but the actual impact of his work was rather small. Soon after 1609, his discovery of the star was forgotten. [9]

vided by Van Helden, *Instruments*. Bruno Latour provides an example of how easy it is to over-interpret these matters when he talks about preprinted forms that Tycho distributed in his network, to accumulate reliable knowledge. Adrian Johns has argued that these forms are a result of imaginative reading by Latour, see: Johns, *The Nature*, 17 footnote 26.

8 The coordinates given by Fabricius lived hidden in the personal papers of Tycho and Kepler, until Hevelius found them there and published on this in: Hevelius, *Mercurius in Sole*, 148-153.

9 On the first sighting by Fabricius the best starting point is Wattenberg, "David Fabricius". On Kepler mentioning Fabricius' sighting, see Kepler *Ad Vitellionem*, 464. For Bayer's listing of the star see: Bayer, *Unranometria*, Cetus. On Fabricius publishing on the star and trying to get Keplers attention see the work done by Edward Rosen and published in Kepler, *Kepler's Somnium*, 230. A plausible reason why astronomers had no interest in variable stars is given recently by Rienk Vermij of University of Oklahoma in a paper that will be published later this year.

Fabricius had observed the star with good instruments and noted down its correct coordinates. He shared these observations with the one person who was a central node in the correspondence network of astronomy of that moment. Fabricius, however, never succeeded in making his discovery public in a way that attracted the attention of the international world of astronomy. Interested colleagues in their turn never pressed his case hard enough nor gave all the relevant details on the new star. Only thirty years later would Johannes Phocylides Holwarda attract the attention of the international world of astronomy, from the small town of Franeker in the Dutch province of Friesland.

Friesland, Franeker and Mathematics

When the success story of the Dutch Republic in the seventeenth century is told, the focus is often on the province of Holland, with perhaps some attention to the provinces of Utrecht and Zeeland. But there was more to the Dutch Republic than these three provinces. The second university of the Republic, after the University of Leiden in 1575, was founded in the province of Friesland, in the town of Franeker in 1585.[10]

With the foundation of this educational institution the Frisians rivalled Holland's dominance on yet another terrain. They also had their own stadtholder (closely related to the Dutch Oranges). They were sovereign in foreign affairs. They had their own blossoming harbours. And they raised their own taxes, with which they (among other things) paid their own soldiers. All through the seventeenth and a large part of the eighteenth century Frisian regents and noblemen tried to emphasize their position as a second centre of power in the Dutch Republic, with various degrees of success. In internal affairs Friesland functioned even more strongly as an autonomous field, with its own currency, judicial system and even a language of its own that was spoken by a vast majority of its population. In trying to establish a second centre, Friesland tried harder than the other provinces of the Republic, even though it was not always more successful. The founding of the university must be seen in this light. It was the result of a policy of competition with a stronger brother, but also of the striving of local politicians who were trying to build a strong Reformed province.[11]

As was traditional in universities in the early modern period, the three most important faculties of the University of Franeker were Theology, Law

[10] On the founding of the University of Franeker, see Waterbolk, "Heeft de hogeschool".

[11] One of the aspects of this Frisian striving is explored in Groenveld, *Nassau uit de schaduw van Oranje*. For an analysis of the position of the Frisian province, see Breuker, *Negen eeuwen*.

and Medicine. Under influence of the ideas of Petrus Ramus (1515-1572), the propaedeutic education of practical mathematicians became a fourth cornerstone of both the University of Franeker and of Leiden from around 1600. Mathematics then consisted of several fields that are no longer associated with this field of academic activity. In addition to the widely recognized presence of astronomy, land surveying (important for imposing taxes and in disputes on ownership), fortification (important for warfare) and music were also considered part of mathematics. It might seem strange to somebody who is educated in the present-day system, but up to the nineteenth century the first job of an astronomer was not commonly considered to be stellar observation, but calculating the positions of celestial objects. The astronomer was thus seen as a mathematician *par excellence*. And astronomy had all kinds of practical applications, such as navigating by the stars at sea.[12]

The first proper professor of mathematics at Franeker was Adriaan Metius (1565-1635), brother to one of the most trustworthy claimants to the invention of the telescope.[13] His father was the *First engineer of the province of Holland*, an official who reported directly to the stadtholder of Holland. In the historiography Adriaan Metius is seen as the best start mathematics could have had at Franeker. In his time he was a well known mathematician who published over twenty editions both in Latin and the vernacular. His teachings and writings were often referred to by his contemporaries, until long after his death. Even at Jesuit colleges the books by Metius were often favorite textbooks. Metius had studied at the Universities of Franeker and Leiden, but equally decisive must have been his stay with Tycho Brahe in Hven. Together with Willem Janszoon Blaeu who would later found the famous publishing house, Willibrord Snell, who would become professor of mathematics at Leiden and Petrus Pontanus, who would become professor at Harderwijk, he was one of four important Dutch mathematicians who independently of each other visited Tycho, as Fabricius had done.[14]

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[12] On Ramism in Franeker, see Van Berkel, 'Franeker als centrum' and Hotson, *Common place learning*, 21 and 95. Both authors state that in the actual university Ramism ultimately was not as important as in other institutions (i.e. Latin Schools), it was however important for the foundation of the university and even more when the professor of mathematics was added in 1598. On mathematics in Franeker, see Van Berkel, 'Het onderwijs in de wiskunde'.

[13] A good biography on Metius is lacking, but a good effort is Jensma, "Adriaan Metius" [unpublished Master Thesis] (Groningen 1984), for details on his life the best reference is Terpstra, *De Friesche sterrekonst*, 53-64.

[14] On Metius as a teacher see the forthcoming book by Djoeke van Netten on Willem Blaeu. The title of he English book *A tutor to astronomy* can be seen as illustrative for how well known his publications were. As late as 1699 (more than sixty years after Metius' death) the full title of this book still held the phrase 'hath been sath forth [. . .] by [. . .] Metius'; see, Moxon, *A tutor*, titelpage. On the visits of Blaeu, Pontanus and Snell see, Christianson, *On Tycho's Island*,

In 1607 Metius commissioned Willem Blaeu to have a sextant built. This instrument is perhaps one of the best examples of how the Tychonian network functioned. Even after the death of Tycho himself, Blaeu and Metius constructed the instrument based on the ideas of the Danish astronomer. They had not studied together in Hven, but they were both familiar with Tycho's ideas. Thus the manual that Metius published for this instrument mentions both Blaeu and Tycho. The Danish astronomer is mentioned to establish credibility for the instrument as a measuring tool. Blaeu is mentioned as the trustworthy builder of such an ingenious sextant. The sextant is believed to have played a major role in Metius' teachings at the university. It is but one of the many examples that justify the conclusion that Metius had established a little Hven in Franeker.[15]

Metius held the chair of mathematics from 1598 to his death in 1635, after which he was succeeded by Bernhardus Fullenius (1602-1657). Fullenius had been Franeker's professor of Hebrew, but changed his position for the chair in mathematics. Because of both its practical applications and (Aristotelian) tradition mathematics was held in academic contempt at the beginning of the seventeenth century, and Fullenius' move has been explained as a step down. However, mathematics at the University of Franeker should not necessarily be seen as an inferior field of education compared to Hebrew. Since Metius and his successors were allowed to teach navigation, surveying and fortification in Dutch, it stood apart from the other chairs at Franeker. This practice of education in the vernacular actually led mathematics to be regarded as an important discipline at the University of Franeker, with many possibilities. The professor of mathematics did a lot of his private tutoring for navigators, sailors and land surveyors who were not members of the university community. For this service they paid him in cash, making the position one of the most lucrative in Franeker. Furthermore the mathematics professor also educated the noblemen of the province. Fortification and other forms of martial mathematics were an important part of their education. It

253-255, 290, 296-299.

15 This was not the only activity of such a kind. Snellius had a Tychonian quadrant build by Bleau, see De Wreede, *Willebrod Snellius*, 101. On the sextant Metius had build no study has been published to date, but I have a brief account in print: Dijksterhuis, 'Van de getallen'. The manual by Metius is published as an addendum to his *Institutionum astronomicarum*. There are many references to Tycho connected to Metius, see the laudatory poem in Metius, *Manuale arithmeticae*, preface for example, which is called 'A New Uranie', which is a jibe at Tycho's Hven; a second example is a verse in the poem on Metius' tombstone, that reads: 'Dania Tychonis floreat ingenio / Illustrem hoc uno se jactat Frisia cive'.

may not have been the most humanistic of studies, but mathematics was one of the most desirable.[16]

The University of Franeker was founded in the late sixteenth century as an educational institution for ministers, lawyers and physicians. Soon after it was established mathematics became an important part of the curriculum. This discipline was taught by highly qualified professors, such as Adriaan Metius who held a strong interest in astronomy. When enrolling at the university Holwarda became a member of this new centre of the Tychonian astronomy.

Johannes Phocylides Holwarda

Johannes Phocylides Holwarda was born as the son of the minister Focco Johannes (1587-1650) and Magdalena Willems in the small village of Holwert, one of the most northern villages of the Dutch Republic. Soon after his son was born Focco Johannes was appointed as reverend in Franeker. In the 1630's he acquired the position of senior reverend in the city of Franeker and as such he was responsible for teaching the catechism to the students of the university. He also published many of his sermons as a sort of instruction book for young ministers. All this places Focco Johannes in the sphere of influence of the University of Franeker. But the content of his sermons and a few of his Latin works are also strong indications of his involvement in matters concerning the university. That he was the minister to whom most of the professors and students had to listen every Sunday must be seen as another indication of this involvement. To understand Johannes Phocylides it is important to note that he grew up as a member of the elite of a university town.[17]

After attending the Latin school in Franeker Holwarda enrolled at the university at the age of 14. He signed the album *studiosorum* as Joannes Fockonides on the 26th of May 1632. One of the first major academic events he probably witnessed as an official student was the inaugural speech of Metius as *rector magnificus* of the University of Franeker just ten days later. Holwarda had matriculated

[16] On Dutch as a language in universities not much is written yet, the best reference is Van Berkel, *A history of science*, 34-35. It is likely that the Frisian example inspired count Maurice of Orange to found a school for practical mathematics in Leiden, de Duytsche Mathematique. On how fortification was taught in Franeker in the second half of the seventeenth century, see Dijkstra, "De opleiding".

[17] On Holwarda's biographical details the best start is offered by Van Ruler, "Holwarda"; On the instruction book for ministers, see Johannes, *Proef-prædicatien*. On other publications by Focco Johannes (one of which is edited posthumously by Holwarda), see Johannes, *Conciones miscellaneæ*.

as a student of philosophy and languages, which was an ordinary enrollment for a first year student. This does not mean that he only studied philosophy however. For example, the skills in mathematics he showed in later publications suggest a thorough education in the matter. The education in mathematics was part of the propaedeutic phase for a student in philosophy. The professor in mathematics would give lectures in Latin, in the central auditorium of the university. But it was not unusual to learn mathematical expertise outside these official classes, at the home of a tutor or at the home of the professor of mathematics. These lessons even found their way into disputations and other academic publications. A student who enrolled as a student in philosophy could very well, in practice, be a student in mathematics or theology as well. For Holwarda this seems to be the case: he was a philosophy student with a strong mathematical interest.[18]

As a student he was also a fond writer of the poems or *carmina* which were printed with the disputations of his fellow students. In these *carmina* Holwarda showed his knowledge of the classics and his understanding of theological matters. In 1637 he finished the first phase of his academic education with a *magistrum* (L.A.M.) in philosophy. For Holwarda this marked a milestone in his academic education. Especially for this occasion his father, who had graduated at Franeker as well, rematriculated into the University of Franeker – probably because this gave him certain rights during the ceremonies that he would not have as an ordinary citizen of Franeker. This underlines how interwoven the family of Johannes Phocylides was with the local academic institution.[19]

In 1639, soon after he had graduated, Holwarda was appointed professor extraordinaire in philosophy by the senate of Franeker. Meanwhile he kept on studying. It is important to note that again philosophy was not his sole focus. In 1640 he took a doctorate in medicine 'privatim' and he is said to have had a busy prac-

[18] On Holwarda's matriculation see Fockema Andreae, *Album studiosorum*, 94; Oddly enough most students that majored in mathematics and enrolled as *mathematicae* did not attend the Latin lectures. They were often not in control of the Latin language (*idiotae*), and were educated to become masters in land surveying or the like.

[19] On Holwarda's laudatory poems see Postma, *Auditorium*, no. 28/1639.2, 47/1635.7, 47/1635.8, 49/1646.1, 51/1640.3. These are probably not all carmina and poems by Holwarda in Frankeriana, still today new prints are found in libraries all over the world. For example Ferenc Postma recently discovered a disputation sub Holwarda in the Royal Library of Denmark (Friendly communication by Dr. Ferenc Postma). On Holwarda's promotion to L.A.M. see Boeles, *Friesland hoogeschool* II, 136-137; this promotion is (as many other) excluded from the 20th century Album promotorum, see Meijer, *Album promotorum*. On Focco Johannes rematriculations see, Fockema Andreae, *Album Studiosorum*, 103 and 109. Focco Johannes had done so previously when a friend of the family took up a professorate at the university.

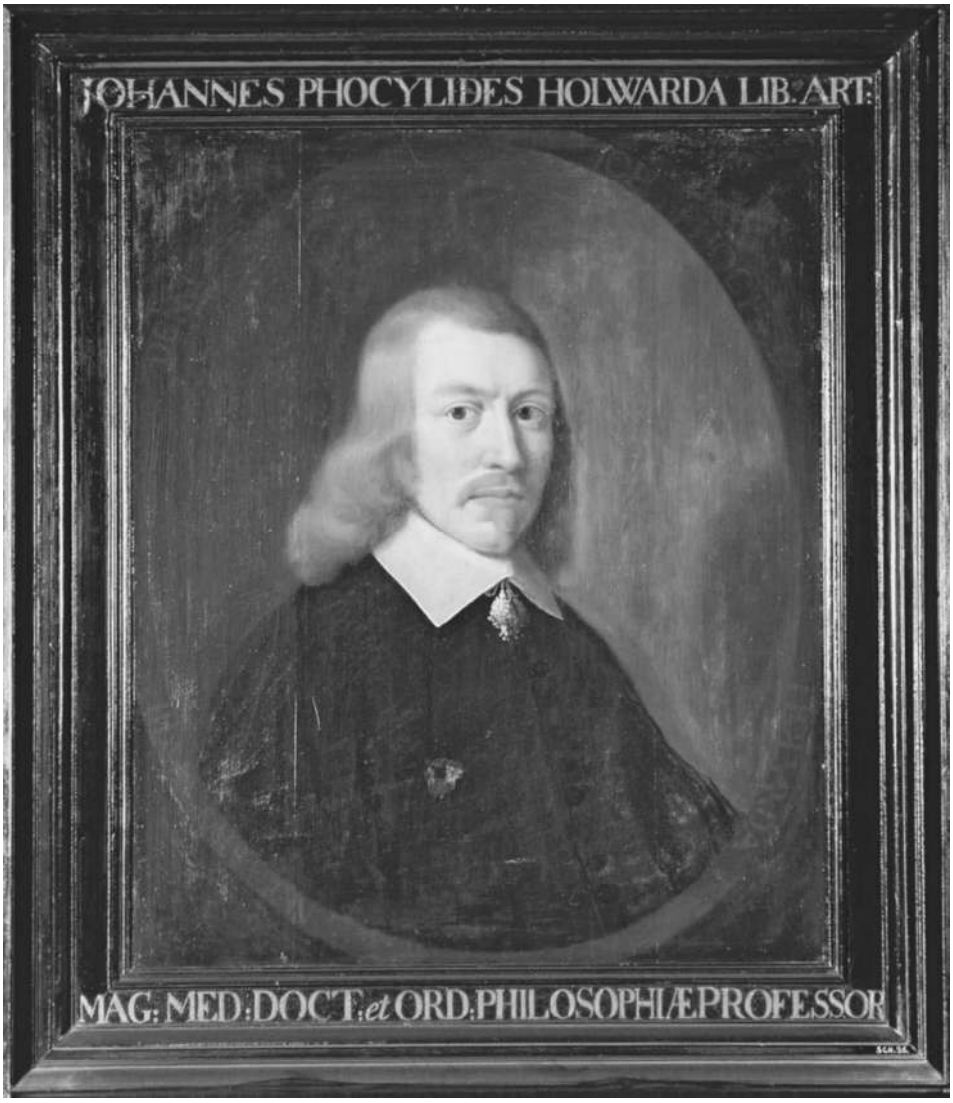

Figure 1: Johannes Phocylides Holwarda (1618-1651). Unknown artist. Museum Martena in Franeker.

tice in Franeker.[20] In 1649 he published a Dutch translation of *Der Weltspiegel*, a

[20] In Franeker as in other universities in the Netherlands a doctoral degree could be obtained without a dissertation. The candidate would have to undergo a severe oral exam for this. These promotions were sometimes (as is the case with Holwarda) done behind closed doors. Only members of the university community were allowed to attend, whereas a 'normal' promotion

world history originally written by the sixteenth century German Protestant Sebastian Franck. He wrote several other works on different subjects. Holwarda obviously had a broad perception of what philosophy was, much broader than current textbooks on this matter might expose. His hard work earned him an ordinary professorate in March 1648. In 1650 Holwarda fell ill with the plague and died the next year. His wife Marijcke Wijbes Piebinga outlived him, together with one daughter.[21]

Johannes Phocylides got his first professorate at the young age of 21. The Deputy States of Friesland, who appointed him, justified their choice for such a young professor saying that they 'had heard of his good qualities and [...] hoped that this position would make him to live up to them'.[22] In all his work Holwarda shows a great drive to advance at the university. He was a young scholar with great aspirations, who apparently convinced the magistrates of the University of Franeker to grant him an important position. The first book he published, his *Dissertatio astronomica* contributed a great deal to this professional success. It is in this book that Holwarda claimed the discovery of a new star.

The *Dissertatio Astronomica*, a Book in Two Parts

In late 1638 Holwarda had been collecting data for a book in which he wanted to attack moon charts that the renowned astronomer Philippus Lansbergen (1561-1632) had published, as well as to start a polemic with Martinus Hortensius (1605-1639), professor of mathematics at the Athenaeum Illustre in Amsterdam. This may seem a bit overambitious for a young student of astronomy, but he felt it was the best way to bring his own ideas to the attention of his readers. By criticizing Hortensius and Lansbergen fiercely he wanted to lure Hortensius into a polemic. This would, in Holwarda's view, not only add to his own 'fame', but in the end it would help gain attention for the work of the astronomers he criticized.[23]

included a public defense by the candidate. See Boeles, *Frieslands hoogeschool*, I, 364-365. On Holwarda's promotion see Meijer, *Album promotorum*, 26 and Boeles, *Frieslands Hoogeschool*, II.1, 171 and 176. The recently appointed professor Johannes Antonides van der Linden (1609-1664) granted Holwarda his doctorate.

21 On the translation by Holwarda, see Franck, *Werelt-spiegel*, preface. On his promotion to an ordinary professorship see Boeles, *Frieslands hoogeschool*, II.1., 180 and Galama, *Het wijsgerig onderwijs*, 92.

22 "om de goede qualiteiten, die van deselvde gehoort werden, [oock tot sijne meerdere opweckinge], ten einde hij, voldoende de hope van hem verwacht, nader mach werden geleth", cited in Boeles, *Frieslands hoogeschool* II, 175.

23 On his attacks on Lansbergen see Holwarda, *Dissertatio astronomica*, IX and 279.

Figure 2: Titlepage of the Dissertatio Astronomica (Franeker 1640). Tresoar Frisian Historical and Literary Centre, Leeuwarden, A 3059.

It seemed that luck was not on Holwarda's side. In November 1638 the skies were often cloudy, rain poured down and he was thus forced to wait and wait before he could collect any kind of data. When December came and a lunar eclipse took place, however, his fortunes changed: '[...] finally things came right, that exactly on the day and the time of the eclipse in the evening the clouds slowly tore open, on several occasions, but not without end, giving me time to observe the heaven at ease.' While he was observing the darkened moon, a strange light drew his attention. At first Holwarda did not realize what he was looking at. Only later did he understand that it was an unnamed light, a new star in the firmament. He decided to add a whole second part to his study, which effectively doubled the size of the book he was working on.[24]

Holwarda had seen a new light. After consulting his books and asking around, he concluded that what he had seen had not been in the sky before December 1638. Realizing this he told his professor Bernhardus Fullenius about the new star. Fullenius replied that he had spotted the star as well. Together they made more observations and concluded that it was indeed a whole new phenomenon. Holwarda looked for an explanation for this newly emerged light and while he was writing this explanation and processing the data he had collected on it, the phenomenon disappeared. His actual proof had suddenly vanished. It is because of this disappearance that he wanted to call it a 'New Star' rather than a star (although he is not very strict in this self-imposed rule). A 'New Star' would, as Holwarda argued, refer not to an actual star, but an emanation of the Sun. Or as Holwarda put it, this was a phenomenon rather than an actual star.[25] In his small booklet Holwarda spent a great deal of space on this explanation. It was only after most of his elaborate account was printed (he was still writing the end of the book while the first parts were already in print) and his book was almost completed that the star reappeared. Amazed by this fact Holwarda wrote an "Appendix, necessary for the reader" in which he mentioned this reappearance. Here he explained to his readers that this reappearance only underlined his account. In this he had after all mentioned that his phenomenon could disappear and reappear. So this return fit his explanation perfectly.[26]

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[24] On Holwarda's first sighting of the star see Holwarda, *Dissertatio astronomica*, 186 (my translation into English); on him adding a second part see Idem, preface.

[25] Holwarda, *Dissertatio astronomica,* 275. When I write 'New Star', I refer to Holwarda's philosophical explanation of the phenomenon.

[26] On Fullenius' observations, see Hevelius, *Mercurius in sole*, 148 and Van Berkel, "Het onderwijs", 219; on Holwarda's account of the events see Holwarda, *Dissertatio astronomica*, 272-286.

The book thus was completed and consisted of two important parts. The first contained charts on the moon, in which Holwarda attacked Lansbergen and Hortensius. The second held his account of the discovery and explanation of a star in the star sign Cetus. This booklet has attracted the attention of astronomers and historians of science alike. Before I explain how other astronomers responded to his *Dissertatio*, it is time to clear up some misunderstandings that surround this little book.

A Variable Star in the Sign of Cetus

In literature on sightings of Mirca Ceti, several things are attributed to its sighting by Holwarda, none of which seem to be true. Firstly he is said to have been the first to write and to publish on the star. However the first to write about the star was the above mentioned astronomer David Fabricius in a private letter to Tycho Brahe in 1596. These observations were published by none other than Johannes Kepler at the beginning of the seventeenth century, decades before Holwarda's book went to press. Secondly Holwarda is said to be the first to have discovered the variability of the star; the variability being that, observed from earth, the star seems to get 'switched on and off'. However in 1609 it was this same Fabricius who first noted a reappearance of Mira Ceti. He wrote about this to Kepler and published on it in a local almanac.[27] Thirdly Holwarda is said to have named to star Cetus. However it was again David Fabricius who coined this name in his letter to Kepler in 1609. It was a copy of this letter that another astronomer, Johannes Hevelius (1611-1687), read and from which he took the name for the star.[28]

Fourthly and most persistent is the attribution to Holwarda as the first to have calculated the cycle of Mira Ceti, its periodicity. In his *Disseratio astronomica* Holwarda does mention two periods of sightings, one starting in December 1638 and one starting in November 1639. On the basis of these two dates he is acknowledged as the calculator of the periodicity of Mira Ceti and to have set it at eleven months. But Holwarda never drew this conclusion himself, therefore it cannot be attributed to him. Because he did not think of the whole phenomenon as a variable star (a concept alien to him) it would be odd if he had evaluated it as such. From the account of his sightings a more plausible conclusion would be that Holwarda spotted the star by accident. He never actively pursued the search for a

[27] Wattenberg, *David Fabricius*, 5 and 12.

[28] Others attribute this to the German astronomer Jungius, see Hoskin, *Stellar Astronomy*, 24. On Fabricius, Kepler and Hevelius' role in this naming process, see Wattenberg, *David Fabricius*, 5.

periodicity. The attribution of the discovery of its periodicity completely ignores the explanation Holwarda gave of Mira as a 'New Star' (that is: an emanation).[29] A short quotation of his second sighting makes this all abundantly clear:

> [B]ut on November 7, almost at the end of the Julian year 1639, when after a few days, weeks even, of ongoing clouds at Cetus, the skies were finally clear again, I by chance went out and observed the phenomenon and it can still be observed by anyone on this day.[30]

This is the last bit of new information Holwarda published on Mira Ceti. It is obviously not the account of a researcher who, after years of precise observations (which would at least have been required), had just established that this star disappears after being visible for five months and then reappears another six months later. This cycle was in fact calculated by Ismaël Boulliau (1605-1694) in 1667, after years of intensive observations.[31] Thus the attribution to Holwarda of the periodicity not only disregards Boulliau's hard work, it also shows a lack of historical insight.

Soon after the publication it was already suggested that Holwarda had not discovered something new. In a disputation at Utrecht University, defended under professor Jacob Ravensberg, it was suggested that Holwarda merely had rediscovered what Fabricius had already found. It was already in 1660 that the famous astronomer Johannes Hevelius gave a nice table of the sightings of Mira Ceti and affirmed the suspicions of Ravensberg.[32]

It is clear that Holwarda in fact discovered nothing; neither did he name anything, nor was he the first to calculate the cycle. But his booklet on the 'New Star' made waves and after its publication precise observations of Mira Ceti were made. This had not happened after Fabricius and it is the surge of research that followed

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[29] Holwarda finds a particular strong advocate in the Dutch journalist Govert Schilling, see for example Schilling, *Atlas van Astronomische Ontdekkingen*, 40-42, but also others attribute this to him, see for example North, *Cosmos*, 565.

[30] 'At die 7 Novembris anni jam labentis 1639 Iuliani post continua aliquot dierum, imo septimanarum apub nos nubilas, vesperi coelo tandem aliquando claro, forte egressus illud observavi, atque etiamnum cuivis observare liberum relinquitur, eodem praecise loco, eodem situ, quo ante.', in: Holwarda, *Disseratio astronomica*, 285-286.

[31] On the calculation by Bullialdius see Hoskin, *Stellar Astronomy*, 24-25. The origin for some of these misconceptions might be: Wolf, *Geschichte der Astronomie*, 416, see also, Boeles, *Frieslands Hoogeschool*, II.1, 179.

[32] On the disputation from Utrecht, see Ravensberg, *De systemate mundi*, thesis 32. I thank Rienk Vermij of Oklahoma University for attending me to this disputation. On a visit to the library of the former Hoheschule in Herborn, Germany I actually found a copy of this disputation. On Hevelius account of the discovery, see Hevelius, *Mercurius in Sole*, passim.

Holwarda's book that can be seen as his great merit. But this was arguably not Holwarda's goal; he most likely had different objectives for his publication on the 'New Star'.

Small is Beautiful. The Ideas Behind the *Dissertatio*

Holwarda had published his findings on the 'New Star' in 'a wonderful little book'. All the specimens of this book that I have seen are simply, but nicely, bound and cut. The ink smears on some pages because of this small size, but the size made it possible for the book both to fit in one's pocket and be read with ease. Even more importantly, the size of the book made its distribution easy. Because of this, as I will show, the book found a good audience.[33]

Furthermore the size of the book is a reference to the most common of all academic publications of that time: disputations. Some of the disputations printed in Franeker around that time have exactly the same size as this book. However none of the disputations proved to 'stir up' the world of astronomy, nor anything of that magnitude. Nor was it odd that they were so small. It was Holwarda's book that was remarkable and stood out, by being so small and causing a stir. But the size did show that it was a publication written in an academic setting. It looked like a disputation, but was something with higher academic aspirations.[34]

His book was not a normal academic publication, however much it looks like one. It was published by Idzardus Balck, the son of the university printer, instead of by the master printer himself. It is in fact the first book Idzardus Balck ever printed for somebody affiliated with the university. In that respect it was also a master proof for this printer, who went on to become his father's successor as the

[33] Hevelius calls the book 'Elegantissimo Libello', see Hevelius, *Mercurius in sole*, 147. There are many other remarks on the size and the appearance of the book besides that one made by Hevelius, Van Berkel for instance calls it "A small but in the history of astronomy controversial little book" ("Dit kleine, maar in de geschiedenis van de astronomie geruchtmakende boekje"), see Van Berkel, "Wiskundige boeken", 87, and John North who calls it "brilliantly devastating little book" in North, *Cosmos*, 399. I have handled the copies of this book in the following libraries: Tresoar in Leeuwarden, sign: A 3059, University Library in Groningen sign: UB PM 3 Magazijn, University library of Leiden, sign: 522 G 33 and University library of Cambridge, sign: Kkk.608. I have seen a 'microprint' of the copy of the University Library of Oklahoma. The Herzogin Anna Amalia Bibliothek in Weimar Germany therefore catalogued the book as being printed in 1649. There never was such a print, but some copies do seem to indicate that year, only a closer look reveals that this is nothing but a smear of ink. It is, however, impossible to verify this with the copy in the Anna Amalia Bibliothek, it was lost in the 2004 fire.

[34] Holwarda himself testifies in the epilogue of the book that he had discussed the matter of size with his publisher, see: Holwarda, *Dissertatio*, 277-278.

official university printer in 1651. If it would have been an ordinary disputation, his father would have been obliged to print it.[35]

Holwarda combined all of this with two things that made the book attractive to read apart from the claim of a new found celestial phenomenon. The first of these is the first half of his dissertation: his attacks on the moon tables of Lansbergen and his critique of ideas of Hortensius. These alone were useful and made the book desirable. In the historiography this is often neglected, because the discussion has always focused on whether or not Holwarda had discovered Mira. The second was an attack on the old Aristotelian values combined with a witty style of argumentation.[36]

To his readers Holwarda constructed his own credibility by referring to Tycho and to his own master Metius. To describe Tycho Holwarda often used words like '*Virum inter omnes*' (A man among men), or even *'Nobilissimum Heroa'* (Most revered Hero). With his discovery of a new star he placed himself explicitly as a successor to this hero, who discovered a new star before him in 1572. His teacher Metius, who was also seen as a successor to Tycho, could also count on the praise of Holwarda. But with Metius he dared to go a step further. He corrected certain tables made by Metius and complained about the sextant he inherited from him, and which was at his disposal the University of Franeker. He did acknowledge, however, that it was precisely this sextant that made it possible for him to make his observations. In other words, he was aware of being part of the Tycho-Metius tradition, but being a member was not enough. He wanted to contribute to this tradition.[37]

Holwarda did so most vehemently with his central strategy, a strike at the Aristotelian world picture. To make this move he used cleverness and wit. He wrote about certain Aristotelians who attacked his findings because they could not find the star in the skies. In the same sentence in which he introduced these critics he made fun of them as well. He claimed that the only reason why they could not find the star was that they were too inexperienced, whereas he was a

[35] On university printers in the Dutch Republic, see Van Netten, "Tot gerief"; On the university printers of Franeker in more particular, see Boeles, *Frieslands Hoogeschool*, I, 307-316. Holwarda's remark that Albertz started the printing process already in 1639 makes it probable that this work by Holwarda was earlier than another book Albertz printed that year for a member of the university community.

[36] About his style Holwarda makes the following remark: 'Ludimus hic, non laedimus, nec magnorum Virorum, famam mordaci calamo proscindimus', see: Holwarda, *Dissertatio*, preface XII.

[37] On Holwarda's complaints see Holwarda, *Dissertatio*, V, 201. On his use of the sextant see, Idem, 72, 196 and 280.

Title page of a tract depicting the sextant Holwarda used to measure the position of Mira Ceti in 1639. Tresoar Frisian Historical and Literary Centre, Leeuwarden, A 4668 kluis.

more than capable astronomer. But in the Aristotelian philosophy this would not function as a recommendation, Holwarda argued, because it was Aristotle who had called experience "the mistress of fools and unbelievers". Thus he made himself (the able and experienced one) a fool and the ones who could not find the star (the inexperienced ones) the opposite of fools, according to Aristotle.[38]

It is with rhetorical tricks like this that he addressed one of the big issues in the scholarly world of his day: Aristotle's philosophy. Holwarda was clear about his stance: the old philosophy of Aristotle needed to be replaced by a new way of philosophizing. A central point in this new program, he argued, should be that of Copernicanism. From the start of the book he made clear that he believed the earth orbits the sun. In this he would become only the second professor at a Dutch university actively to promote a Copernican world picture, the other being Hortensius in Amsterdam. But Holwarda's attacks on Aristotle went back to discussions predating his own academic education. From the second half of the sixteenth century there had been strong opposition to the dominance of Peripatetic philosophy in Franeker, as in universities all over Europe.[39]

It is probable that other scholars connected to the University of Franeker attacked Holwarda's discovery of the 'new light' with Aristotelian arguments. It is important to note that it was exactly his defence against them that helped Holwarda gain a position at the University of Franeker. At Utrecht University, for example, the fierce debates between advocates of Aristotle and advocates of new philosophies were outlawed 1643. But in Franeker it seems to have been the practice to have professors for and against the old philosophy appointed in the faculty of philosophy. His propagated views may thus have helped Holwarda gain a university position as professor extraordinaire with a salary of 400 guilders a year. He continued building a successful career, gaining full academic honours at the age of twenty nine in 1647, when he was appointed professor *ordinaire*. With the sources at hand, it is impossible to determine if Holwarda chose his view as anti-peripatetic in order to gain a position, but it is possible to conclude that it did not harm his career. In fact, in practice the professors *pro* and *contra* Aristotle seemed to have worked in good harmony. They even took turns in the auditorium of the university every other week.[40]

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[38] Holwarda, *Dissertatio* 199.

[39] On Holwarda as a copernicist see Vermij, *The calvinist*, 120 and 129-130. Holwarda seems to have sought a connection with the ramist movement, which had build the strongest case against Aristotelian philosophy until the publication of Descartes' *Discours de la methode* in 1638. Holwarda is more explicit about this in his *Skiagraphia.* See Holwarda, *Skiagraphia*, 4 and 6.

[40] On the different philosophical schools in Franeker see Galama, *Het wijsgerig*, 37-38 and 223-

Another point about the way Holwarda presented his newly found star that cannot go unaddressed is the date he gave to it. He claimed that the data he used in his book were collected on 25 December 1638. It can hardly be a coincidence that he chose exactly the night on which it was believed that the most famous of all extraordinary stars ever appeared.[41]

Word of his discovery spread quickly in Friesland and, besides his personal gains, his university also benefited. The Deputy States of Friesland gave the university extra funds to expand their instrument collection, which the university used to buy the collection of the late Adriaan Metius. His widow profited from this since she sold the instruments for 450 guilders. Holwarda already had the collection at his disposal before this purchase, however. Following the publication of his *Dissertatio* (which was not his doctoral thesis!) Holwarda also got his 'privatim' doctorate in medicine. In Franeker his discovery and the way he presented it were well received. Holwarda had written and published a book for the local market, he wanted to impress the local regents and make a name in the Netherlands. The book itself was dedicated to the local regents. However the *Dissertatio* reached a much wider audience.[42]

Reception

The book was not just a success in Friesland. Soon it reached other circles of men, who started looking at the phenomenon Holwarda had discovered. In Dutch academic circles the book was critically assessed. It was also discussed in the Hartlib Circle in England and Hevelius (who positioned himself as the true successor to Tycho) got hold of a copy. Holwarda's phenomenon became one of the

225; On the promotion to a full professorship, see Schippers, "Johannes Phocylides". Schippers said his anti-Aristotelianism damaged his career, but how this was expressed in the actual career eludes me, Holwarda got all his academic achievements at a fairly young age. On him sharing the *Compendium Physicum* see Galama, *Het wijsgerig*, 63.

41 On the sighting on Christmas Day, see Holwarda, *Dissertatio*, 190. Even today it is still believed that Mira Ceti was the actual star that would have pointed the way of the Magi to the stables in Bethlehem, see: http://www.quodlibet.net/articles/sigismondi-mira.shtml (retrieved December 2008).

42 On the extra funds granted to the university and on the dedication by Holwarda, see Holwarda, *Dissertatio*, dedication (unpaged). On the money received by Metius' widow see Tresoar, Frisian Historical and Literary centre, archief Bestuursinstellingen 1580-1795, inventory number 2320, resolutions of the Deputy States; On his promotion see footnote 20 above.

most researched celestial objects of the time and his name always stayed closely connected to it.[43]

An intriguing question that surrounds the spread of Holwarda's ideas, is how his book containing them travelled through Europe. Within a few years most important astronomers seem to have gotten hold of a copy. Perhaps Antonides van der Linden, who had granted Holwarda his doctorate, was instrumental in this. Van der Linden had a strong link with the Hartlib Circle in England. Because of his Amsterdam connections, where he was the president of the *collegium medicum* before he became professor in Franeker, he was in close contact with men like William Hamilton and Johann Moriaen (c.1591-1668), a German church minister, physician, natural philosopher and alchemist. It is possible that it was through these connections that men in the Hartlib circle came to know of the existence of Holwarda's book. Van der Linden arrived in Franeker in 1639, just when Holwarda was about to 'rediscover' his star. It seems possible that it was Van der Linden who sent the curious little book immediately to his friends in Amsterdam or England, after it appeared the following year. As early as 1640 it was discussed by the Hartlib Circle.[44]

In was in 1640 that John Twysden (1607-1688), a friend to Samuel Foster (c.1600-1652), handed a copy to John Wallis (1616-1703). From a letter Wallis sent to Hevelius in 1663 it seems that Holwarda's book came exactly in time. The famous learned men in England had also seen the star in Cetus and were making observations. Men like John Palmer (1612-1679) and Jeremiah Horrocks (ca. 1617-1641) were discussing their results with Wallis and others. All these astronomers and mathematicians probably took notice of Holwarda's little treatise.[45]

The most obvious connection between Franeker and the Hartlib Circle, however, may have been through the French pastor and mathematician Marin Mersenne (1588-1648). Mersenne corresponded frequently with Philips Ernst Vegelin van Claerbergen (1613-1693), the secretary of the Frisian stadholders. It was Vegelin who kept the Hartlib Circle up to date on what was happening in

[43] Next to the afore mentioned Ravensberg in Utrecht, the book was also discussed in a disputation defended under Antonius Deusing by Johannes Achterkercken, see: Deusing, *De novis Stellis*, B3ro.

[44] On the connection of Franeker and the Hartlib circle, especially between Van der Linden, Hamilton and Moriaen two letters by Hamilton of 1650 are telling, see Hartlib, *The Hartlib papers*, 9/11/27A and 9/11/25A.

[45] On all the men mentioned in this paragraph, see Wallis, *Correspondence*, 83-86; On them using Holwarda, see idem, 86. Horrocks published a treatise in 1639 on the passing of Venus through the sun, observed from earth. This was printed in 1639, but it contains no mention of the star in Cetus, see Hevelius, *Mercurius in sole*.

Friesland, mostly via Mersenne and sometimes through yet another member of this circle, Theodorus Haak (1605-1609). Vegelin however only arrived in Friesland in 1641 and learned of Holwarda's treatise in 1642. He immediately brought it to Mersenne's attention and offered to have a copy sent to Paris. What the reaction was of the learned father is unknown. But it shows that the book was of interest in the scholarly correspondence of the early 1640's.[46]

How Hevelius obtained a copy is not clear, but it is evident that he had gotten hold of one. His attention was arguably not just drawn by the much discussed second part of the book. It was more than probable that the first part of the book proved its value here. Holwarda had written on the moon and on lunar tables, which was Hevelius' field of study at that time. He was preparing his much praised *Selenographia*, which would be printed in the late 1640's. However, in later writings Hevelius came back to the wonderful star in Cetus, to which he dedicated a long section in his *Mercurius in sole visus* (1662). And this was not all the attention Hevelius gave to the matter. Apparently he started corresponding on this star already in the early 1640's with several people. One of these contacts was probably Holwarda himself and, certainly, Holwarda's colleague and old mentor Bernhardus Fullenius. The publication of *Mercurius in sole visus* marks the moment astronomers stopped seeing Mira as a phenomenon and started regarding it as a variable star. One could argue that it completed the process that had started with the publication of Holwarda's treatise.[47]

The contacts between Franeker and Gdansk seemed to have persisted. In the 1670's Fullenius' son went to make observations with Hevelius and his wife. These contacts in turn brought the youngest Fullenius into contact with one of the Bernoulli brothers. This is just one example of how important it could be to correspond with important learned men. Of course these contacts did not solely originate from the book by Holwarda. But this book did obviously function as a vehicle of introduction to other astronomers, as an excuse to start corresponding with Hevelius for Fullenius. The results of new observations were consequently something about which to keep the correspondence going.[48]

Close to the Hartlib Circle was Ismaël Boulliau, who in the 1660s did some important work on Mira Ceti. Just a year prior to Holwarda's *Dissertatio*, he had published a book on Copernicanism. Because he was afraid of possible consequences in his home town of Paris, he had it printed in Amsterdam with Joan Blaeu

[46] On the link between Vegelin and the Hartlib Circle, see Malcolm, "Six unknown letters"; On Vegelin writing to Mersenne about Holwarda's book, see Mersenne, *Correspondance*, 114-115.

[47] Hevelius, *Mercurius in sole*, 140 ev.

[48] On the connection between Franeker and Gdansk see Van Berkel, "Wiskundige boeken", 86.

(1596-1673). Boulliau and Holwarda, who obtained a copy of his book, were not just kindred spirits regarding the place the earth should take in the universe, Holwarda also recognized in him a fellow admirer of Pierre Gassendi (1592-1655). His praise for this work is enormous: "This is a man of exceptional cleverness and erudition in all branches of scholarship; he is not the lesser man of anybody, in my opinion."[49]

This was perhaps the best review Boulliau could have had. He does not seem to have known it, though, for in December 1644 he was still complaining to Mersenne that he did not know how his book on Copernicanism was received. In 1667 however he was aware of Holwarda's book and used some of Holwarda's observations to recalculate the periodicity of Meri Ceti. He narrowed this down to 333 days, which was much more precise than the periodicity Hevelius had calculated earlier. When Boulliau got hold of a copy is impossible to tell[50]

The German astronomer Joachim Jungius (1587-1657) worked on Mira Ceti, while he was a teacher at a German secondary school and he also seems to have known of Holwarda's *Dissertatio*. The Dutch scholar Isaac Vossius (1618-1689) owned a copy of the *Dissertatio*. And as late as 1675 the English Astronomer Royal Flamsteed (1646-1719) mentioned Holwarda's book to the president of the Royal Society Henry Oldenburg (1619-1677). It is safe to conclude that the book was widely read by all kinds of scholars and learned men.[51]

The *Dissertatio* did not just have a good reception in Franeker and Friesland. But there are even more indications that Holwarda's work was well read at the time. Michael Langrenius (1598-1675), an astronomer of the Southern-Low Countries referred to Holwarda on his map of the moon. Langrenius was the first ever to create such a map and he named one of the craters on the moon after his colleague from Franeker. In his correspondence on his lunar map Langrenius explicitly stated that it might be best to name a good deal of the craters after 'noblemen' and 'learned men' from the Dutch Republic. He feared that if he neglected to do so, the Protestant Dutch would come with their own maps soon and Langrenius thought he could very well do without this competition.[52]

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[49] On Holwarda's comments on Boulliau see, Holwarda, *Dissertatio*, 260-261.

[50] On Boulliau complaining about the attention for his book on heliocentricity, see Robert Hatch http://web.clas.ufl.edu/users/rhatch/pages/11-ResearchProjects/boulliau/06rp-b-lttrs.htm (retrieved December 2008); cited is a letter from Boulliau to Mersenne from 16 December 1644. Original is in the Bibliotheque National in Paris, N.a.f. 6205, 228-231 [f 112r-113r, ad.v]; On Boulliau's oberservations of Mira see: Boulliau, *Ad astronomus*.

[51] On Flamsteed and Henry Oldenburg, see Flamsteed, *Correspondence*, 412 and 417. It is a remarkable coincidence that Holwarda is mentioned in the same sentence as Horrocks.

[52] On Langrenius see Van der Krogt, "De Maankaart". On Holwarda mentioned by Langrenius

Holwarda's dissertation was soon sold out. A small reprint appeared together with an *Epitome astronomiae reformatae-generalis* in 1642. Although there are few copies of this dissertation still extant, it was probably well spread in the seventeenth century. But his audience was wider than just academia. Also in more popular works, like that of the seventeenth century Dutch historian and bon-vivant Lieuwe van Aitzema, Holwarda's discovery is mentioned.[53]

In all the new work on the phenomenon, in the new observations, in the calculations and the discussion that followed, Holwarda was often referred to. But his explanations were not taken for granted. As he had done himself, others refuted his ideas. It was Hevelius who proved that it was not Holwarda who was the first to observe Mira Ceti. As Holwarda had tried to do to Lansbergen and Hortensius, he became a subject of discussion himself. Perhaps this was the best sign that his ideas had become part of the discussions that astronomers had in the seventeenth century.[54]

Conclusion

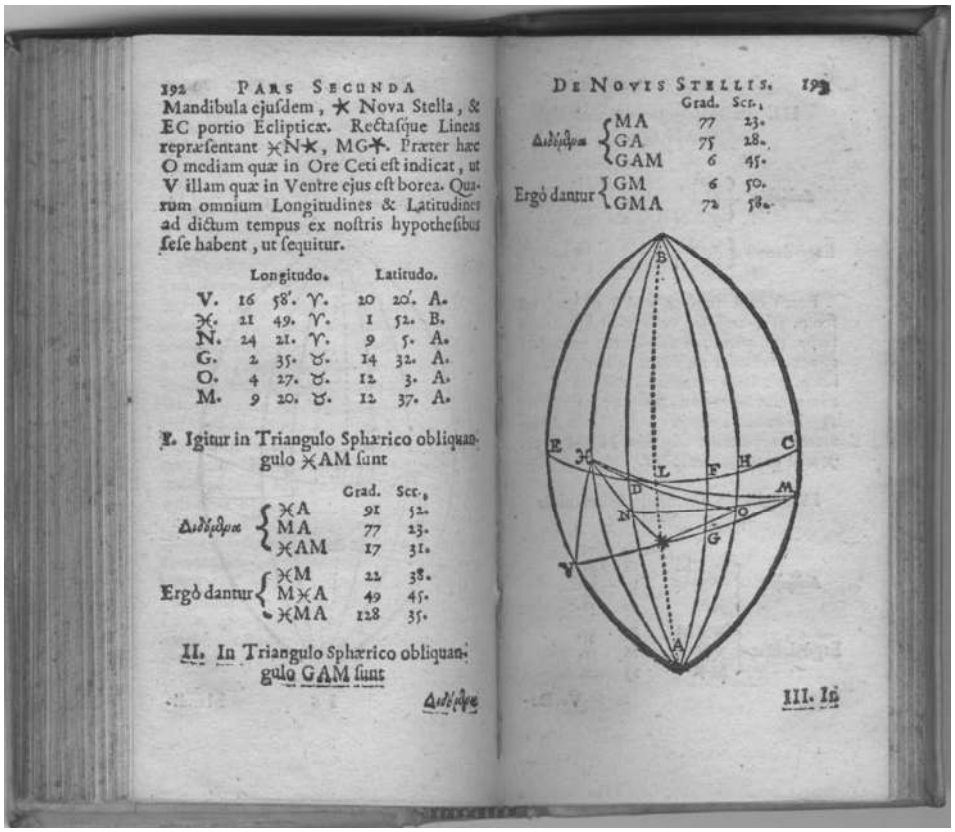
When his 'little book' left the press Holwarda did not stop trying to shape its reception. He wrote a manual on how to interpret the book – in the form of an afterword – though even that did not ensure that it was received in an unambiguous way over time. The text and the diagrams proved to be less solid than one might first expect. This book did not prove to be immutable, but instead asked for ongoing attention from its writer. Holwarda never had full control over it, even though he tried very hard. With the publication of Hevelius' *Mercurius in sole visus* in 1662 this reception seems to have been pushed to the background. From then on the most important publication on Holwarda's phenomenon was Hevelius' book.

The *Dissertatio Astronomica* was Holwarda's ticket into the university. It brought his mentor, Bernhardus Fullenius, into contact with famous astronomers. It was the first book printed by Idsardus Balck a young printer who was born and raised in the city of Franeker. Following the publication, the University of

see: Holwarda, *Philosophia Naturalis*, 399-400; and Whitaker, *Mapping*, 196; Phocylides Holwarda's name is misspelled as Phorilidi. On the motives of the maker of the first moon map to name a few craters and 'lakes' to public figures from the Dutch Republic see: Puteanus, *Honderveertien*, passim.

53 This reprint has been considered lost for over a century, but there appear to be copies both in the National Library in London as in the Univerisity Library of Göttingen Germany. Unfortunatly I have not yet handled a copy of this book. On Van Aitzema talking about Holwarda, see Van Aitzema, *Historie*, 809.

54 Hevelius, *Mercurius in sole*,



192 PARS SECUNDA

Mandibula ejuſdem, ✶ Nova Stella, & EC portio Eclipticæ. Rectaſque Lineas repræſentant ♈N✶, MG✶. Præter hæc O mediam quæ in Ore Ceti eſt indicat, ut V illam quæ in Ventre ejus eſt borea. Quarum omnium Longitudines & Latitudines ad dictum tempus ex noſtris hypotheſibus ſeſe habent, ut ſequitur.

	Longitudo.		Latitudo.	
V.	16 58′.	♈.	20 20′.	A.
♈.	21 49.	♈.	1 52.	B.
N.	24 21.	♈.	9 5.	A.
G.	2 35.	♉.	14 32.	A.
O.	4 27.	♉.	12 3.	A.
M.	9 20.	♉.	12 37.	A.

I. Igitur in Triangulo Sphærico obliquangulo ♈AM ſunt

		Grad.	Scr.
Δεδόμενα	♈A	91	52.
	MA	77	23.
	♈AM	17	31.
Ergò dantur	♈M	22	38.
	M♈A	49	45.
	♈MA	128	35.

II. In Triangulo Sphærico obliquangulo GAM ſunt

Δεδόμενα

DE NOVIS STELLIS. 193

		Grad.	Scr.
Δεδόμενα	MA	77	23.
	GA	75	28.
	GAM	6	45.
Ergò dantur	GM	6	50.
	GMA	72	58.

III. In

Page 191-192 of Holwarda, Dissertatio Astronomica, depicting a chart and tables with the position of Holwarda's star. Tresoar Frisian Historical and Literary Centre, Leeuwarden, A 3059.

Franeker received formal ownership over an important collection of instruments. The impact of the *Dissertatio Astronomica*, which caused such a stir in the international astronomical society, had first and foremost a local cause and impact.

Holwarda came to his publication because he used the accumulated resources available to him to their full potential. For his research he used the expertise of his teachers, the books in the university library and the instruments at hand. He used a local printer and press, which made it possible for him to keep a close eye on the printing process. These typical local conditions were put to good use by Holwarda when he marketed his 'New Star'. It was this process that turned Holwarda into a producer of knowledge who was recognized by the outside world.

The instruments Holwarda used to do research for his book were previously owned and even developed by Adriaan Metius. A famous sextant made it possible

for him to do the precise observations he wrote about. With this instrument the link with Tycho Brahe became particularly clear, because the sextant was constructed following his ideas. Holwarda could make his observation because Metius, as his predecessor, had engineered the infrastructure necessary for making potentially authoritative observations.

For an astronomical find and measurements to be identified as a 'discovery', they had to be legitimized by other astronomers. But the case of David Fabricius makes clear that this was not all there was to it. Tycho legitimized Fabricius' observation, but never placed the star seen by Fabricius on his maps. Johannes Bayer did, but he was the only one and his star atlas did not draw enough attention to this particular star. Kepler also discussed Fabricius, but his observations were still not recognized by others. That is exactly what Holwarda did better. Following Holwarda's publication, the phenomenon was discussed by others such as Hevelius in Gdansk and the Hartlib Circle in England. All these other astronomers kept on discussing Holwarda's book, because he had given them something to discuss. He had explained the new light as a phenomenon, as something with strong philosophical implications, as a further means attack the philosophy of Aristotle.

Holwarda had described an event and had given a philosophical explanation. It was his labelling of the 'disturbing light' as a phenomenon that made it attractive for others to discuss and study. Because this phenomenon possessed so many different aspects, because it could be contested by other astronomers, the discussion that followed the publication was fruitful.

In this essay I have shown that the way in which Holwarda presented his new light helped him to be credited with the discovery of a new phenomenon. This result might have been more than what he had hoped for. He wanted to impress local scholars and authorities to establish himself as a young philosopher and astronomer, to accomplish this he tried to explain what he had seen in the sky in philosophical terms. The ultimate result was a new star on the charts, which was never his intention.

The Company's Garden and the (Ex)change of Nature and Knowledge at Cape of Good Hope (1652-1700)

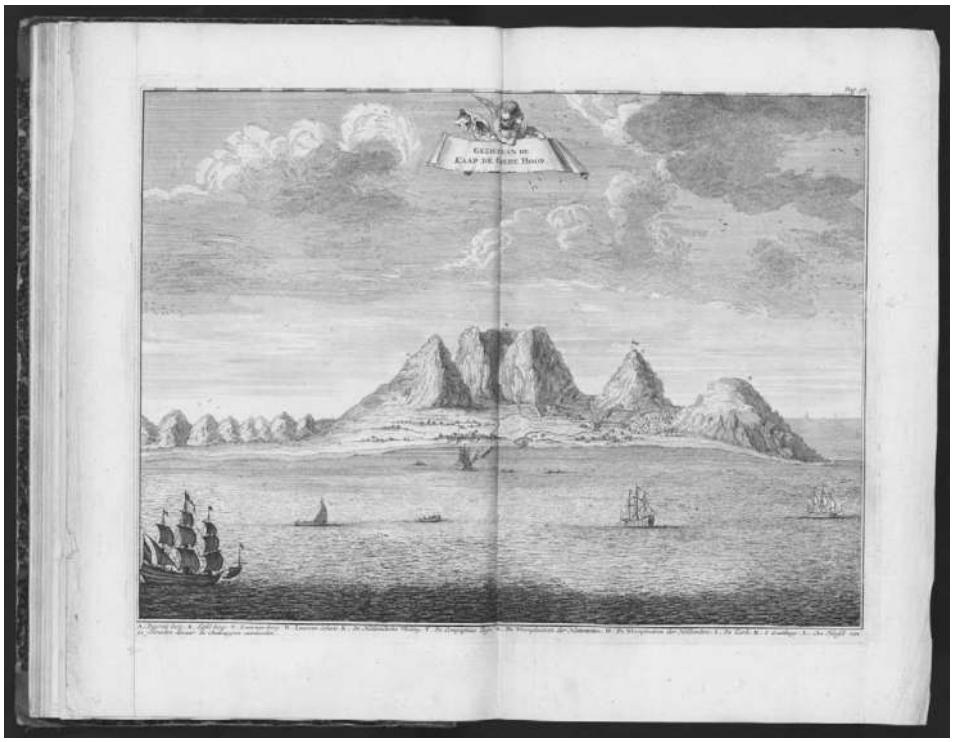
Alette Fleischer[*]

The Dutch East India Company, the General Government at Batavia, and the Cape Government may be compared to three seas, each having a distinctive source, yet flowing into one another. Ebb and flow would constantly re-act upon them – from Holland to Batavia, and back from Batavia to Holland; from Holland to the Cape, and back from the Cape to Holland; from Batavia to the Cape and back again to Batavia – thus the tide would come and go. These seas must also be regarded as of great depth, but in surface area the one representing the Cape is very small in comparison to the rest, which, however, does not impede its tidal flow and reaction upon the other seas.[1]

With these words the German Otto Mentzel ended the first volume of his three-volume book on the Cape of Good Hope, having worked for the Dutch East India Company (VOC) in the Dutch colony between 1733 and 1741. He represented the three stations of the VOC as separate water courses that blended, transformed, and transported people, information and goods. Mentzel clearly saw the significance of the Cape colony as contributor to the vast VOC network. Indeed, the founding years of South Africa's colony underscore the existence and effect of a 'tidal flow' of the circulation of knowledge, people, and objects to and from the Cape and its hinterland. The VOC garden at the Cape (usually referred to as the Company's garden), in particular, functioned as a point of intersection where local knowledge, needs, and networks flowed into the global (trade) canals, to be brought to distant shores.

[*] I would like to thank the participants, and notably Ben Schmidt, of the 2008 Gent conference 'Centers of Accumulation: Collecting points and the circulation of knowledge" for their comments. I also deeply thank Prof. Lissa Roberts for her patient support and advice on earlier versions of my paper. This research was made possible thanks to an Aspasia graduate fellowship from the Netherlands Organization for Scientific Research (NWO).

[1] Mentzel, *Geographical and Topographical*, 181. Batavia is nowadays known as Jakarta, Indonesia.



1. Peter Kolb, View on Cape of Good Hope, engraving in P. Kolb, Naaukeurige en uitvoerige beschryving van Kaap de Goede Hoop, (Amsterdam: Balthazar Lakeman, 1727), vol. 1, 58. Amsterdam, University Library (UvA) special collections OTM OF 63-19.

In 1652, the VOC began a refreshment station at Table Bay as part of its commercial expansion.[2] [Fig. 1] Here, passing ships revictualized while sailors regained their health. Fresh vegetables and fruits were grown in the Company's garden and the VOC bartered with the nomadic inhabitants of the Cape, the Khoikhoi, for cattle to provide them with meat and dairy products. The construction of the colony entailed experimenting with local and imported plants and exploring the land in search of Khoikhoi merchandise and Cape minerals. The development of commerce and cultivation, in short, went hand in hand with a growing understanding of the Cape's natural and geographical knowledge.[3]

2 For more images and maps of the Cape of Good Hope visit http://www.atlasofmutualheritage.nl

3 The Dutch distinguished the hunter/gatherers San (or Bushmen) from the herdsmen Khoikhoi (or Hottentots). This was based on their practices (hunting/gathering or herding) rather than 'race'. A Khoikhoi without cattle became a San and vice versa. The seventeenth-century settler considered all 'Hottentots' more or less related to each other since they share a similar language.

Examining the Company's garden and, subsequently, the Cape's agricultural settlement tell us how Dutch colonizers and merchants adapted and transformed South African nature. Broadening our scope, this allows us to consider the Cape Peninsula in its entirety as a garden, since uncultured nature was viewed as an invitation for settlers to claim these lands and transform them into a Dutch-European landscape yielding cereals, pastures, and vineyards. 'Gardening' untamed nature justified the colonization and transformation of the Cape. This essay thus discusses the Cape as a site where gardening transformed the local landscape as well as its native and foreign inhabitants. Both settlers and Khoikhoi adapted to the changing circumstances, appropriating knowledge and practices of the 'other' and merging the unfamiliar with what was already known and practiced. This inventive fusion took place with the aid of local go-betweens who mediated between Khoikhoi and Dutch. The agricultural enterprise of the Dutch blossomed, the Company's local presence and global network strengthened while that of the Khoikhoi increasingly weakened, gradually becoming disconnected from their nomadic ways and their pastures.[4]

Through its extensive communication system, which afforded both the local and long-distance accumulation of (embodied) knowledge, the VOC tried to stimulate and control this process. To further their commercial goals, the Company demanded regular shipments of geographical and natural knowledge and objects, while simultaneously prohibiting the disclosure of these secrets to others. Historian of science Klaas van Berkel signals this cautious attitude in his article on the VOC by describing the company as a reluctant patron of natural knowledge. Rather than analyze the production of natural knowledge as an integrated aspect of VOC activities, however, Van Berkel separates out and focuses specifically on the "natural scientific researches" undertaken by VOC men in their spare time, such as Hendrik Adriaan van Reede tot Drakenstein and his *Hortus Malabaricus* and Georg Eberhard Rumphius and his work on the natural history of Ambon.

Elbourne, *Blood Ground,* 71-75. I use 'Khoikhoi' as an encompassing name paralleling the 'Dutch' VOC servants. Although the VOC was a Dutch enterprise, its employees originated mostly from Germany and to a lesser degree Scandinavia, Poland, Portugal and France, see: Gelder, *Oost-indisch avontuur*. In this essay 'the Dutch' is used as shorthand for this mixed group.

4 Drayton, *Nature's Government,* see chapter 3 for an in-depth discussion on agriculture and gardening as justification for colonization of wild nature. Latour, *Science in Action,* 217. Latour argues that bringing back information makes "a second visit stronger than the first" which starts the whole cycle of accumulation that is accumulated in 'centres of calculation' that makes these centres strong. Likewise the VOC gained local information and goods that enabled the Company to grow stronger.

What he thereby underestimates is how the production of natural knowledge and the VOC's commercial interests actually depended on each other, something that is not at all contradicted by his observation that the VOC in Amsterdam controlled the circulation of findings and kept natural secrets from their mercantile rivals by withholding manuscripts from publication. If we accept that the commercial goals of the VOC stimulated as well as fed off the accumulation of (local) natural knowledge, goods, and oral information, we can identify a constant flow of knowledge and practices moving between various cultures.[5]

Reluctant or not, with or without the VOC's consent, people, objects, and information interactively gathered at the Company's garden. This garden became what Richard White has termed a 'middle ground' where these interactions took place.[6] In the early years, the accumulation, exchange and dispersion of natural knowledge and practices between Khoikhoi and colonizers were a mundane reality of everyday life, facilitated by local mediators. Following Mentzel's water metaphor, the accumulating knowledge and practices flowed from one cultural location to the other, transforming in the process of making their way to both a European 'scientific centre' *and* to the minds and hands of the Khoikhoi peoples. At the Cape, the Company's garden became a 'centre of accumulation' for the VOC and a site through which both cultures encountered and appropriated previously unknown knowledge and practices.[7]

Both Western and Khoikhoi networks followed their own set paths of demand and supply of information and goods which each tried to control and transport to other areas for further observation and distribution. A constant production of charts, reports, drawings, herbals, seeds, and other samples flowed from the Cape to the VOC centres in Amsterdam and Batavia. The Khoikhoi likewise amassed information and practices from the Dutch, which they dispersed for other African peoples to become acquainted with. Befitting their nomadic lifestyle they circulated knowledge orally or embodied it in objects and ways of doing which travelled with them.

This essay begins by introducing the original inhabitants of the Cape region, their knowledge and practices.[8] Then follows an examination of the start of the

5 Berkel, "Een onwillige mecenas?" 39-58.

6 See: White, *Middle Ground,* Pratt, "Arts of the Contact Zone"; Hall, "The Archaeology," and Turnbull, "Boundary-Crossings".

7 Latour, *Science in Action,* 220. He suggests that gaining knowledge is "a whole cycle of accumulation: how to bring things back to a place for someone to see it, at a distance."

8 We need to recall that virtually all the information we have about this is based on the (written) testimony of Westerners.

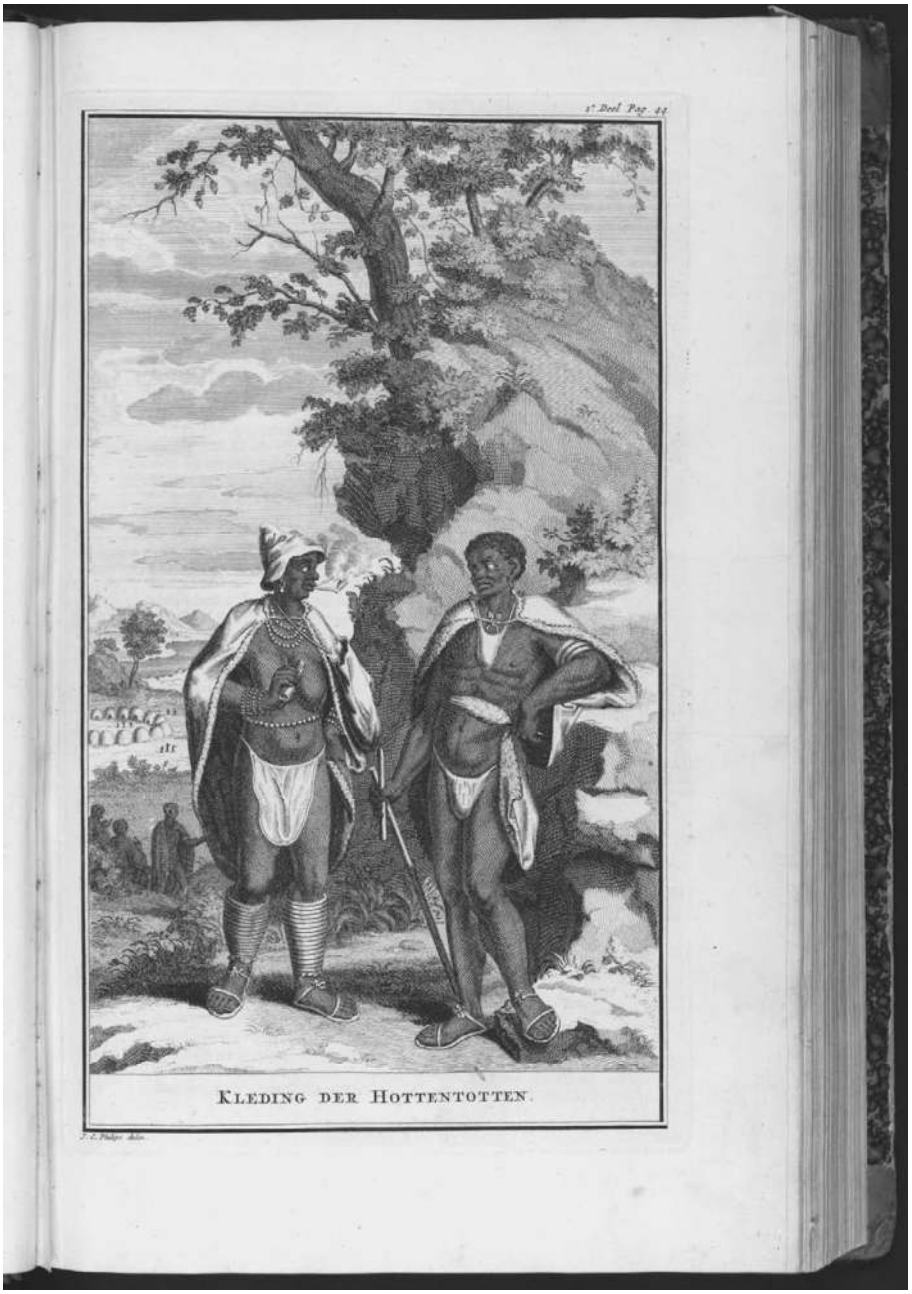
Cape settlement, how the Dutch settlers commenced their gardening practices and brought progressively more land under cultivation, against which the natives protested. The next section discusses the different ways to establish and maintain a middle ground, to use Richard White's helpful term, in which European settlers and the Cape's indigenous peoples developed means of communication and enlisted intermediaries in order to negotiate trade and exchange information. Lastly, the conclusion brings these sections together and critically reflects on the culturally laden portrayal of civilized Europeans bringing (agri)culture to 'ignorant' natives which continues to persist and recounts how intermediaries enabled the accumulation of local information and objects which were transformed so that distant 'others' could become familiar with the unknown while trying to strengthen their position.

The Khoikhoi

Various nomadic peoples roamed along Table Bay, following the Cape of Good Hope and trekking inward from South Africa's coast, including the hunter-gatherers San and the herdsmen Khoikhoi. These horizontally organized nomads lived in different clans of several hundred to a few thousand people, with one person per group functioning as leader. The Dutch labelled this person 'captain' giving him a stick with a copper badge with the VOC logo. This staff symbolized the trade ties between the Dutch and the locals, while making the 'captain' a recognizable figure for both natives and newcomers as main negotiator of goods and knowledge. [Fig. 2]

The Khoikhoi regularly trekked across the land searching for fresh pastures and water. They took into account the alternating dry and wet seasons, whereby experience and examination helped to determine the location, availability, and quality of fresh water, grasslands, and useful plants. The Khoikhoi returned to the same spot perhaps once a year, depending on the weather conditions. They lived for "the most part on beef, mutton, all sorts of game, and other flesh that suits their taste, well roasted or boiled [and] on wild fruits and roots, and other unpurchased victuals" as the Dutchman Johannes Grevenbroek mentioned in his journal. According to the well-informed armchair traveller Olfert Dapper, the men herded and hunted whilst the women searched for "certain type of round roots vegetables" along the riverbanks and other sites, which they "eat either boiled or fried, according to taste." [9]

[9] Grevenbroek, "An elegant and accurate account," 179; Dapper, "Kaffrarie of Lant der Kaffers," 54



2. Peter Kolb, The Hottentots and their dress, engraving in P. Kolb, Naaukeurige en uitvoerige beschryving van Kaap de Goede Hoop, (Amsterdam: Balthazar Lakeman, 1727), vol. 2, 44. Amsterdam, University Library (UvA) special collections OTM OF 63-20.

The natives possessed knowledge of medicinal plants and ways to make cures. They had ointments against bruises and treatments against bites of poisonous animals and insects. According to the Dutch traveller Willem ten Rhyne, they cured "colic quickly by [using] a certain aromatic root." For sick people the women would prepare a mixture of "cabbage, mallow, and mustard leaves, cooked with a little stamped blubber." Various types of the mallow plant could be found along Table Bay, which was used as a treatment against "respiratory diseases, coughs and internal aches, as stimulants or purgatives, to soothing wounds and cuts." The women had acquired knowledge of medicinal plants, of preparation, and dosage to cure their sick and wounded that they handed down from one generation to the next. Likewise, the men knew which toxic plant parts to prepare as poison. With these concoctions they would treat arrowheads and the tips of assegais that would kill an animal "the day after the wound." These activities suggest a deep familiarity with natural knowledge achieved through experiment and observation.[10]

Some contemporary sources acknowledged that the Khoikhoi possessed knowledge of the Cape's nature and that they knew how to manage and manipulate it. The German VOC employer Johann Wilhelm Vogel described that when the grass

> ... is so high that it comes up to one's knees, and, when it is too old and tough to be eaten by the beasts any more, it is set on fire by the inhabitants, so that at times it is to be seen burning for several miles. But in order that the fire may go no further than the inhabitants wish, they dig out a trench, where the fire decreases and dies out when it reaches it, for lack of more near-by grass to feed it. The ashes of such burnt grass manure the land where the fire was, and make it so fertile that, when light rains fall, in a short time new or young grass grows up, into which the animals are driven to graze; and thus in one region after another where the grass has become too old, it is thus renewed by the operation of burning it.

The Khoikhoi knew when and how to regenerate nature and they knew how to constrain these grass fires. The Dutch later copied this custom, noted the German VOC servant Peter Kolb, after "having seen, learned and approved of it." The Dutch, however, transformed this process of the nomads by adapting it to the needs of European-style agriculture.[11]

[10] Rhyne, "Short Account of," 153; on mallow see: http://www.plantzafrica.com/planthij/hermannia.htm and on toxic plants: Wilson, Toussaint van Hove, van Rijssen, *Codex Witsenii*, 10; on the familiarity of events see: Latour, *Science in Action* and Lévi-Strauss, *Savage Mind*, 14.

[11] Grevenbroek, "Elegant and accurate account," 245, Tachard, *Voyage to Siam*, 71; Vogel in: Raven-Hart, *Cape Good Hope 1652-1702*, vol. 1, 213; Kolb, *Naaukeurige beschrijvinge*, vol. 1, 463.

The Khoikhoi used their knowledge of the landscape and the position of the stars to find their way to fresh pastures, water sources, and to other roaming groups. Their trade routes led to the lands of the Xhosa all the way in the east, and probably across the Orange River in the north to Bantu-speaking areas. These groups exchanged information, arranged marriages, and traded cattle for luxury items (metal and herbs). This trade, as historian Richard Elphick remarks "was not of sufficient scale to alter fundamentally the Khoikhoi economy or political structure." These pastoral people did not create a market, a merchant class, nor did they obtain "such large accumulations of nonpastoral wealth that previously existing differences between rich and poor, or between ruler and ruled, were markedly intensified."[12]

Their nomadic lifestyle did not allow for excess accumulation of wealth or endless accumulation of goods and (non-portable) knowledge; a person with cattle was wealthy and someone without cattle was poor. This non-scriptural society carried their worldly goods on their oxen and their backs, and their knowledge of the environment in their hands and minds. Accumulation beyond a certain point was not manageable, since it could not be contained and transported via known means. What the natives required for nourishment was found while trekking across the land. They circulated with their knowledge of the land and nature from one pasture to next. This meant that they did not process, relocate, store or accumulate food and water supplies in one fixed site, which they could use in times of need. The only surplus they created was of their cattle and sheep, which they considered a sign of wealth rather than a commodity.[13]

Given their nomadic existence, the Khoikhoi did not need to put in extra work-effort (to collect vegetables or dairy products) to create a surplus. In keeping with this, there was no need for a paper administration or a written language. Interpreting this as a significant cultural marker, Olfert Dapper described the Cape natives as "bereft of all science and literature, very uncouth, and in intellect more like beasts than men." Westerners valued, and still do value, the written word over oral information. The nomads, however, actively acquired knowledge and goods that they subsequently transported, traded, and transformed.

With the arrival of the Dutch, the Khoikhoi groupings adapted to the new circumstances and found ways to deal with the Western settlers. One of the first steps the natives took was to learn Western languages. Dapper signalled that

[12] Mossop, *Journals of the Expeditions*, 233-4; Marks, "Khoisan Resistance," 60; Elphick, *Khoikhoi and the founding*, 65-67.

[13] Marks, "Khoisan Resistance," 63.

some Khoikhoi "through steady intercourse with our countrymen, gradually let the sparks of their human nature come to light, just as several at the Fort are also beginning to grasp the Dutch language." [14]

These nomads, in the eyes of the Westerners, did not undertake any recognizable agricultural activities other than herding beasts, which were kept primarily for their dairy products and not so much for their meat. They did not live in fixed houses, nor cultivate the land. And when the colonizers copied the natives' way of grass burning, for example, it was not accompanied by an acknowledgement that the natives' agricultural knowledge was worth adopting. Dutch settlers neither acknowledged Khoikhoi knowledge and practices, nor the natives' notion of ownership and habitation of the lands.[15]

Christian sentiments regarding the cultivation of one's garden as well as the notion that the Western way of commerce and agriculture were superior to those of the nomads undergirded Dutch disparagement of Khoikhoi knowledge. This allowed the VOC to propagate the claim that the Cape was 'vacant' of agriculture and settlements, which justified their colonization and further exploration of the land. To validate their settled ownership and cultivation of the land, the Dutch emphasized the Khoikhoi's lack of culture and agriculture. With the plough and surveying instruments in one hand and deeds of acquisition in the other, Europeans changed the Cape's landscape. This contributed to a centuries-long presumption regarding how the West cultivated the under-developed 'Rest' while the Dutch in fact profitably absorbed Khoikhoi knowledge and practices.[16]

The Start of the Settlement

In 1652, Commander Jan van Riebeeck landed at Table Bay to set up a refreshment station. Previously passing Portuguese, English, and Dutch ships had used this natural harbour to collect fresh water and barter food with the natives. Riebeeck's small fleet of three ships carried the necessary goods to start a settlement, such as materials to build houses, furniture, utensils, and various garden seeds and bulbs. Armed with a limited knowledge of the Cape but with their agricultural skills, the first group stepped ashore, where they began 'improving' the Cape's nature. The

[14] Dapper, "Early Cape Hottentots," 45.

[15] Biewenga, *Kaap de Goede Hoop*, 23.

[16] On the vacant land myth, see: Bank, "The Great Debate," 261-281. On facts, see: Cook, *Matters of Exchange*. For in-depth discussion on agriculture and gardening as justification for colonization of wild nature see: Drayton, *Nature's Government*, chapter 3 and Fleischer, "Beemster Polder," 145-166 on the improvement of nature in Holland. Schreyer in Raven-Hart, *Cape Good Hope 1652-1702*, 114-139.

settlers started to change what they viewed as an untidy landscape into an orderly, well-maintained and productive garden, while organizing a steady water flow by digging basins and canals.[17]

Every step of this transformation was reported to the VOC directors in The Netherlands who demanded regular reports with information on the local geography, climate, types of soil, rivers, fish, plants, animals, mountains, and samples of its natural riches. Expeditions provided further charts and information about the Cape's elevation, orientations, soils, and water supply, as well as descriptions and drawings of plants and animals. It was essential for this long-distance corporation to receive the latest geographical and natural information and samples to further their mercantile goals. The Company stretched its tentacles out as far as possible, reeling in information that was rendered stable in charts, drawings, and reports. From a distance, the board of directors tried to manage the process through rules and regulation on how to deal with native peoples in order not to damage trade and negotiations regarding land and information.[18]

The first locals the Dutch encountered along Table Bay were the *Goringhaicona* (renamed 'beach-rangers' by the Dutch). They were cattle-less hunter-gatherers roaming along the coast. From circa 1600, this group had become familiar with European trade goods such as copper, iron, alcohol, and tobacco, from their encounters with recurrent Portuguese, English, and Dutch East Indiamen. These items were handed out as tokens of friendship and exchanged for food, firewood, assistance, and information, which the locals, in turn, used as currency to barter for cattle with trekking Khoikhoi. Seen from the native standpoint, these passing European tradesmen were like them: a mobile people who periodically returned to the same spot for water and food and then moved on to the next site. When the Cape natives realised that Riebeeck's group wanted to stay at Table Bay, this notion of a nomadic European counterpart changed dramatically. At first,

[17] There is extensive literature on the Cape of Good Hope founding years, as well as primary sources. The National Archives in The Hague houses the VOC archives, and published in Leibbrandt, *Precis of the Archives*; Bosman and Thom, *Daghregister*; and online http://databases.tanap.net/. Other published sources: Schapera and Farrington, *Early Cape Hottentots*; Meister, *Orientalisch-Indianische Kunst- und Lust-Gärtner*; Mentzel, *A Geographical and Topographical Description*; Tachard, *Voyage to Siam*; Valentyn, *Beschryvinge van de Kaap*; Böeseken, *Memoriën en instructiën 1657-1699*. See for recent literature: Verstegen, *Indische Zeeherberg*; Biewenga, *Kaap de Goede Hoop*; Elphick, *Khoikhoi and the founding*; Guelke, "The Anatomy"; Guelke and Shell, "Landscape of Conquest" 803-824; Schoeman, *Armosyn*; Karsten, *Old Company's Garden*.

[18] Waterhouse, *Simon van der Stel's Journal*, 4; Harris, "Long-Distance Corporations," 269-304.

however, the Dutch did not meet with much hostility while commencing with their agricultural enterprise.[19]

Sailors and soldiers with a background as gardeners or farmers, and with handicraft knowledge were put to work by the VOC in and around the Fortress and the Company's Garden. This "motley crew" of Europeans had left behind their homes and families to join the VOC. The group consisted of those who sought to escape poverty in search of fortune and those who were tricked by 'soul merchants' to sign up with the VOC either as sailors or soldiers in exchange for ready cash. Some left from Amsterdam with their wives and children to start a new life elsewhere for good. This group merged into a workforce that constructed the settlement and the Cape garden. At the Cape, they prepared the soil by clearing it of weeds, shrubs, and rock since the land "was covered with thick growing, shrubby plants of various heather types and proteas."[20]

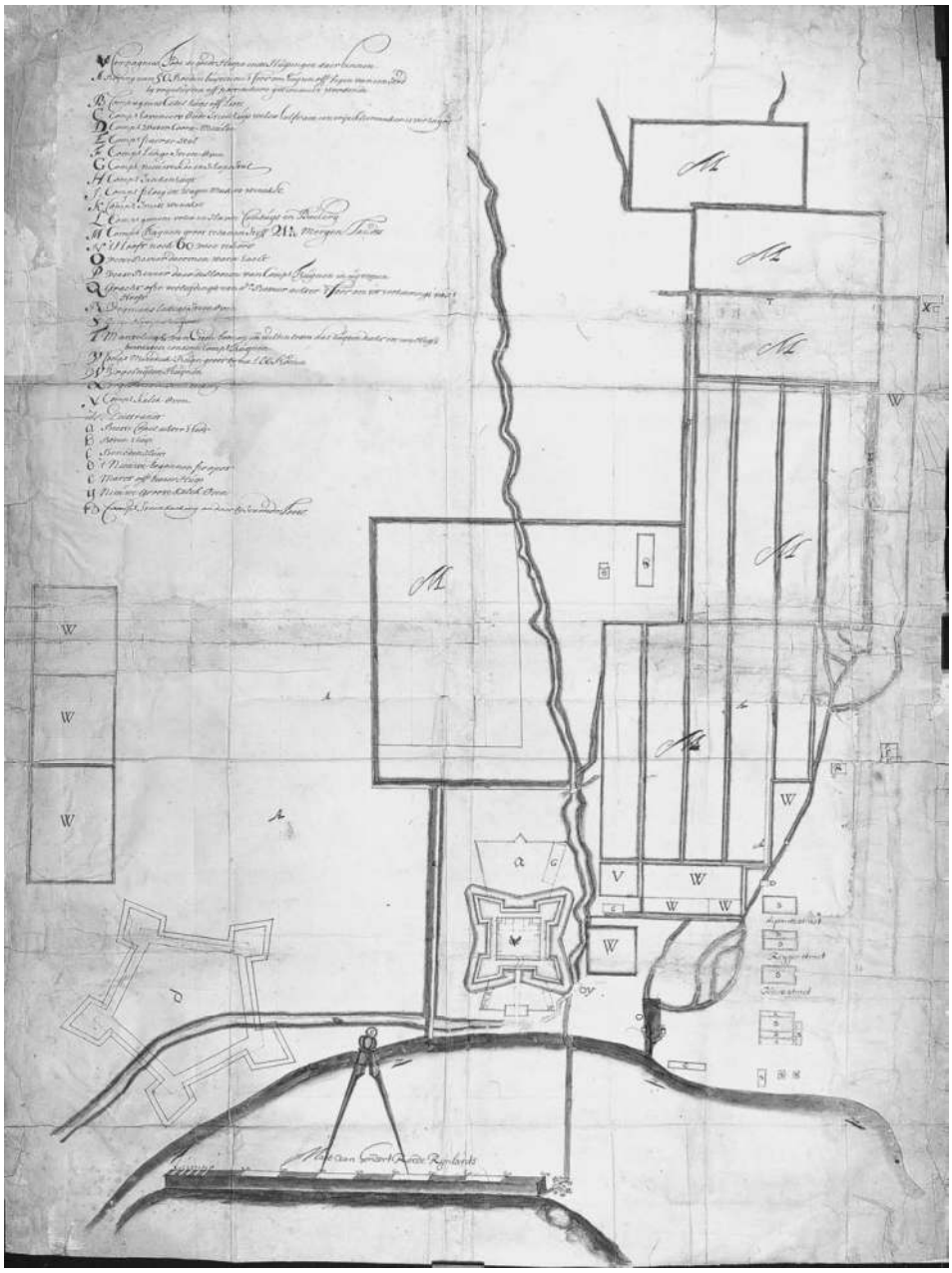
Johan Schreyer, a German in the service of the VOC, commented in 1668 that the Cape was "all uncultivated and uncleared, just as it was made at God's Creation. And I assert, that if there were folk to cultivate, plant and inhabit this fallow land, better ground would be found here than in all Europe." To transform this land, the settlers started by staking out a terrain of circa forty-two acres close to the Fort, and dividing it by paths and irrigation canals into rectangular sections. This was to become the Company garden; a testing ground for seeds, roots, and plants, not only from and to Holland and Batavia, but shipped directly from all parts of the world, through the extensive Dutch commercial network.[21] [Fig. 3]

Arriving with the Commander was Hendrik Boom, who became the first head gardener at the Cape and who, according the VOC lists, had previously worked in Amsterdam as a gardener. Boom had brought vegetable and herb seeds from Holland, which he sowed in the Company's newly constructed garden. But the garden soon became a global centre of experimentation and accumulation, as he received seeds, roots, and plants, not only from Holland and Batavia, but directly shipped from all parts of the world, through the VOC's extensive commercial network. The gardener planted cabbages, carrots, and "other root vegetables," rosemary and laurel, cereals, apples, pears, and grapes from Europe. From the Americas and

19 Elphick, *Khoikhoi and the founding*, 86.

20 Schoeman, *Armosyn van die Kaap*, 18-19.

21 Schreyer, "Reise nach dem Kaplande," 22. Das Land ist alles ungebauet, ungeräumet, allerdings, wie es in der Schöpffung von Gott erschaffen worden. Und halte ich davor, wenn Leute wären, welche diese ungebaute Erde beaueten, pflantzten und bewohneten, daß hier das beste Land seyn solte, besser als in gantz Europa nicht zu finden. See for more on "motley crew" on British ships and colonies: Linebaugh and Rediker, *Many-Headed Hydra*, 26-29, and Gelder, *Oostindisch Avontuur*, 56-57 for the Dutch situation.



3. Pieter Potter, Map of the Company's garden and fortress, c. 1665. The Hague, Nationaal Archief, The Netherlands, 4.VEL 825.

Indies he grew pineapples, sweet potatoes, calabash, cucumbers, Indian radish, banana, peanuts, "and all other imaginable seeds…" In January 1653, skipper Teunis Eyssen from the galliot *Swarte Vos* passed Pernambuco (Brazil) and brought "some Brazil pumpkin, melon and watermelon seeds [which were] already sprouting beautifully." From the Far East came various plants such as banana and guava. Tea and camphor were brought from Japan and Batavia by the German gardener and VOC employee George Meister to the Cape where the plants rested for a period of time before being transported to Amsterdam. A single camphor tree remained behind in the medicinal section of the Company's Garden.[22]

This centre of accumulation showcased the orderliness as well as the wealth and might of Dutch enterprise while simultaneously feeding hungry settlers and sailors. In this sense, the garden can be compared to a laboratory or modern factory in which local conditions are minimized as much as possible, in favour of constructing a standardized environment in which the same results can be achieved as in any other such space, regardless of the actual geographical setting. By recontouring the ground along geometrical lines and planting it with seeds drawn from elsewhere, VOC gardeners sectioned off a part of nature. They changed this portion of the original landscape into a cultured environment in order to nurture the global network of which it was now an integrated node.[23]

The Dutch put a great deal of effort into making these cultivating experiments a success. But hunger loomed. In the first years, imported saplings were washed away by the May rains. Harvests were destroyed by the dry south-eastern winds, and seeds failed to grow because of unfit circumstances. Boom planted a screen of trees to protect his vegetation against wind. To control the water flow, he constructed a system of canals that enabled him to irrigate the garden during the dry season. This stood in opposition to the farming practices in the Low Countries where ditches relieved gardens and farmlands from excess water. The gardener redirected water from a stream further uphill into straight canals reaching every part of the garden. The Dutch transformed the familiar overflow canal into an indispensable irrigation system at the Cape. They adapted to the new circumstances, that is to say, by changing their land management and agricultural practices to

[22] Karsten, *Old Company's Garden*, 24¸ Meister, *Orientalisch-Indianische*, 26; the VOC feared that the camphor might get stolen by the competition, Heniger, *Hendrik Adriaan van Reede*, 75.

[23] A number of historians and sociologists of science have commented on this process where human and environmental spaces are standardized in order to accommodate the production of scientific knowledge. David Livingstone sums this up by calling laboratories 'placeless places' see: Livingstone, *Putting Science,* 23.

meet local requirements – but with the ironic goal of eradicating the effects of local conditions.[24]

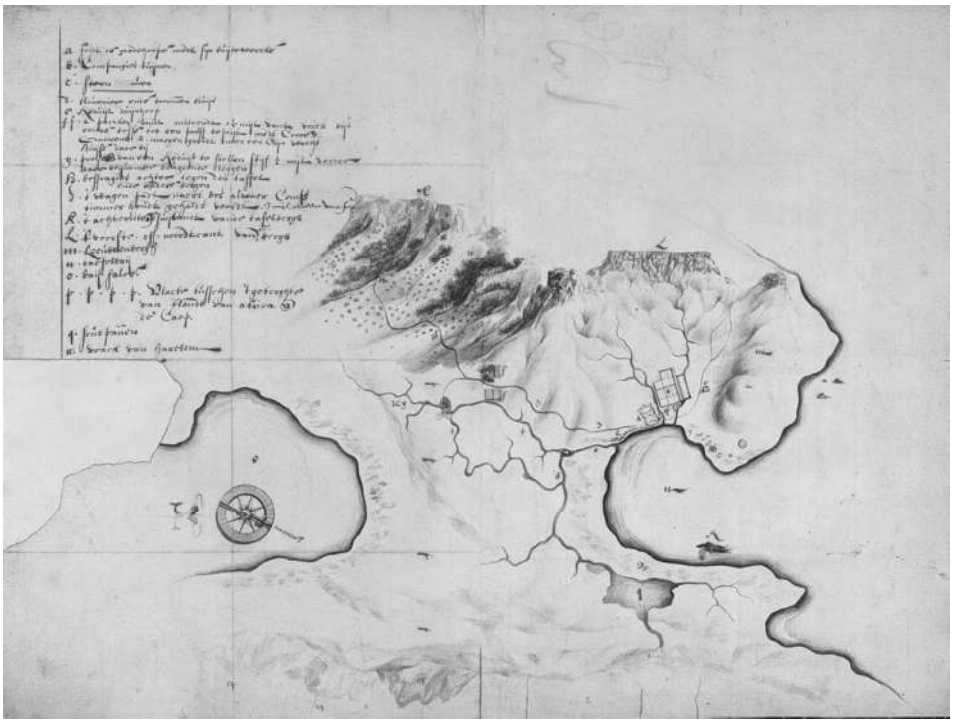
Meanwhile, the colonizers learned to prepare and eat local plants and avoid scurvy or starvation. Boom, while planting wild asparagus, sorrel, wild leek, and a type of mustard seed, simultaneously contributed to the VOC's constant demand for information by inquirying into local vegetables and herbs. The natives had informed Boom or his garden helpers about the edibility of wild asparagus (also known as the *hotnotskool*) which was widely eaten by the natives. The Khoikhoi furthermore showed the Dutch how to cook bitter almonds, which Riebeeck said he would try at his earliest convenience. But the gardeners were more interested in the thickly foliaged evergreen shrubs that bore these almonds as a protective hedge around the gardens against animal and human intruders. The Commander gathered information on various nutritious Cape plants, but it seemed that the settlers only occasionally adapted their palate to Khoikhoi cuisine. They adopted the wild asparagus into their diet, whereas the bitter almond entered their gardens for protective purposes. At the Cape, VOC-servants took over local knowledge and transformed it to suit their requirements.[25]

Over time, ever larger parts of the Cape became cultivated and colonized, fenced in to guard them against human and animal intruders. The aim of these new gardens was to feed settlers, soldiers, and sailors. The oldest Company's garden in the meantime was being transformed from a kitchen garden into a botanical garden, filled with both ornamental and useful plants from various parts of the world. It lost its primary victualizing function as the yields of settling farmers and of other gardens increased. Commerce and cultivation motivated the VOC to transform the Cape's environment, turning more and more land into gardens, and replacing local plants with imported vegetables and fruits. Pursuing agriculture was a way for the Dutch to understand, possess, transform and exploit the Cape's geography and nature.[26]

To make the settlement self-supporting, the Commander explored the possibilities of bringing other areas which were farther away from the fortress under the plough. Near Devil's Mountain a garden of about eight acres appeared; at the foot of Lion's Mountain a plot of land which was shielded from the wind was prepared for the growth of delicate ground-fruits and fruit-trees. A bit farther away, at Rondebosch, was "the Company's cornfield and orchard, where experiments were carried out with various plants, European and Indian, with widely divergent

[24] Verstegen, *Indische Zeeherberg*, 31-40.
[25] Karsten, *Old Company's Garden*, 3-4, 56-7, 60. Valentyn, *Beschryvinge van de Kaap,* 206.
[26] Drayton, *Nature's Government*, 51-60.

results." During the first decades the Cape Commander ordered surveyors to draw up maps of the whole peninsula with information on elevation, water sources, and types of soil. Helmsmen executed the surveyor tasks, since they were trained in and responsible for map making and triangulation on board ship. Aided by an ongoing influx of skilful sailors and soldiers, the VOC was able to rule the waves *and* cultivate the Cape.[27] [Fig. 4]



4. Anonymous, Map of Cape of Good Hope with trial farmlands with sowed corn, c. 1656. The Hague, Nationaal Archief, The Netherlands, 4.VEL 803

One of the early maps of the area shows the settlement, the fortress, the Company garden and, at a short distance from the community, the planned agricultural development. The map projects a landscape with familiar elements and symbols (houses, gardens, rivers, trees) understandable to the Western viewer. The mapmaker left out any sign that indicated indigenous existence. He did not mark, for instance, the lands that the nomads used as pastures for their cattle. Thereby he created the image of a de-nativized space, suitable for cultivation and exploitation. These sorts of representations propagated the 'vacant land' myth as they did

[27] Karsten, *Old Company's Garden*, 11.

not show evidence of native habitation. Land surveying, therefore, was one step toward subjugating this perceived wilderness to the rules of geometry. Another step was the plough, which implemented the geometric rule by turning the land into straight furrows. On the cleared and prepared rectangular terrains, the settlers could sow, plant, and fence the terrain and construct housing and sheds.[28]

A farming frontier, which started small and existed at first only in words and charts, became a growing reality that pushed further inland. This conquest hit the Khoikhoi hard. On returning to their peninsular pastures, sometimes after a period of absence of one or even two years, the nomads saw their land changed into plantations and vineyards, fenced off and well-guarded against animal and human intruders. Khoikhoi pastures and water sources had been claimed in the name of the VOC, since nobody before had cultivated this 'wilderness'.

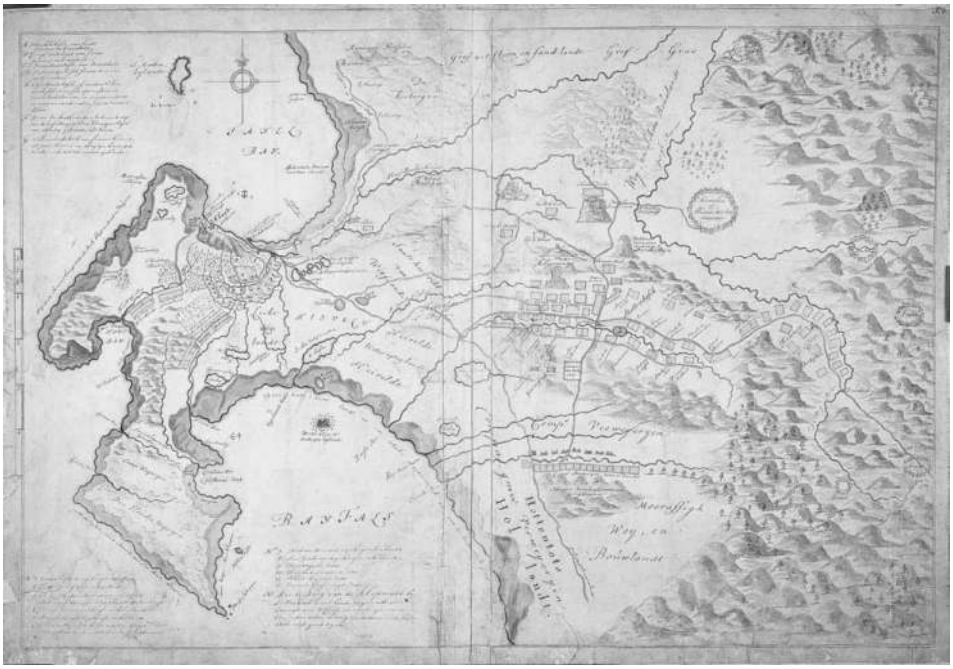
In spite of the Khoikhoi's recurring raids and protests against the ongoing agricultural subjugation, the Company forced them to move to other pastures, based on the argument that they were not fixed to one place. In so doing, the land- and cattle-hungry settlers redirected the natives to inferior grounds. As several historians, including Elphick, Guelke, and Shell, argue, the Khoikhoi were no match for the Dutch hunger for land. The nomads were too scattered over a large territory to act in union against the agriculturalists. In the end their arrows and assegais could not chase away the mounted soldier-settlers and their firearms.[29]

The Dutch obtained a firm grip on the land and the cattle trade by herding cows and sheep themselves, for which they had previously bartered copper and tobacco with the Khoikhoi. Herding large numbers of cattle put even more pressure on the available grassland and water sources. Along the peninsula groups of nomads trekked to other, more barren, regions in search of pastures, food, and water. Here, they struggled to maintain their former nomadic lifestyle, choosing between roaming even deeper inland and adapting to colonial farming and work for Dutch farmers as poorly paid cowhands and housemaids. The colonizers firmly consolidated their presence along Table Bay and progressively moved further inland. Over time, the Dutch increasingly pressured the local inhabitants to give up their nomadic lifestyle. As illustrated by a map of 1692, mapmakers were now prepared to include the natives in their charts. The map representationally transformed the Khoikhoi's mobile shelters into groups of neat circles, thereby fixing them at the periphery, far removed from their old pastures and water sources. The

[28] Harley, *New Nature of Maps*, 169-195.

[29] Elphick, *Khoikhoi and the founding,* 124 and further; Guelke and Shell, "Landscape of Conquest," 803-824.

cultivated sections were marked with their Dutch names, representationally fixing the new rule. [Fig. 5]



5. Isaac de Graaff, Map of Cape of Good Hope, c. 1695. The Hague, Nationaal Archief, The Netherlands, 4.VEL 809

Giving a territory a name was one way of knowing or owning the land. Descriptive labels provided information about the layout of a landscape so that others could become familiar with its geography and inhabitants. In a way the settlers entered the Cape like a worldly Adam, naming places, plants, and people. To incorporate the peninsula into Western culture, the settlers gave Dutch names to the encountered landmarks, which appeared on the newly made maps. VOC employees 'christened' the landscape, making it part of the VOC's growing realm.[30]

The Dutch gave names to land marks based on their characteristics or shapes, or to remind them of their homeland. The colonizers, for instance, named the Orange River in commemoration of their Stadholder, the Prince of Orange. In some cases both local and Dutch names were recorded. Boom's successor Jan Hartog copied both Khoikhoi and Dutch names in his journal of the 1707 expedition into

[30] See for renaming of plants: Wijnands, Wilson and Toussaint van Hove, *Jan Commelin's monograph*; Scholtz, *Naamgewing*. Gunn and Codd, *Botanical Exploration*, 24-25.

the hinterland. He renamed the river Koutema the Palmiet River for the palm trees growing nearby and the Doggha kamma became Swarte (Black) River. Although the Dutch could not reproduce the Khoikhoi clicks and other sounds in writing, these names helped the Commander and the native interpreters at the Cape to retrace the expedition's footsteps, together with newly compiled maps. This collection of charted knowledge was furthered to the VOC headquarters in The Netherlands, making the unfamiliar geography of a distant district understandable, and manageable.[31]

Incorporating the Cape's landscape into the Dutch realm enabled the VOC to explore and exploit it for the benefit of the settlers, the passing East Indiamen, and for those at home. The settlers, however, needed the help and cooperation of the local inhabitants to further their commercial enterprise. Instructions from the VOC board were clear: the Dutch had to befriend the natives in order to exchange tobacco, alcohol, and copper for food (mainly cattle) and information.

It could be difficult for the newcomers to trade with the roaming Khoikhoi and their herds, since they were not always close to the Cape when needed. The cattle-less 'beach-rangers' first helped the Dutch by mediating the cattle trade and establishing contact with these herdsmen. A little later a young Khoikhoi woman became the main mediator for negotiating the exchange of Dutch goods for cattle and information, thanks to having learned to speak Dutch while living with the Riebeeck family. This go-between temporarily bridged the gap between the two opposing cultures, each of which considered the other as alien, suspect, and threatening.

The Middle Ground

The strangeness of the 'other', their unfamiliar ways and practices, together with the language barrier, allowed for a mutual distrust between natives and settlers. This distrust stood in the way of bartering goods and acquiring information. However, the Dutch needed the local products and knowledge for their survival whereas the Khoikhoi desired the proposed Western goods. Both parties were willing to come together to negotiate prices in exchange for the other party's offered valuables (copper, cattle, information, etc). By doing so they created a middle ground where they established communication and rules of exchange.

In his book *The Middle Ground, Indians, Empires, and Republics in the Great Lakes Region, 1650-1815* historian Richard White develops the concept of a middle ground, which enables him to explore and explain the interactions between

[31] Stock, "Diary of a Cattle Expedition," 610-622.

French and Algonquin Indians in the Great Lakes region of North America. White explains that a middle ground allows one group to achieve the cooperation or consent of others without using force. The creators of the middle ground, he argues, justify their actions according to what they perceive "to be their partner's cultural premises," while convincing the 'other' that the mutual action is fair and legitimate. The presence of a mediator makes the formation of a middle ground possible through the constitution of a communal language and/or signs. Through these tools trade is negotiated, information exchanged, and certain rights and practices explained. To explore this at the Cape, the first part of this section discusses the challenges of establishing and maintaining a middle ground due to a limited vocabulary paired with cultural difference regarding property, which led to a confusion of use and interpretation of words. The second part introduces the young Khoikhoi woman Krotoa also known as Eva who, as alluded to above, functioned as a mediator between the Dutch and the Khoikhoi.[32]

As mentioned, the first Khoikhoi the colonizers encountered around Table Bay were the so-called beach-rangers. These hunter-gatherers had traded regularly with passing sailing ships and had over time acquired some Portuguese, Spanish, English and Dutch words. With them the Dutch established a communal language based on this existing but limited vocabulary. Over time, the VOC employee Johannes Grevenbroek signalled that natives had acquired "a good speaking knowledge of Dutch." He advised the settlers to do the same and learn Khoikhoi, since they "ought to be aware how firm a bond of union a common language is, and how powerful a means it is of keeping peoples loyal and peaceful."[33] The beach-rangers' basic knowledge of European idiom enabled the creation of a middle ground that allowed for the exchange of cattle versus copper. At the same time this feeble verbal base led to mutual misunderstanding and furthered distrust.

One example illustrates the difficulties that attended this situation. When a group of Khoikhoi encountered a few Dutchmen in search of cattle, the natives used their limited knowledge of Dutch and its culture to express their right over a certain territory. The natives attempted make the settlers understand that they had strayed into land which the Khoikhoi used as pasture. According to the colonizers who reported the incidence, they explained that the land was their Holland, calling it 'Hottentots' Holland'. This eventually led to a creative (mis)interpretation by the Dutch, who understood this land to be as lush (and therefore as desirable) as Holland itself. Both cultural differences and language difficulties made it

[32] White, *Middle Ground*, 52.

[33] Grevenbroek, "Elegant and accurate account," 283.

problematic for the Khoikhoi and the Dutch to pass on information regarding this territory.

The name 'Hottentots' Holland' began to appear on maps and in reports. In March 1670, Riebeeck informed the VOC that "circa twelve hours from the fort lies a certain site named Hottentots Holland of about 2,000 morgen with extremely good land." The agriculturalists were "unanimous in their decision" to put it under the plough, as the cultivation of Hottentots' Holland would benefit the settlement and the Company's ships. The name's significance thus shifted from underpinning the Khoikhoi's claim to (purportedly) indicating its agricultural potential. Introducing this name to the VOC board suggested that this land was as fertile as Holland, thereby giving priority to 'Holland' as a defining category which transcended the local, fixed geography. In his resolution Riebeeck failed to mention that the natives had claimed this land. He asserted it to be empty, alienating them verbally from their pasture. In December 1671, the Commander ordered a land surveyor to "inspect the situation and the cultivation of the lands," and make a map for the VOC head-office. Both in words and in drawings, Hottentots' Holland fell in the hands of the Dutch. The subsequent misinterpretations or mistranslations enabled the Dutch to further their agricultural goals.[34]

Not only did the Dutch possess a larger network and more ways of transporting information, the roaming herdsmen were not always present to oversee the grounds that the nomads experienced and sought to express as their pastures. The colonizers used the Khoikhoi's lack of consistent presence, either embodied in maps and decrees, or buildings and agriculture, to strengthen their own position and enlarge their settlement. The middle ground which the Khoikhoi originally helped establish was washed away by the tidal waves of the strengthening Dutch mercantile and knowledge network, 'validated' by a growing accumulation of charts, reports, and deeds.[35]

Learning a foreign language made communication possible while initially giving the natives a certain advantage in negotiations, since the Dutch could not understand what the Khoikhoi said amongst themselves. Moreover, the VOC dealt with different groups of roaming nomads in their quest for more cattle. Each time the Dutch encountered another clan, a middle ground had to be formed in concert with a willing and able local mediator, as the colonizers remained unwilling to learn Khoikhoi and were unable to distinguish different dialects. Despite initial disadvantages, continuing to speak their own tongue signified Dutch power

[34] Bosman and Thom, *Daghregister*, vol. 2, 135, see the entry of 6 June 1657.

[35] Resolutions of the Council of Policy of Cape of Good Hope. Reference code: C. 7, 1 December 1671.

over the 'other', and over time the language of the 'victor' did indeed become the dominant idiom.

In the founding years of the Cape settlement a few 'beach-ranger' natives became important to the Dutch as go-betweens, helping them to negotiate trade and introducing them to the Cape's nature and its people. These mediators tried to maintain and manipulate the middle ground that was established around the VOC fortress, while helping to construct similar spaces of negotiation with other groupings further inland. One individual played a key role: a young woman called Krotoa, who supplied the Commander with information on the whereabouts of roaming herdsmen and their cattle. Furthermore, she collected and passed on knowledge about the South-African geography and geology. In turn, she used her Dutch connections to settle disputes regarding pastures and cattle between her kinsmen and their rivalling groups, and she mediated between Dutch and Khoikhoi conflicts by trying to appease both parties.[36]

In 1654, the twelve-year-old Krotoa entered the Riebeeck household. Her relatives regarded her presence in the household of this foreign 'chief' as honourable and as a token of friendship. Her task, at first, was minding the children of Riebeeck and their cousins. Here, she received her Dutch name Eva. Again the Dutch acted as if they were Adam by naming her after the first woman God created. During her stay, she learned to read and write and she became familiar with Dutch culture.

Krotoa became the Commander's most trusted translator and informant, gathering knowledge on distant peoples, their habits and wealth along the way. This fuelled the VOC's thirst to obtain (semi-)precious metals and minerals, which they believed could be found somewhere further inland. A 1623 chart drawn by the mapmaker and adventurer Jan Huygen van Linschoten made this notion tangible. It indicated the whereabouts of the Monomotapa, a mythical and powerful people who lived close to the Vigiti Magna River. The Cape VOC officers seized every chance to prove that the charted information was correct. Krotoa's effort to collect local knowledge helped the Commander organize expeditions inland. These expeditions had multiple goals; to search for more cattle and trade-willing nomads, enable an inquiry into the Cape's nature, and find the mythical Vigiti Magna River and the Monomotapa.

[36] See for Krotoa's efforts: Resolutions of the Council of Policy of Cape of Good Hope Cape Town Archives Repository, South Africa, Reference code: C. 1, p. 387, 30 October 1658, C. 2, pp. 10-13, 21 June 1659, C. 2, pp. 17-19, 1 July 1659. And: Wells, "Eva's Men," 417-437, 420. This article gives a good insight in Eva's position as go-between and her ability to make use of the given situation.

Krotoa informed the Commander that two nomadic groups living deeper inland could bring them to the river and beyond. These groups were known as the Namaqua and Chobonas. The Namaquas (sometimes spelled Amaquas), she said, were approximately twenty to thirty days on foot away from the Cape. They had light skin, long hair and lived in stone houses, had churches, and prayed to a god like the Dutch. The Dutch could obtain elephant tusks and large quantities of cattle from them, for which the Namaqua in return desired copper pieces and brass string, red beads, and so forth. She claimed that the Chobonas lived even further inland and possessed gold and pearls. This sounded very promising to the VOC officers, for maybe the Chobonas wanted to trade and direct them to the Vigiti Magna River.[37]

It is unlikely that this young girl, living mostly with the Dutch, possessed this information beforehand. She had to make an effort to find out more about these distant groups. Both were akin to Krotoa's people, but differed somewhat in appearance and language. To make her story trustworthy she added her knowledge of Dutch presumptions to the obtained local information as contained in the Van Linschoten chart. She accumulated and transformed knowledge in order to present a credible story. By creatively combining her understanding of Dutch and local stories, she fabricated a promising middle-ground geography that the Dutch found credible enough to guide them on their quest inland.[38]

Krotoa's motivations to help the settlers remain unclear; what was she or her people to gain? Historian Siegfried Huigen speculates that 'Eva' was just sweet-talking the VOC by combining Dutch beliefs with local stories, whereas historian Julia Wells argues on the other hand that Krotoa tried to serve the interests of her kinsmen by securing her position as 'ambassador' while she simultaneously assisted the Dutch in finding new trading partners. Wells emphasizes Krotoa's role of intermediary between both parties, as a girl who actively gathered information and then transformed local knowledge into Dutch, fitting it into the VOC's knowledge network in order to benefit her own people.[39]

In November 1661 the VOC organized an expedition to find the Namaquas and get one step closer to the Vigiti Magna and thus to the riches of the Monomotapa. The leader of the expedition was instructed to make "calculations with the compass and draw on a map how many hours, half hours, longer or shorter, taken on

[37] Resolutions of the Council of Policy of Cape of Good Hope, Cape Town Archives Repository, South Africa, Reference code: C. 1, 402-403. 1 February 1659.

[38] See Cook, "Capitalism and Science" on the connection between credit/trust and accumulation of knowledge/money.

[39] Wells, "Eva's Men,"; Huigen, *Monomotapa,* 46.

their course, in the way helmsmen do that at sea." Furthermore, the VOC wanted additional information regarding the soil. The expedition should

> ... add where [they] found clay for farmland, sandy, stony, hilly, and the flow of rivers and their course; if there is anywhere in the mountains or rivers any type of mineral, silver or gold; make note on the roads and the conditions thereof, and write down the most significant sites with the names of the people and their superiors and their cities, so we know that in the future.

The collected and processed data informed the VOC board in Amsterdam and Batavia about the Cape's nature and the possibilities to explore and exploit its land in the future, in order to further their agricultural and mining activities.[40]

The VOC appointed the Danish VOC under-surgeon Pieter van Meerhoff to keep all travel records. The young Meerhoff became the father of Krotoa/Eva's two children and, after she converted to Christianity, her husband. Krotoa remained at the Cape, but it was likely that she had given Meerhoff all the information she possessed on the Namaqua. Her role as mediator expanded beyond her physical presence and probably contributed to the success of the 1661 mission.[41]

In the official expedition journal Meerhoff recorded the company of a few other Khoikhoi who acted as intermediaries. These nameless guides gathered and translated information from the nomadic groups they met along to way. One of these groups, the Sonquas, informed the Dutch about the possibilities of finding water along a certain route that would take them to the territory of the Namaqua. The Dutch combined their charts, based on older maps and speculative information, with the accumulated local knowledge of the natives. Meerhoff welded the collected information into the official reports and onto the maps enabling later expeditions as well as the VOC head office to follow in their footsteps.[42] [Fig. 6]

The Dutch persuaded one Sonqua to accompany them to the Namaqua, in exchange for some tobacco. When they encountered the Namaqua, the Table Bay and the Sonqua guides received instructions to explain that the expedition had come in peace. The intermediaries and the Namaqua started their communication at a distance, on either side of a swamp. After long negotiations, the Namaqua

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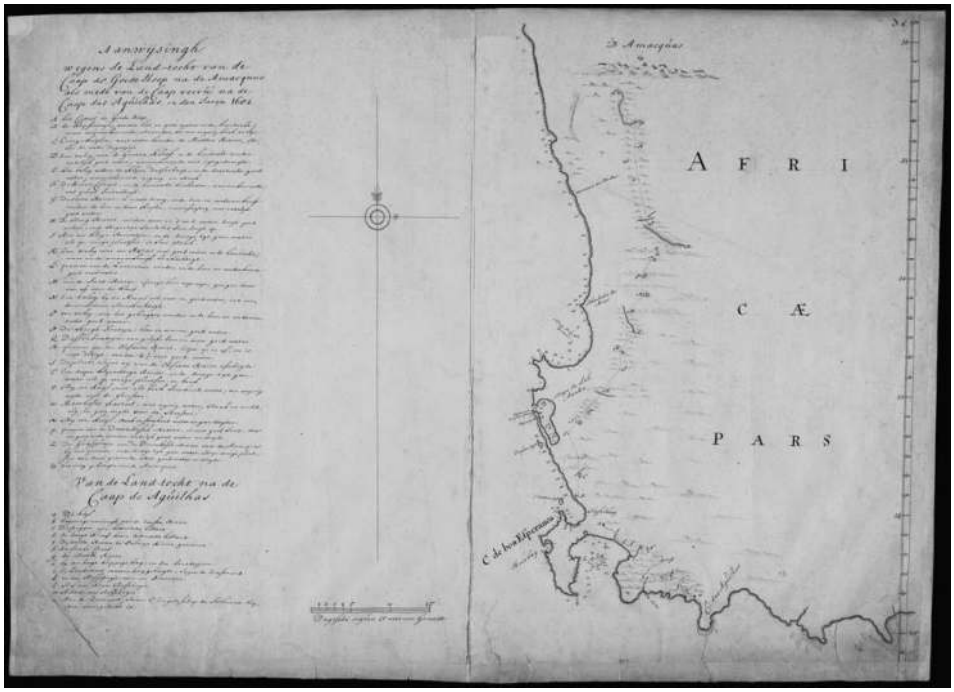
40 Bosman and Thom, *Daghregister*, vol. III, 410. Daer dan mede bijvougen waer cley ofte bougront, sandigh, steenigh, berghachtigh, en waterafflopende revieren sijn, en hoe sij strecken; ook te stellen off ergens in 't geberghte ofte revieren eenigh minerael steekt daer silver off gout uyt te tre[c]ken sij. Item acht te nemen off de wegen overal off ergens met wagens sullen te passeeren sijn, gevende sommige remarcable plaetsen ook namen van 't volcq en haer oversten ende steden, om te kennen in toecomende.

41 Huigen *Monomotapa,* 35 and 54 and further.

42 Bosman and Thom, *Daghregister*, vol. III, 482.



6. Maker unknown, Map made after the expedition to the Namaqua in the year 1682. The Hague, Nationaal Archief, 4.VEL 850.

allowed the Dutch to come closer, accepting their gifts of bread and stuffed tobacco pipes, which the Dutch showed how to smoke. The first steps toward the establishment of a middle ground between the two groups seemed successful. The expedition party left with some livestock bartered for copper, pipes, and tobacco, urging the Namaquas to come to the Fortress at Table Bay with their herds in order to trade larger quantities.[43]

The assumed agreement turned out not to be very solid, since the Namaquas did not show up at the Cape settlement. The VOC tried to regularize trade by organizing regular missions. But the Namaqua kept their distance staying well beyond the reach of the Dutch. The expeditions "were unable to meet or reach that nation, as the Namaquas had retired beyond a large area of 4 or 5 days journey, a dry, salt and sandy country, without even the least drop of water." The Dutch supposed that other groups scared the Namaqua away by "making them believe that it was our intention to injure them with a hidden force of men…" What motivated their decision can only be guessed. Maybe other Khoikhoi warned the

[43] Bosman and Thom, *Daghregister*, vol. III, 486.

Namaqua about the Dutch or the Namaqua refused to trespass the pastures of other groups on their way to the fortress. In any event, the Namaqua had not been won over by the VOC officers and refused take a further step toward the middle ground that the Dutch had tried to establish.[44]

Things changed for the Namaqua, when in 1685 a large expedition led by Governor Simon van der Stel pushed well into their territory. Packed with their charted knowledge and experiences of previous expeditions, this group of VOC men knew what to expect regarding water sources, routes, mountains, and other geographical obstacles. There was little need to obtain further information from other nomads. The growing Cape settlement and agricultural independence of the settlers went hand in hand with pushing further inland in search of cattle and natural riches. More and more Khoikhoi groups became familiar with the Dutch and their mercantile needs. The necessity to maintain a middle ground in order to allow trade had faded. The VOC position at the Cape grew stronger and did not depend on the services of local translators and guides.[45]

Krotoa's role as go-between diminished in just over a decade. The departure of Riebeeck as Commander changed her position as a dependable translator. His successor Zacherias Wagenaar did not regard her as notably trustworthy, even though she had converted to Christianity and married Meerhoff. Then, in 1666 her husband died, leaving her without an income. Her situation went into further decline, since the Company did not need her services as translator. She died eight years after her husband, after being accused of being an ill-fit mother, a prostitute, and an alcoholic. The Dutch opinion of her had changed from that of a valuable intermediary to a nuisance and they expelled her from the settlement. Krotoa/Eva fell victim to the deteriorating relationship between the two cultures as the colonizers took over more and more Khoikhoi land, local knowledge and practices, therefore making her services as an intermediary redundant.[46]

The Dutch no longer needed indigenous mediators to establish their commercial and agricultural enterprises. The Khoikhoi groupings became marginalized as the VOC either pushed them into a peripheral existence or incorporated them into the colonial realm. Returning to the 1692 chart, we see that the mapmaker transformed the mobile huts of the Khoikhoi into small circles that were firmly placed in a geometrized landscape [see Fig. 5 above]. The 'vacant land' had been neatly filled. The worldwide network of the Dutch trading company and its linked centres

[44] Leibbrandt, *Precis of the Archives*, vol. III, 219.

[45] Wilson, Toussaint van Hove-Exalte and Rijssen, *Codex Witsenii*, 12; Wijnands, Wilson, Toussaint van Hove, *Jan Commelin's Monograph*, 15. Huigen, *Monomotapa* 49-51.

[46] Wells, "Eva's Men," 417-437.

of accumulation proved stronger than the nomadic culture of the Khoikhoi. The middle ground within which the Dutch and the Khoikhoi temporarily operated was no longer in place, the need for a partnership was gone.

Conclusion

The constitution of a middle ground initially allowed the two parties to negotiate trade and information. It was a way to come to terms with their mutual distrust and the desire for the goods of the 'other'. At the same time both tried to gain the upper hand while trying to explain or justify their actions in order to maintain or strengthen their own positions. The Khoikhoi at first dominated the middle ground since they possessed knowledge of the lands, its vegetation, and its peoples. The indigenous inhabitants occupied it through their understanding of nature and way of living, while the Dutch joined them out of need. Partially because the Khoikhoi circulated their accumulated knowledge and practices orally and manually, however, the Dutch would manage to strengthen their position.

The Dutch motivated and justified their (agri)cultural conquest by propagating the notion of a vacant land, often fixed in the mobile form of written charts, maps and regulations. Since the VOC in Holland stimulated the Cape settlement to become financially independent they urged the colonizers to expand their agricultural enterprise. This entailed taking from the natives their natural and geographical knowledge and practices in order to augment cultivation and trade. The balance within the middle ground changed as the Dutch became familiar with the Cape environment and found ways to contain this information in charts, reports, and deeds. This written knowledge was then transported and exploited in order to strengthen the European knowledge and mercantile centres, while these facts simultaneously became disconnected from their original Khoikhoi roots. Subsequently, the settlers had no more use for a middle ground or indigenous mediators to negotiate such a space.

When the Dutch arrived at the Cape, however, this land was indeed not empty nor did it lie there waiting to be discovered and cultivated. Lacking a centre of accumulation does not imply that the Khoikhoi were 'bereft of all science'. Their mobile culture moved along different (nomadic) paths. Without a 'paper' circulation to anchor and connect concentrations of accumulation and sources or the firepower to back up its claims, the Khoikhoi knowledge network could not resist the ever-stronger VOC network.

The vacant land myth allowed for the 'development' of both nature and natives and exploration and exploitation for the benefit of the commercial enterprise

of the West. The agricultural undertaking gave rise to experiment and inquiry into the Cape's nature, originally mediated by the Khoikhoi. The nomads lacked a lasting infrastructure that was stabilized and strengthened by the immobility and permanence of centres. The Dutch trade network, on the other hand, depended on a continuous production of representations on paper to manage the Company and the Cape settlement. This made their network the so-called victor. We should nonetheless reconsider the position of Europe as the 'scientific' or 'technological' driving-force in so-called uncultivated areas. Dutch dependence on local knowledge and practices was part of the ongoing agricultural and mercantile enterprise, while it slowly pushed the original inhabitants aside. The traces of the Khoikhoi and their network on the Cape land were once visible, but have since long, to use Mentzel's words, been washed away by the tidal waves of the VOC seas.

Accumulating the World: Collecting and Commodifying 'Globalism' in Early Modern Europe

Benjamin Schmidt

Making Knowledge and Manufacturing Malabar

For one particularly pregnant moment in the history of early modern expansion–a moment that arguably begat our own modern era of globalization–the Netherlands served as Europe's entrepôt for knowledge of the world. In the years spanning circa 1670 to 1730, the Dutch dominated the field of geography in its myriad forms; and during this period the ateliers of Holland might collectively be thought of as a leading "centre of accumulation" for global knowledge. Their role was truly that of an entrepôt–they performed *entrepreneurially*, to invoke a more bluntly commercial phrasing–in the way they gathered geographic information and materials from across the globe and repackaged them for Europe-wide consumption. This essay explores this moment of geographic production as a case study of knowledge accumulation, knowledge production, and knowledge distribution in early modern Europe.

The setting for this geographic moment was the global expansion of Europe at the dawn of the so-called age of empire. By the second half of the seventeenth century, as the colonial ambitions of Britain and France began to challenge those of the long-time imperial superpowers of Iberia, Europeans with an interest in the world overseas turned to materials made overwhelmingly in the Netherlands. These included maps and books pertaining to geography, to be sure, yet also prints, paintings, decorative arts, and several other categories of consumable products that engaged descriptively with the non-European world. Bookmakers and cartographers of the Low Countries had, of course, long played a substantial role in the business of geography. From at least the mid-sixteenth century, Antwerp held a principal position in the map trade; and, from the beginning of the seventeenth century–by which time the Dutch Revolt had pushed Protestant printers and engravers northward from Antwerp to Amsterdam–Holland played a prominent

role in the manufacture of travel literature and overseas atlases.[1] Yet by the later decades of the seventeenth century and into the first few decades of the eighteenth, Dutch ateliers all but monopolized the market. There was, moreover, a boom in the business of geography. Lavishly produced books on the exotic world, surveying its polities and peoples, products and wonders; maps, globes, atlases, and other cartographic engagements with the places lately visited by expansion-minded Europeans; richly embellished ceramics, tapestries, textiles, and other decorative arts that incorporated exotic motifs; landscape and still-life paintings showcasing overseas places and exotic *naturalia*: all streamed out of the ateliers of Holland and into the hands of consumers across Europe.

Above all, Holland printers and publishers assumed a disproportionate role in the production and distribution of European print geography. This goes for visual as well as textual materials, and for multilingual products no less than Dutch ones (the pictorial materials, however, not needing translation as such). For Holland-based bookmakers, publishers, engravers, and draftsmen collaborated to create a relatively novel form of print geography that exploded onto the market in the final third of the seventeenth century: a blend of word and image that borrowed from the genres of history, religion, cartography, and ethnography to create a type of hybrid, omnibus description of the exotic world. These products developed a discursive language to describe the non-European world, and they formulated an iconography of exotic peoples and places. They established, moreover, a canon of texts and pictures, which were reprinted in multiple editions, multiple languages, and multiple forms for decades to come. All of this was pivotal and instrumental in shaping Europe's image of the world during this vital period of colonial enterprise.[2]

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1 The renaissance in cartography and geography that took place in the Low Countries—the fundamental innovations of Mercator and Ortelius in the field of atlas-making, and the fertile Amsterdam ateliers of Claesz., Jansonnius, and finally Blaeu—are surveyed in Zandvliet, *De groote waereld*; see also Zandvliet, *Mapping for Money*, which addresses colonial cartography more particularly. Van Groesen, *Representations of the Overseas World*, surveys the business of De Bry in large-format geography books.

2 I have written elsewhere on the connection between the Netherlands' geographic enterprise and its colonial projects, making the point that, *pace* Edward Said (e.g. *Orientalism* [1978]) and others, the Dutch project of knowledge production of ca. 1670-1730 took place not at a moment of Dutch colonial ascendancy but a moment of *decline* in terms of overseas control. While Holland became a centre of accumulation in terms of its production of global and thus colonial knowledge, in other words, it did not stand out, at this point, as a centre of colonial hegemony–a fact that poses important questions to the Foucauldian knowledge/power equation and to many basic assumptions of postcolonial theory. See Schmidt "Mapping an Exotic World," and Schmidt "Inventing Exoticism."

All of this, too, offers a distinctive and perhaps also richer and more dynamic way to think about the production of knowledge in early modern Europe: its collection, accumulation, circulation, and codification as "universal" knowledge. Bruno Latour has written insightfully and influentially on the manner of making knowledge, using as one of his prime models–by happy coincidence—early-modern Europe's collection and circulation of information on the overseas world.[3] His case study derives from the encounter of the French commodore Comte de La Pérouse with the local inhabitants of Sakhalin Island and the subsequent French reconnaissance of the land in an effort to determine its as-yet-unverified insularity–an inquiry, in other words, into exotic geography. Latour describes this episode in terms of the "cycles of accumulation," the "centres of calculation," and the "circulations of knowledge" that developed from this critical moment in geographic and imperial history. The exchanges between La Pérouse and the indigenous fishermen he met; the recording of the data in written form by the navigator and his crew members; the subsequent treatment of the ship's journals back in French-navy headquarters in Versailles: all of these processes led to the establishment of what Latour terms "universal knowledge," namely a broadly accepted form of knowledge that readily circulated among the capitals of Europe. Latour's spatial metaphors for these processes of knowledge making are all circular (or perhaps elliptical)–cycles, centres, orbits–and, as per Latour's hermeneutical habit, he sketches these episodes in a series of oval-shaped rings, which loop from a central command post to a colonial outpost. These rings are meant to depict expeditions moving from a centre of calculation (the French naval offices, for La Pérouse) to a distant source of information (in this case, the colonially desirable territory of Sakhalin Island). And these circuits, taken together, sketch out the "cores" and "peripheries" not only of global knowledge production, but also–and not unrelated–imperial history.

Yet in their neat and rhythmic loops, Latour's rings leave out significant parts of the process. If critically attentive to the interchanges that occur between metropolitan and colonial sites (and to the modes that enable the former to colonize the data of the latter), Latour's paradigm does not comment much on the perhaps messier networks that exist at both "ends" of the circles: the interchanges among and between indigenous groups, which shaped those forms of knowledge that got offered to European interlopers; and, most critically in terms of print geography, the webs of exchange that developed among metropolitan producers, who

[3] Bruno Latour's writings on the topic are extensive, yet see, most essentially, Latour, *Science in Action*, 215-57 (chapter six, on "Centres of Calculation").

converted knowledge products into the commonly *commercial* forms in which they ultimately circulated.[4] These latter activities, which entailed the acquisition, recovery, extraction, reframing, and compilation of material, in print no less than manuscript form–"accumulation" by another name–suggest a focus, as well, on the ateliers of Holland, where geographic knowledge of this period gained its most public form. In place of circles and cycles, then, we might imagine circular shapes with further spirals and curlicues at various points; or, to switch visual cues, we might think of networks and nodes, with sea-going vessels doing the grunt work of bearing knowledge from network to network (with the caveat that knowledge, no doubt, could also change on board and en route).

Latour's model of knowledge production is implicitly imperial, which makes a fair amount of sense in the context of the eighteenth century. It has the merit not only of explaining how information from afar could be rendered stable, controllable, and transportable to imperial centres of calculation–this is accomplished by what Latour famously terms "immutable mobiles." It also dramatizes the process of making "universal" knowledge from the parochial ("local") exchanges that took place at a considerable distance from European centres of production. It underscores, furthermore, the Foucauldian power/knowledge dynamic of Western imperial projects–the extraction of intellectual no less than material resources from overseas territories, and their transformation back home into profitable commodities. And it shows, finally, the value of "natural" wealth in all senses of the word: natural objects and knowledge of how nature works ("natural history" in the idiom of early modern Europe).[5] Yet the imperial implications should not be wholly determinative, nor should they exclude other factors plainly at work. [6] Absent from Latour's analysis is an account of how the inscriptions and drawings from La Pérouse's voyage were transformed back in Paris into a valuable publication: they served as the basis for a stupendous atlas, an elephant folio printed in 1797, which

[4] Much recent work is at pains to complexify the processes of "European" knowledge production that take place overseas. See, for example, Raj, *Relocating Modern Science*; the essays collected in Bourguet, Licoppe, and Sibum, *Instruments, Travel, and Science*; and, more recently, the essays in Schaffer, Roberts, Raj and Delbourgo, *Brokered World*. The question of non-European contributions to "science" is also explored in a suggestive essay by Roberts, "Situating Science in Global History." Attention to the non-European "local," however, should not wholly detract from that other important locus of early modern colonial knowledge production—metropolitan Europe—where processes of production, as this essay argues, are likewise in need of greater nuance and richer analyses.

[5] The colonial implications of Foucault's work were laid out most famously in Edward Said's *Orientalism*; cf. also Foucault, *History of Sexuality*, especially 1: 92-102.

[6] This point is alluded to (yet not highlighted) by Latour, who suggests the "need to get rid of all categories like those of power, knowledge, profit or capital" (*Science in Action*, 223).

can only nominally be attributed to La Pérouse, who had disappeared somewhere in the Pacific shortly after his Sakhalin venture. More broadly, Latour's model fails to account for what might be thought of as the commercial agenda of knowledge transactions. If it does consider "cycles of capitalization," this is meant in a more obviously colonial sense rather than the commercial sense that pertains to a printer's atelier.[7] There were certainly profits in empire and in news of the colonies, yet the earnings from the La Pérouse atlas and the many related publications come closer to what Stephen Greenblatt calls (in reference to another imperial moment) "mimetic capital," which is not identical to the extractive capital that was the aim of imperial enterprise.[8] More to the point, while one form of knowledge derived from voyages such as La Pérouse's accumulated in the royal offices of Versailles (and London, Lisbon, Madrid and so on), yet another form of knowledge from these voyages materialized in the printers' offices–a competing, yet in a certain sense overlapping, form–and this knowledge accumulated in the decades surrounding 1700, above all, in the robust workshops of Holland.

The production of geographic sources in Dutch ateliers, beginning in the final decades of the seventeenth century and continuing into the early eighteenth century, offers another way to conceptualize the accumulation and circulation of early modern knowledge. It highlights the several layers of activity that went into knowledge production, as well as the more plainly entrepreneurial practices of making and commodifying knowledge.[9] Dutch ateliers accumulated knowledge in the basic sense that they avidly acquired manuscripts from employees of Dutch trading companies, from other returning travellers, and, not least, from the open market, both inside and outside the Netherlands. These materials furnished first-hand textual accounts of the exotic world; provided valuable cartographic studies of the overseas spaces of interest to Europeans; and yielded on-site sketches of the curious peoples and wondrous objects witnessed (or described) abroad. Yet once accumulated, this knowledge was not simply or directly distributed; it underwent, naturally, the critical processes of transformation and manipulation that were necessary to render the disparate and often idiosyncratic sources that had been assembled into a form of readily distributed knowledge. Along with the collection and accumulation of knowledge, then, there occurred several further cycles of massaging, manipulating, reconfiguring, and repackaging of that knowledge; and this permitted sometimes parochially-made materials to be repositioned as broadly

7 Latour, *Science in Action*, 218.

8 Greenblatt, *Marvelous Possessions*, 6.

9 On the production of value from knowledge—from what might be termed the "knowledge economy"–see Clucas, "Thomas Harriot's *Brief and True Report*."

agreeable and widely accepted forms of European–"universal"–knowledge. Dutch ateliers collected, accumulated, and *compiled* in the original sense of that word–from the Latin, *compilare*, it meant to plunder or pillage in the time of Virgil, who was reproached precisely for such literary proclivities[10]–and they thereby produced a form of knowledge that gained traction in the market. These mediating practices, while often elusive, are critical, all the same, to our assessment of early modern sources of geographic knowledge.

When "compiling" and "reconfiguring" join "collecting" and "accumulating," our understanding of knowledge production becomes richer and more complex. Consider the early modern reportage on South Asia, particularly the most broadly distributed printed source on the region in the period circa 1670, Philippus Baldaeus's *True and exact description of the most celebrated East-India coasts of Malabar and Coromandel*. [figure 1] The *True and exact description* made its print–that is, public–debut in 1672, the creation of the Amsterdam publishing duo Johannis Janssonius van Waasberge and Johannes van Someren.[11] Their handsome, richly illustrated, and exceedingly popular volume (as gauged by the number of editions) was strategically pitched as a "true" and "original" account of the southern parts of India and Sri Lanka, particularly the coastal regions in the southwest (Malabar) and southeast (Coromandel), where Europeans had been making steady commercial inroads. It was advertised, more essentially, as a precious eyewitness report of South Indian society–the "Manner, Habits, Oeconomies and Ceremonies of the Inhabitants"–with special emphasis on the strange and exotic religions of both ancient and modern India. Its titular author, furthermore, was presented as uniquely qualified to report on religious matters: a Calvinist *predikant*, Philip Balde, or Baldaeus, had personally journeyed to Sri Lanka to spread the gospel. He was not only "an Eye-witness of those [overseas] Transactions," but a minister trained in the word of God and hence uniquely able to assess (and properly critique) those local religions that he could study *in situ*. These religions also included Catholicism, to be sure–a small number of local inhabitants had been converted earlier in the century by the Jesuits–and the volume's opening and fram-

[10] The *Oxford English Dictionary* notes the more aggressive sense of *compilare*, while also recording its other connotations and the word's shifts in meaning over the Middle Ages. See the *Oxford English Dictionary* (online edition, 15 July 2010), s.v. "compile" (particularly the notes on etymology).

[11] Baldaeus, *Naauwkeurige Beschryvinge*. The English translation rendered *naauwkeurige* ("careful" or "exact") into "true"—which effectively conveys the publisher's strategic framing of the volume. For complete bibliographic data (including most of the early modern translations), see Landwehr and Van der Krogt, *VOC*, 336-41. On the religious approach of the text, see Subrahmanyam "Forcing the Doors of Heathendom."

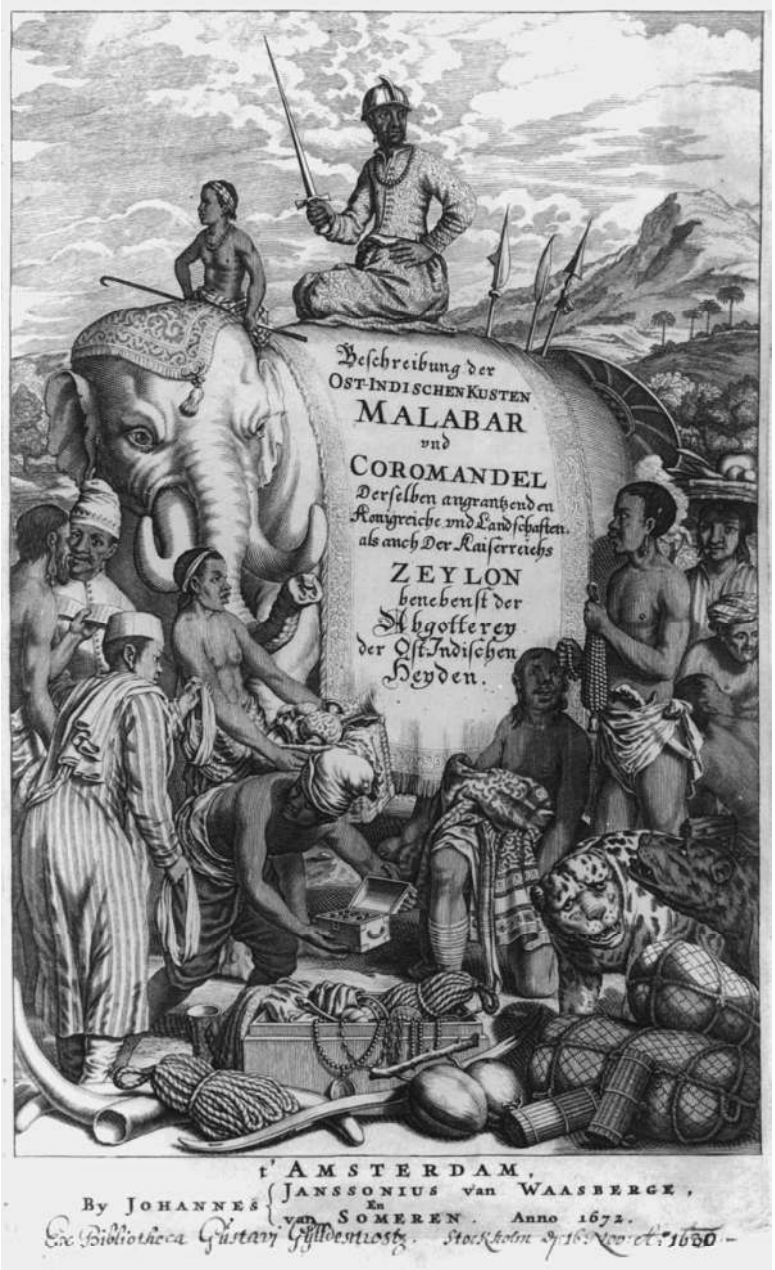

Figure 1: Frontispiece (engraved), Philip Baldaeus, Wahrhaftige ausführliche beschreibung der berühmten ostindischen kusten Malabar und Coromandel, als auch der insel Zeylon *(Amsterdam, 1672)*

ing devices highlight the proselytizing labors undertaken by the Society of Jesus, whose industry in India had spurred the up-to-the-challenge Baldaeus to file his report.[12] Yet these earlier ministrations notwithstanding, the volume is plainly and emphatically credited to Baldaeus, whose personal reports and on-site efforts give the volume its cachet.

Except they do not, since, on closer inspection, Baldaeus's reports–and the subsequent construction of South Asian knowledge based upon them–are not what they seem. Or rather, the process of knowledge production suggested so ardently on the title page of the *True and exact description* turns out to be more complex, and the "cycles of accumulation" less neat, than one might expect. Loops of knowledge are interrupted in Dutch ateliers (and likely in South Indian and Sri Lankan ones, as well), where the volume was ultimately constructed and where publishers blithely asserted Baldaeus's authorship of–and authority over–a volume that blends the Dutch minister's own spotty description of the region with far more thoroughgoing investigations, particularly on Hinduism, penned by one or more unidentified authors. For, despite its claims of "ocular testimony," the volume relied on unnamed reporters–"invisible technicians," as Steven Shapin might call them–who would have been integral to the original processes of knowledge accumulation.[13] At least two of these sources left their traces. The first was Philips Angel, a draftsman in the employ of the Dutch East India Company (VOC), who left in the hands of a high-ranking officer of the VOC, Rijcklof van Goens, a manuscript describing South Indian religious practices.[14] Angel's document, in turn, derived from a Portuguese source–our second mediator–that was composed in the early seventeenth century by one Jacobo (or Giacomo) Fenicio, a Jesuit who had spent several years in western India, in the area of Cochin (Kerala). With considerable labour, Fenicio had mastered the local language (Malayalam), interviewed the indigenous "priests," and composed a first-hand account of the region's religious life.[15] Angel, who enjoyed a fairly eventful career as a painter, art theorist, and overseas merchant, turned out to be an invisible technician with relatively high visibility. He published a well-known account on painting, the

[12] See, for example, Baldaeus, *Naauwkeurige Beschryvinge*, "Voor-reden" (n.p.).

[13] Baldaeus, *True and exact description*, sig. Dddd2 ("ocular testimony"); and, for similar comments, see the unpaginated "Preface to the Reader" in ibid. On "invisible technicians," see Shapin, *Social History of Truth*, 355-408.

[14] Angel was in Galle in 1649, yet there are no known autographed works from this period. He also painted, prior to his Sri Lankan service, in Persia and in Batavia. See Kumar de Silva and Beumer, *Illustrations and Views*, 477; and Bergvelt and Kistemaker, *Wereld Binnen Handbereik*, vol. 2 [catalogue], 186-87.

[15] Bergvelt, *Wereld Binnen Handbereik*, 2: 187.

Lof der schilder-konst (1642); and he very likely produced the several sketches of Hindu gods that correlate to engravings in the Baldaeus volume. Fenicio, on the other hand, went under the radar. He became known to scholars only in the nineteenth century, when his manuscripts on South India, including his valuable and bona fide on-site observations, came to light. But his connection with the Holland-published text of 1672 went largely undetected at the time.[16] Thus, on the most conspicuous marketing pitch of the volume–the promise of exotic religious fare–the putative author delivered an "eyewitness" report at a distance twice removed (at least). More to the point, he offered a "Calvinist" assessment of Indian faith extracted from a Jesuit perspective–a remarkable irony, in the context of seventeenth-century confessional politics.

There are several other signs of such constructedness: of atelier practices of compiling, or "plundering," by the publishers in their effort to configure a desirable rendition of South Asia. Along with its religious reporting, the *True and exact description* was distinguished, as well, for its excellent "cuts," or engravings; it boasted thirty-five single-page plates and nearly fifty text illustrations.[17] These were among the volume's chief selling points, highlighted on the title page of all editions of the book (there were multiple, including German and English translations), and they reflect one of the great appeals of Dutch-made geography, more generally: pictures. Once again, however, the putative author would have had little to do with these contributions. Most of the engravings came from the workshops of Janssonius van Waasberge and Van Someren–standard atelier products, in other words, done by apprentices–and the outstanding depictions of the "Ten Avatars of Vishnu" were almost certainly developed from Angel's drafts.[18] [figure 2] The latter were in all likelihood based on another set of theoretically "original" Indian sources—these may have been Gujarati, that is from northwest India—which would have served as models for Angel. Whatever their origins, once launched, these pictures took on a life of their own. They appeared in other editions, other

[16] Fenicio's text was known in the seventeenth century, yet rarely acknowledged and certainly not credited by Protestant printers. See Lach and Van Kley, *Asia in the Making of Europe*, vol. 3, book 2, 874-76, 911-12; and Clooney, "Roberto de Nobili's *Dialogue on Eternal Life*," esp. 413-12. There is a 1933 printed edition of Fenicio's text: Fenicio and Charpentier, *Livro da seita dos Indios orientais*.

[17] As the title-page announces: "Met Kaarten en afbeeldingen van Landen, Steden, Drachten, Boomen, Vruchten, na het leven [drawn to life], in Indiën afgeteekent, en kurieus in kooper gesneden." For an index of these "cuts," see Landwehr, *VOC*, 336-40.

[18] Bergvelt, *Wereld Binnen Handbereik*, 2: 187. The volume did contain two signed portraits, one by the well known Dutch painter Govert Flinck and the other signed "G. Appelmans." In most cases, however, there was no attribution for the graphic work.

Figure 2: Artist Unknown [after Philips Angel?], First Avatar of the God Vishnu (engraved), in Philip Baldaeus, Naauwkeurige Beschryvinge van Malabar en Choromandel, der zelver aangrenzende ryken, en het machtige eyland Ceylon *(Amsterdam, 1672)*

(not necessarily related) geography books, other literary genres, and even other media–on single-page prints, on embellished maps, in the decorative arts, and the like. And in these new forms, the images naturally took on new meanings. In this way, the "Baldaeus" images–they had, needless to say, only a tenuous connection to the VOC *predikant* Philip Balde–translated into other modes of knowledge and transcended virtually all identifiably original contexts. This fluidity allowed the title-page vignette of Baldaeus's bestselling volume, intended in its initial form to advertise a narrative of Malabar religion, to adorn a decorative map of South Asia, its ornamental elements now insinuating overseas commerce.[19] Such iterations of imagery exemplify what Craig Clunas has called an *iconic circuit*: "an economy of representations in which images of a certain kind circulated between different media in which pictures were involved."[20] They also show, in a particularly vivid fashion, the *instability* of accumulated knowledge (be it "calculated" or not) or perhaps its variability; and they demonstrate, ultimately, the tenuous correlation between circulated knowledge and its shifting points of origin.[21]

The tricks of the print trade, it should be granted, are hardly unique to the field of geography. The massaging of texts, manipulation of images, recycling of plates, and adaptation of forms were all common enough techniques in the business of bookmaking and printmaking more generally. Modern concepts of originality, moreover, do not so easily apply to early modern practices. And the Dutch case does not resemble, either, the sort of bibliographic instability analyzed (for example) by Adrian Johns for the London book trade.[22] What is distinctive and noteworthy about this late seventeenth-century moment of geography is how these

[19] The map bore the title *Peninsula Indiæ citra Gangem hoc est Orae celeberrimae Malabar & Coromandel cum adjacente insula non minus celebratissima Ceylon*. It appeared originally at the address of the Amsterdam printer Hendrik Donckers (c. 1680) and in several derivative maps over the coming half century: for example R. and J. Ottens map of South Asia in their *Atlas maior* (c. 1730); a London-made map of c. 1730; and a map printed in Nuremberg by the heirs of Homann in 1733. The image thus became "canonical" in the medium of cartography and was included, as well, in other European publications on Malabar that contained graphic content.

[20] Clunas, *Pictures and Visuality*, 46. Clunas borrows this idea partly from Carlo Ginzburg's discussion of Renaissance erotic imagery, where Ginzburg makes a distinction among sets of images that circulated in distinct spheres, e.g. private and public ("Titian, Ovid, and Sixteenth-Century Codes for Erotic Illustration"); yet Clunas's discussion of the concept is more sustained and (to my mind) richer.

[21] The "Baldaeus" volume was granted a 15-year privilege from the States of Holland, including rights of translation. It became a "bestseller" (in the context of early modern geography), appearing in Dutch, German, English, and French editions. Within much of Europe, it was a "universally" accepted body of knowledge on Malabar.

[22] Johns, *Nature of the Book*.

processes of reconfiguration and commodification were used not simply to produce a book or two – to advantageously pirate a bestseller or to stretch the value of a copper plate. They were enlisted, more expressly, to create a full-fledged industry of knowledge production. It was not so much a slapdash manoeuvre of a printer's atelier as it was a deliberate, strategic, and entrepreneurial technique of the producer to gather, process, and promote a kind of knowledge of the world–and to make books, prints, maps, and profits in the process. Dutch-made geography was predicated on these practices. And Janssonius van Waasberge and Van Someren were hardly alone–or even preeminent–among those in the business of exotic geography. Their products followed (and hotly competed with) those of Jacob van Meurs, the leading printer from the mid 1660s to early 1680s of folio works on the non-European world; and they foreshadowed those of Pieter van der Aa, who dominated the market for serial geography publications in the opening years of the eighteenth century, and whose products mark the highpoint of this brand of geography. "Brand" is in fact an apt term and "branding" a useful way to conceptualize this phenomenon, which has much to do with the commodification of knowledge. Van Meurs, Van der Aa, Janssonius van Waasberge, Van Someren, and the many other Holland-based impresarios of print geography transformed their "accumulated" knowledge into more readily recognizable, easily adaptable, consumer-friendly products. In the process, they not only collected, accumulated, and circulated knowledge; they further commodified, commercialized, and distributed their products to the broadest possible range of consumers. In the process, they also codified and standardized a form of "universal knowledge" – a widely consumed knowledge product – that shaped the field of European geography for years to come.

The Global Galleries of Pieter Van Der Aa

After accumulation and calculation came transformation and commodification, then standardization. This, at least, was the process of constructing geography in Dutch ateliers of the late seventeenth and early eighteenth century. And this, by extension, was the manner of processing the forms of "globalism" and standardizing the forms of the world that would circulate so broadly and influentially in this period. This, in short, was the process of *making* the world for early modern Europe.

These processes and strategies emerged from Dutch ateliers in the mid to late 1660s (there are precedents in the earlier 17th century, yet nothing quite as intensive or extensive), when Holland served as fertile ground for such centres of accu-

mulation, hubs of production, and, more basically, engines of profit for the field of geography. The geography business heated up in the 1670s and 1680s, with a brief pause following the *Rampjaar* (disaster year) of 1672; and it reached its peak at the turn of the eighteenth century. Perhaps nowhere was it more brilliantly on display than in the atelier of Pieter van der Aa, a bee-hive of geographic production; and perhaps no product was more exemplary than the *Galerie agréable du monde* (c. 1730), Van der Aa's tour de force of print geography. [figure 3] The massive,

Figure 3: Romeyn de Hooghe, engraved frontispiece to Pieter van der Aa, La Galerie agréable du monde *(Leiden, ca. 1730)*

magnificent, multi-volume *Galerie agréable* marked the culmination and summa, from a circulation-of-knowledge perspective, of early modern print geography– especially of the lavishly printed and profusely illustrated variety of the genre produced in the Netherlands. Weighing in at a staggering thirty-some volumes (the work comprised sixty-six "tomes," which could be apportioned and bound into separate volumes according to the buyer's preference) and incorporating close to

2,500 double-folio engraved leaves bearing nearly 4,000 illustrations, the*Galerie agreable* brought together a stupendous accumulation of material, compiled and organized by the entrepreneurial Leiden printer Pieter van der Aa.[23] It comprised maps of various scale, illustrations of major world sites–famous architecture, religious sculpture, antiquities, global "wonders"–*vedute*, portraits, and so on. Most of these materials came from Van der Aa's own considerable stock: the work capped a lengthy career as a bookmaker, cartographer, and all-around publisher of geography, and it served as a veritable *magnum opus* for its maker. The remainder of its contents were assembled from existing sources that circulated among Van der Aa's colleagues in the world of print (sometimes, too, from fierce competitors). The *Galerie agréable*, thus, collected and collated a remarkable amount of amassed geography. It brought together, in a single, sumptuous, all-encompassing work, the broadly circulating bric-a-brac of early modern geography. In this sense, it was a massive accumulation of previously accumulated knowledge.

The *Galerie agréable du monde* clarified its purpose as a centre of accumulation right from the title page and the very metaphor it invoked: a "gallery" of geography, where the visitor/reader could survey the vast contents of the world accommodated within. While it may seem perfectly appropriate, in retrospect, to imagine geography as an "exhibited" form–geographic wares hanging in display for all to see–the conceit of a gallery or museum to showcase global knowledge indicated a distinct innovation for the discipline of geography. The most famous collection of geographic materials in any early modern library–and the progenitor of virtually all volumes of assembled geography–was Abraham Ortelius's *Theatrum orbis terrarum*, the original and most influential atlas of its age. Ortelius's metaphor of the world as a stage—*theatrum*–implied theatrical performance as well as display, and it gestured toward an older conception of the globe as the site of divine drama.[24] Harking back to the late-medieval worldview from which Northern humanism sprang, Ortelius's *Theatrum orbis terrarum* also suggested the drama of the mundane world and the folly of human "performance." (A contemporary world map depicted the world in the shape of a fool's head.) It offered

[23] The *Galerie agréable* would be printed, according to its publisher, in "limited editions"—a mere one hundred copies–and made available only per subscription; yet this may have been part of the marketing pitch. Although each "set" could potentially be different in terms of "tomes" per bound volume (the total number of tomes, however, being constant), there is nonetheless a remarkable consistency among the versions of book that I have examined. The relative "stability" of the book is discussed below.

[24] Compare the typical medieval T-O map (named for the T-shape of the Mediterranean and Nile and Don rivers, and the oceans that encircle the world in a schematized O), which featured the static figure of Christ embracing the world orb in a gesture of eternal love.

a metaphor of dramatic action and interaction, engaging the viewer with the contents of the volume. While Ortelius's metaphor retained a strong grip on cartographers and geographers for decades to come–it is remarkable how many printed atlases and printed world maps invoke the imagery of theatre–it had challengers by the late-seventeenth century. In the context of Dutch-made geography, the most interesting of these competing conceits may have been those pointing to the merchant's world and to geography's alliance with commercial exchange. The popular *veelschrijver* Simon van de Vries produced several compilations of global geography whose titles invoked the world of trade: most bluntly, "The *Warehouse* of Wonders" (the title of a collection on global history).[25] Van der Aa's metaphor of the gallery headed in yet a different direction. It combined a sense of display and theatricality with an even stronger sense of collecting and exhibiting. It shifted the older "theatre" metaphor, which implied a developing plot (drama), toward something more fixed and stable: a place where things had been gathered and assembled for the purpose of observation and organization. It suggested, in short, a centre of accumulation.

The *Galerie agréable* primarily accumulated pictures, and this was the chief focus and principal appeal of the enterprise. The work contained a truly astonishing number of engraved illustrations – more, even, than Joan Blaeu's colossal *Atlas maior* – and it underscored, at every opportunity, its visual presentation. The pictures were assertively advertised on the title page, which invited the reader to enter the gallery and "view" (*voir*) the world. The title page also broadcast the names of the gallery's illustrators, which included many of the premier graphic artists of the day: Jan Luyken, Joseph Mulder, Jan Goereé, Jacob Baptist, Daniel Stoopendael, and so on.[26] And Van der Aa listed the images themselves in a massive paratext, which sets the tone for the tomes to come. Thirty one pages are deployed to enumerate nearly 4000 pictures, with separate tables

[25] De Vries, *Groot historisch magazijn* (emphasis added). Note also De Vries's *Groote historische rariteit-kamer*, which invokes the collector's world (as would Van der Aa several years later); and, more traditionally, his *Groot historisch schouwtooneel*, which reverts back to the theatrical conceit. On De Vries's fascinating career, see Baggerman, *Een drukkend gewicht*.

[26] As the volume's full title records: "La Galerie agreable du monde: ou lon voit en un grand nombre de cartes très-exactes et de belles tailles-douces, les principaux empires, roïaumes, republiques, provinces, villes, bourgs et fortresses … dans les quatre parties de lunivers. Divisée en LXVI. tomes / les estampes aiant eté dessinées sur les lieus, & gravées exactement par … Luyken, Mulder, Goereé, Baptist, Stopendaal, & par dautres maïtres renomez, avec une courte description qui précède chaque empire, roïaume &c. & même avec le sommaire sous chaque planch."

in individual sections providing additional detail.[27] The *Galerie agréable* in fact overflows with paratexts that are either inherently pictorial (tables, charts, cartouches) or dedicated to the glossing of pictures: captions, lists, indices, and so on. The volumes collectively, by contrast, offer relatively scant text.[28] The paratexts, moreover, shape the way the reader—or better, viewer or browser, since there is, in truth, precious little to read—might approach the work: through the overwhelming illustrations, which the paratexts endeavour to sort out. Finally, the very forms of the pictures further enhance their visual effect. In several instances, pictures are engraved within *trompe l'oeil* frames, and some scenes are presented in the manner of early modern postcards–small "vistas" of exotic attractions, suggestively "tacked" on to the page. [figure 4; see also figure 3] This mode of imagery–pictures *qua* pictures or pictures in frames hanging in metaphorical

Figure 4: Jan Goereé, Views of Greek cities (engraved), in Pieter van der Aa, La Galerie agreable du monde (Leiden, ca. 1730)

[27] The main table comes at the very opening of the first volume: "Table generale de 'ordre des feuilles et figures des LXVI tomes" (1: [7]-37). Each section also has a unique table, which breaks things down into great detail.

[28] On the function of paratexts, see Genette, *Paratexts*.

galleries–offers a variant of what the critic Wu Hung terms "metapictures": images presented within pictorial contexts, or visual frames, which serve to highlight yet more intensively their pictorial quality.[29] The image-rich *Galerie agreable du monde* not only accumulated global geography and organized the world for its early Enlightenment consumer. It also presented that world as a *visual* (rather than textual) commodity, instituting a distinctly pictorial approach to geography. Van der Aa's *magnum opus* transformed an enormous, disparate body of material into a singular, accessible, and "agreeable" gallery of knowledge.

Part of the achievement of the *Galerie agreable* was to create a colossal collection of images that both easily circulated–they were, after all, just books–and were easy to assimilate, in the sense that the viewer obtained the world in a lightly captioned pictorial form. The pictures displayed in Van der Aa's global gallery came in several variations, although some generic patterns do emerge. There was a surfeit of maps, of course, presented in an assortment of scales, sizes, and formats; and these derived overwhelmingly from the publisher's enormous stock of plates accumulated over a long career in cartography. There were also pictures of the "habits" of various nationalities and social groups, as well as the multiple other sumptuary markers of social class: vocational dress, military costume, religious garments, and so on. And there was "historical" imagery–royal family trees, aristocratic coats of arms, ancient medallions and coins–and displays of exotic flora and fauna, commonly grouped by species, rather than locale. All of this originated, once again, from the available reservoirs of prints, which were adapted, adjusted, or just plain copied for the occasion. Perhaps the predominant genre in the *Galerie agréable* was the city view and its variants, which encompassed townscapes, harbour views, depictions of central squares, significant buildings (temples and palaces, for examples), and other topographical details. These follow a readily identifiable formula, familiar to most consumers of early modern geography. A vignette of "local" life occupies the foreground, a city skyline dominates the middle part of the picture frame (with at least one recognizable landmark), and a landscape fills the background, generally featuring appropriately exotic flora and fauna (yet with a typically Dutch sky).[30] In most cases, too, these prints derived from earlier volumes of Holland-made geography, especially from a series of ge-

[29] Hung, *Double Screen*, especially 183 and 246-59; and cf. Clunas, *Pictures and Visuality*, 25-76. See also the discussion in Mitchell, *Picture Theory*, especially the section on "Metapictures" (35-82): "the principle use of the metapicture is, obviously, to explain what pictures are–to stage, as it were, the 'self-knowledge' of pictures" (57).

[30] For a typical example, see the view of Buda (in the volume on Hungary), which happens to derive from Braun and Hogenberg, *Civitates orbis terrarum*.

ography books published in the 1660s and 1670s by the indefatigable Jacob van Meurs, the plates of which would have been sold upon the death of Van Meurs' widow circa 1690. Some of the Van der Aa plates, moreover, came from even earlier sources–such as Jan van Linschoten's 1598 *Itinerario*, which, despite its obvious datedness, was perhaps the single most quoted iconographic source on the Indies.[31] Yet the familiarity of these materials was not an issue. Unlike the Baldaeus volume (or the Van Linschoten, for that matter), the *Galerie agréable* made no claim of delivering "eyewitness reports" of the exotic world–although Van der Aa might have said as much, if he wished, since his prints came almost invariably from other accounts that asserted this commonplace of ocular truth. The message of the Van der Aa *oeuvre* was less the originality of the material than the sheer feat of its accumulation, the skill of its organization, the attractiveness of its presentation, and the fact of its codification in print and wide distribution, accordingly, by the industrious Pieter van der Aa.

Van der Aa clearly understood his market. The recycled nature of his pictures–their banality and readily accepted lack of originality, the habit of their replication and obvious datedness–did not at all disqualify them as a viable product. On the contrary, the *Galerie agréable*, printed in one hundred deluxe editions, was pitched to the market. It was sold as a luxury item and made available per subscription. It was evidently a success, too, and it made a profit for its publisher, who, although he died shortly after its publication, left a substantial fortune to his wife and heirs.[32] The *Galerie agréable*'s publication took place at the end of Van der Aa's professional life, and the strategy of its presentation followed the logic of a career in publishing. It was the epitome, in many ways, of Van der Aa's brand of intensely pictorial and only mildly textual geography, and the archetype, more generally, of this format of Holland-made illustrated book. It demonstrates superbly two emblematic features of exotic geography produced in this period.

First, it reflects an attitude toward the reproduction of pictures that tends to be associated–perhaps too quickly and too uncritically–with modernity: with Walter Benjamin, above all, and the "age of mechanical reproduction."[33] It is not

[31] Van den Boogaart, *Civil and Corrupt Asia*. Note also the use of Braun and Hogenberg, which comes from the same cultural moment, more or less, as Van Linschoten (the late sixteenth and early seventeenth century).

[32] Van der Aa lived from 1659 to 1733. While we do not know much about his finances while he lived, we do know that his widow "was one of the richest women of Leiden," and that his daughter and heir was worth over 100,000 gulden. See Hoftizer, *Pieter van der Aa*, 87.

[33] Benjamin's "The Work of Art in the Age of Mechanical Reproduction" was published originally in 1935 as *Das Kunstwerk im Zeitalter seiner technischen Reproduzierbarkeit* (in *Zeitschrift für Sozialforschung*). Cf. Clunas, *Pictures and Visuality*, 134-48 (chapter 6, "The Work of Art in

merely the assiduous duplication of images in these sources of early modern geography that holds significance, but also the context of their replication, the form and meaning of the "final" products–the ultimate shape of their expressed "knowledge"–and the variability of their function. Van der Aa borrowed widely and opportunistically, and tracing his prints to their origins can be tedious. It may be claimed with a fair degree of confidence, however, that most of the images begin and end in ways that defy any singular or predictable "iconic circuit." The path travelled by a set of widely-admired prints, generically depicting "the Indies" and easily attributed to Romeyn de Hooghe, are a case in point. The prolific Baroque draftsman and engraver Romeyn de Hooghe designed scores of "exotic" engravings early in his career, including a few dozen for Simon de Vries, who integrated them into a series of small-format, Dutch-language books of wonders. These appealed to "popular" readers interested in global curiosities. Later, De Hooghe collaborated on a series of prints that incorporated these earlier images into an oblong-format quarto picture book–no text at all–bearing the somewhat generic title, *Les Indes Orientales et Occidentales et autres lieux* (ca. 1700). [figure 5] Van der Aa served as the publisher of this latter product, which would have sold at a higher price point. Later still, in the hands of Van der Aa (De Hooghe had by this point died), the images were reconfigured and reframed (literally) for the *Galerie agréable*, that princely publication pitched to an elite and international audience. In this way, the *Galerie agréable* circulated De Hooghe's depictions of global "wonders" ever more widely and codified them in a form that could now be counted as "universal knowledge" of the exotic world: broadly distributed and widely accepted renditions of global geography, sanctioned by an elite European audience.[34] Yet the images did not rest. From Van der Aa's "gallery" (or perhaps from an earlier iteration), the images moved on to the decorative arts. Some appear, for example, on a collector's cabinet, made in stylish imitation-lacquer,

the Age of Woodblock Reproduction"), which challenges the Benjamin thesis not only for its clumsy understanding of "mechanical reproduction" (and of the world of print, in China no less than Europe), but also for its narrowly Eurocentric conception of modernity.

[34] De Hooghe, *Les Indes Orientales et Occidentales* (1710), for which see the modern facsimile (Amsterdam, 1979), based on the edition in the Royal Library in the Hague. On De Hooghe, see Van Nierop et al., *Romeyn de Hooghe*, which offers a useful overview of the engraver and his oeuvre, including a brief description of the genesis of *Les Indes Orientales*. The latter begins its life as an illustration program for Simon de Vries's *Curieuse aenmerckingen* (1682); the images are later redone to create a picture book by Pieter van der Aa (58). The dating of the Van der Aa publication is variable, yet the Getty edition is sensibly listed as ca. 1685 (Getty Research Institute Library cat. no. 92-B13189; this copy is likely purchased from Landwehr himself); the later dating of 1710 may correlate to a second edition. See also the bibliographic record for the Harvard Libraries edition (dated c. 1685): Houghton Typ 632.80.455 F [Hollis: 002162559].

Figure 5: Romeyn de Hooghe, Thee / Lakwerken (engraved), in Les Indes Orientales et Occidentales et autres lieux *(Leiden: Pieter van der Aa, ca. 1700) [plate 15]*

which would have housed the very exotica described in the printed volumes.[35] In other cases, they decorated the surfaces of ceramics of various sorts–Holland-made delftware or imported porcelain—or other decorative arts that bore exotic motifs. In all cases, the datedness of the images, produced in myriad guises for well over half a century, seems beside the point–Van Linschoten's images, after all, were viable more than a century after their production.[36] And the original processes of collection and accumulation also seem secondary to later strategies of presentation and configuration, as well as to the devices of commercialization and commoditization. The various lives of these images suggest, if anything, the instability of this brand of exotic knowledge.[37]

A second point pertains to pictures and permanence–or lack thereof–and to the relative presence of textual materials in the Dutch-designed genre of exotic

35 The cabinet is reproduced in Bergvelt, *Wereld Binnen Handbereik*, 1: 86; its date is uncertain.

36 And Van Linschoten's images, and De Bry's too, could likewise migrate to the decorative arts: cf. the "Netherlandish Black Lacquer Cabinet with Chinese and American Motifs" in the Walters Art Museum, Baltimore (accessions number 65.89), dating from the same period (c. 1710-20) and decorated with vignettes of Amerindians from "Florida," taken mostly from De Bry prints.

37 Mason, *Lives of Images*.

geography. Van der Aa himself broached the visual strategy of his publications in another work, the *Nouvel atlas*, which appeared twice (both times undated) in the first third of the eighteenth century.[38] The "nouvel" atlas is anything but: its maps are plainly derivative, despite the not uncommon appeal on its title page to novelty and innovation, a point reiterated in a prefatory note. What *is* new, the author asserts, is the format. Once again Van der Aa offered images readily available on the market, yet now repackaged with an unusual layout, in this case oblong folio (the plates thus all fold out).[39] The preface further clarifies the volume's tactical approach to pictures and the author's belief in the primacy of the visual. The *Nouvel atlas* not only promotes itself as a picture book–as a proper atlas, it was by definition an assemblage of graphic materials–but it flaunts the emphatically pictorial presentation of its contents (maps with impressively decorative cartouches) and its marked deficiency of words. Even more than the *Galerie agréable*, the *Nouvel atlas* almost wholly lacks sustained texts (as opposed to its very brief and insubstantial captions). Van der Aa expressly commented on this in the "Avis au Lecteur," where he proposed that, with cartographic materials, matters can change in a hurry–wars, treaties, border disputes, and the like can swiftly intervene–and substantive text, therefore, had been deliberately left out. This allows the "reader" to see for him or herself how the world "truly" appears, rather than having to rely on textual descriptions, which might fall victim to the vicissitudes of history.[40]

This fairly deliberate abnegation of history was an innovation, which deviated sharply from the famous Renaissance dictum that conceived of geography as the eye of history.[41] In the case of the *Nouvel atlas*, geography's divorce from history–its assertion of history's meagre relevance to geography and its uncoupling of pictures from narrative–reflects a typical approach of Van der Aa and his colleagues in the business of exotic geography. The exotic world was the site of the most contested territorial disputes–history changed most quickly abroad–and

[38] The *Nouvel atlas* was printed in Leiden by Pieter van der Aa around 1714 and, after his death, by the Amsterdam printers Covens and Mortier circa 1735.

[39] The graphic materials are largely from French sources, and the textual matter (meager though it is) is typically delivered in both French and Dutch.

[40] See the bilingual "Avis au Lecteur" (sig. Ar). The preface also draws an analogy between the atlas at hand and a dictionary, which must shift according to the changes in language. Atlases and geographic materials, it is proposed, will not need to be replaced so quickly. As befit virtually all works in this genre, the *Nouvel atlas* did carry a prose description of geography, which comprised a meager four pages.

[41] *Historiae oculus geographia*: Ortelius invoked this aphorism in the *Theatrum* orbis terrarum (1570), following an earlier Renaissance tradition that conceived of geography as an "eye" on the world (cf. Petrus Apianus, *Cosmographicus liber* [1524; revised 2nd ed., 1533]).

was therefore the least narrated part of the globe. Exotic geography, consequently, was presented visually. This pictorial formulation also demonstrates an approach to the non-European world identified by Johannes Fabian in his classic study of modernity and anthropology, *Time and the Other*.[42] The ethnographic world stands still in Fabian's eloquent exposition, while the Western observer moves in time and according to history. Van der Aa's printerly commentary and Fabian's theoretical insight help to explain the methods of exotic geography. The originality of the material–the acquisition of new images, the drafting of original maps, the inclusion of fresh textual descriptions: in short, the accumulation of collected knowledge–is ultimately less important than the form of its packaging and the shape of its configuration. *Re*configuring and *re*presenting older and ostensibly outmoded material, in printerly rather than writerly forms, counted for much in the business of exotic geography. It was arguably the principal contribution to the production of this brand of knowledge.

Branding aptly describes Van der Aa's approach to geography and underscores both the commercial and epistemological agenda of his enterprise. The *Nouvel atlas* distinguished itself from the pack of cartographic products by its idiosyncratic design (oblong folio).[43] It standardized its material–in this regard, it followed the modus operandi of atlas makers since the time of Ortelius–yet it did so in a non-standard way. Oblong affords an unusual format. It lengthens a square or, in book printing, renders a vertical shape (the folio) into a horizontal one. By doing so, moreover, it almost invariably distorts another, original shape. Van der Aa adapted this format partly in the service of quality–the reader could fold out maps and see part or most of a visual cue while taking in the contents of another page. Yet his innovation also came at the expense of cartographic quality: the distortion of Euclidian (geometric) space. It delivered a distinctly recognizable and evidently attractive style that was, no doubt, consumer-friendly. Consumable knowledge was standardized, in other words, even as it was disfigured.[44]

One final example from the stockroom of Pieter van der Aa makes this point even more plainly. The twenty eight volume *Naaukeurige versameling* was a collection of travel narratives printed in 1707-08, and it offers further evidence of the accumulation and configuration, standardization and distribution, of geographic knowledge in the early eighteenth century–in this "enlightened age," as the vol-

[42] Fabian, *Time and the Other*.

[43] See Arjen Dijkstra's essay in this collection .

[44] It underwent, as well, a process of commodification: cf. Clunas, *Pictures and Visuality*, 38, which considers the "market edge" gained when otherwise extraneous (or innovative) pictures are added to a book.

ume's preface puts it.[45] A truly massive feat of publication, the *Naaukeurige versameling* appeared in the amazingly brief span of two years. It solidified Van der Aa's reputation as a powerhouse of print geography, and it established his brand for decades to come. More modest in scale and price than the *Galerie agréable*, the *Naaukeurige versameling* consolidated several centuries of travel literature into volumes of uniform size and appearance, which could be purchased either as a set or as individual books. Its proportions were convenient, according to the publisher: not so large that the books could not be taken along on a trip (think Baedeker, for which this series might be seen as a forerunner), yet ample enough to incorporate the plentiful "extra" features of print geography–maps, plates, tables, indices, and other paratexts.[46] And it is the format that the publisher accentuated in his preface. The content, while not at all original, had "never before been seen *in this manner*."[47] "In this manner" entailed, in particular, a unique presentation of the maps, which are printed on double octavo (two pages in width) that is attached to an extra blank page. This allows the map, when unfolded, to be seen in full even when the reader turns the page (the blank page, on the inside, is the only part that gets covered while the map is unfolded, leaving the graphic material visible even as one scans ahead in the volume). This convenience came at a price though. It caused "a horrible deformation of subjects as a result of inadequate map projection," as the great carto-bibliographer, Cornelis Koeman, indignantly remarked.[48] But this might have been of no concern. Standardization and homogenization of content contributed in this case to the value and viability of the product, which was reissued in several modestly adjusted formats and in multiple languages. The *Naaukeurige versameling* was a huge success, accordingly, both for the producer and consumer of early modern geographic knowledge.

Coda: Collecting, Accumulating, Configuring, Commodifying, Reforming Knowledge

Centres of accumulation work in myriad and complex ways–as the essays of this volume readily show–and their distinctions provide valuable lessons on the

[45] Van der Aa, *Naaukeurige versameling*, Preface ("Noodig voor-berigt aan den Leser"), sig. **r: "in dede verligte Eeuw."

[46] A massive, 31-page "register" details the chronology of European travel; each part receives, further, its own title page, preface, and index. Maps, illustrations, and layout are uniformly designed throughout.

[47] Van der Aa, *Naaukeurige versameling*, frontispiece (following the title page): "noyt te vooren zoo gesien."

[48] Koeman, *Atlantes Neerlandici*, 1: 2.

production of knowledge. Pieter van der Aa's workshop functioned according to different principles than those that governed (for example) the offices of the French royal navy in Versailles; and the knowledge products created by the two "centres"–both of which collected, accumulated, configured, and circulated knowledge, in their manner–were, likewise, distinct. But Van der Aa's own products differed from one another, as well, and his case demonstrates the richness and density of the processes of knowledge production. Van der Aa's atelier practices point to the importance of consumption no less than production–a factor that reminds us of the basic market value of knowledge–and they illustrate the way "circulations" of knowledge could follow multiple circuits.

Pieter van der Aa excelled at the handling of previously accumulated knowledge. He took extant print materials–previously-made knowledge products–and he reconfigured them in innovative ways for the open market. Or rather, Van der Aa printed for the open *markets*, since he published at all economic levels–often manipulating and reconfiguring the very same material for multiple products, which he sold at multiple price points. He excelled at the commodification of knowledge. This had the effect, as well, of shifting the meaning of identical content: form indeed influences meaning, as Roger Chartier has so effectively argued regarding the varieties of print (and as Marshall McLuhan posited before him).[49] Van der Aa's most impressive contribution to the world of print was unquestionably the *Galerie agréable*, a stupendous "accumulation" of all manner of geographic knowledge. This princely product was pitched to elite consumers, to be sure. Yet it had the effect of replicating, and even challenging, a still more elite form of knowledge: the *atlas factice*.[50] The latter was an individually designed, privately compiled atlas, "accumulated" by a typically wealthy connoisseur, who assembled both manuscript and print materials from a range of available sources. The factice atlas was an accumulation of geographic knowledge that had a relatively restricted distribution. It exemplified a prior, gentlemanly habit of collecting and circulating knowledge–it was, by definition, a one-of-a-kind assemblage–and it was meant to be rare. Yet the factice atlas did have a limited distribution and permitted some circulation of its contents by dint of those early modern "culture tourists" who would have called on an atlas's owner to gain a private viewing.[51]

[49] Chartier, *Forms and Meanings*. See also McLuhan, *Understanding Media*, which follows McLuhan's equally classic *Gutenberg Galaxy*.

[50] Studies of the factice atlas are rare, yet see the scholarly edition of the exemplary atlas of Laurens van der Hem: Aikema, Van der Krogt, and De Groot, *Atlas Blaeu – van der Hem*.

[51] Van der Waals, "Met boek en plaat"; and see the discussion of the culture of collecting in de Groot, *World of a Seventeenth-Century Collector*, 278-306. See also Rina Knoeff's essay in this

These visitors were commonly drawn from the same elite classes that nurtured the preponderance of atlas collectors–they endeavoured to keep tabs on their privileged peers–yet they also came from the ranks of the scholarly, who compiled factice atlases themselves, if on a less grand scale and with a more focused professional purpose. There were overlapping categories, too. Nicolas Witsen, from a wealthy Amsterdam merchant family, avidly collected and visited collections; while he also composed learned treatises on the technology of ship building and on the geography of Muscovy.

Van der Aa's most ambitious products, especially the *Galerie agréable* and the publisher's other grand *oeuvres*, approximate in several ways the form of the factice atlas: large, omnibus, luxuriously pictorial, globally sprawling accumulations of materials gathered in one bibliographic place. Van der Aa's publications do so, however, in a way that transforms the hitherto private, idiosyncratic, one-off form of "local" knowledge that is the factice atlas into a comparably grand yet now publicly marketed, much solidified, widely-dispersed form of "universal" knowledge, which reached the most powerful courts and finest libraries of early modern Europe. They achieve this, of course, through the mechanism of print, which creates other forms of knowledge via other centres of accumulation. Indeed, Van der Aa incorporated many of the same materials that circulated in private factice atlases into his printed geographies. In some cases, draftsmen worked directly with manuscript material in the possession of a collector.[52] Van der Aa, however, commodified and publicized these materials; he circulated, as it were, the rarest of bibliographic forms–the factice atlas—which housed the most sought-after geographic knowledge of the period. This did not create a definitive form of geographic knowledge—Van der Aa himself would recycle these materials in other forms, and later printers would reconfigure and republish his materials at will. Yet he created new cycles of circuits, so to speak. His efforts, in all cases, demonstrate in yet another way the variable modes of "calculation" and "accumulation," and they illustrate the changes that can occur between accumulation and circulation–between the amassing of geographic materials, in this case, and the printing of grand geographic projects.

The ateliers of Holland served in the period covered by this essay (circa 1670-1730) as centres of accumulation, calculation, and distribution for geographic knowledge. They collected knowledge in the form of texts, maps, drawings, artefacts and more; and they processed and circulated these materials for a growing

volume on cultural tourists and anatomy collections.

[52] See the discussion in Schmidt, "Atlas Blaeu-Van der Hem."

market of consumers. Dutch print shops played an enormous role in feeding European appetites for global knowledge and wonders–exotic geography is the broad rubric that I have used to describe these materials collectively–and by dint of its role as producer, Holland did much to shape European attitudes toward the world at this critical stage of global interaction. The processes of making this global knowledge, however, are less straightforward and transparent than generally assumed. Accumulation preceded several further stages of production: massaging, manipulating, reconfiguring the sources of geography collected by Dutch manufacturers, who then rendered parochial materials into "universal" knowledge–or at least into a form of universal knowledge, since other variants would soon follow. "Global" exotica was terrifically popular. Accumulation, in this context, led to commodification, a progression driven by atelier practices and the market. This process, furthermore, reveals the "constructedness" of the many sources of geography commonly (and perhaps too casually) invoked in discussions of early modern expansion and colonialism. Insofar as these materials were constructed, greater attention should be paid to the strategies of their production and their intended consumption (as revealed, for example, in paratexts, formats, styles of presentation, and so on). The work of Pieter van der Aa and others in the business of exotic geography suggests an approach to production based on precociously modern marketing techniques. The "look" might trump the content, the style could supersede the substance, and the much-touted originality was almost certainly disingenuous. The success of the Van der Aa "brand" was considerable, which suggests the exceptional richness–in this Dutch context and at this particular moment–of the processes of accumulation, configuration, circulation, commodification, and, finally, reformation of knowledge.

The Visitor's View

Early Modern Tourism and the Polyvalence of Anatomical Exhibits

Rina Knoeff

In October 2009 the artist Karen Ingham opened her exhibition "Narrative Remains" at the Hunterian Museum in London, which houses the anatomical collections of the Royal College of Surgeons of England. Her aim was to "textually and visually reunite patient narratives with their displayed organs" so that visitors no longer heedlessly pass the anatomical objects. With her exhibition, Ingham intended to show that "a sense of humanity may be found within a single organ."

> ... for example, object RCSHC/364 the throat of Marianne Harland, a young woman famed for her musical talents and the beauty of her singing voice. Her death was particularly poignant as she lost first her famed voice, and soon after her life, as a result of tuberculosis. Her oesophagus, larynx and trachea now hang suspended and forlorn and many visitors would easily pass by these seemingly modest remains without ever knowing the human story behind them. [1]

The exhibition, in other words, brings home the message that what makes an anatomical exhibit culturally meaningful is its translation into a story. In this case, (non-medical) visitors of the exhibition can appreciate Harland's organs of sound through knowledge of her talents and tragic death.

Ingham's project is in fact an old one – "Narrative Remains" could as well have been the title of the anatomical collections exhibited in the seventeenth-century Leiden anatomical theatre, where anatomical preparations were explained and understood through local and popular storytelling. Although anatomical preparations from the anatomical theatre were sometimes used in medical teaching, the Leiden anatomical collections *primarily* functioned as touristic attractions. It follows that the collections were mainly geared to the public eye: preparations had to be somehow enticing. They illustrated tales about crime and punish-

[1] Ingham, *Narrative Remains*, 2-28.

ment and they carried moral lessons. Most importantly, anatomical exhibits were accompanied by *narrative*: that is, visitors interacted with anatomical preparations through exciting and puzzling stories that often originated in the Bible or related to tales of crime and punishment. In other words, the anatomical knowledge embodied in the Leiden collections not only represented the 'medical state of the art' but also were the result of folk imagination and storytelling. For this reason, I argue that anatomical exhibits were 'polyvalent'. Like the many facets of a diamond, they meant different things at the same time, sometimes even to the same person.[2] Anatomical knowledge, then, was a complex phenomenon that linked physical or material attributes to a broader cultural (moral, aesthetic, geographical, exotic) context. Consequently the visitor's view and with it the irreducible polyvalence of exhibits must take centre stage in any study of early modern (anatomical) collections.

Central to this essay are the popular stories and images related to seventeenth-century anatomical preparations and collections. I expand and historicize the Latourian way of thinking about collections in terms of 'cycles of accumulation', which narrowly focuses on collecting for the sake of classifying and stabilizing 'scientific' knowledge. Bruno Latour's image of accumulation is mainly about *scientific* productivity, precision, profit, efficiency and control. To collect, in Latour's view, means to transport specimens (which is already a scientific term that does not fit the seventeenth-century category of anatomical preparations) from their original 'indigenous' context into 'scientific' places such as natural history museums, where "a few scientists in frock coats" can "visually dominate" specimens from around the world.[3] Latour's image of collections, however, does not do justice to the history of early modern collections. He presents a general idea that collections were stored behind closed doors and shielded from the public eye. While this might have been the case for some nineteenth-century anatomical collections, this was not so in the early modern period – collections (and anatomical collections in particular) were hugely popular, which means that 'non-scientific' values such as spirituality, aesthetics, joy and curiosity were equally important

[2] In calling early modern preparations polyvalent, I steer away from the explanation of museum objects as 'boundary objects' (see Leigh Star & Griesemer, 'Institutional Ecology'). Rather than speaking about the translation and reconciling of intersecting social worlds which in the understanding of Star and Griesemer is always directed at the making of scientific knowledge, I emphasize that in the case of the Leiden early modern anatomical preparations, the visitor's view was equally, if not more, important than the 'scientific' view for the survival of the collections.

[3] Latour, *Science in Action*, 225. Sam Alberti has recently argued in a public talk that the correct term for early modern anatomical objects is 'preparations'. Quoted in Cunningham, *The Anatomist Anatomis'd*, 231.

in the making of knowledge.[4] In the case of the Leiden anatomical collections it should not be underestimated that a steady stream of visitors brought money and prestige to the town and university, which meant that anatomists and particularly the curators of the anatomical theatre were keen to adapt the outlook and meaning of collections to whatever the visitor wanted to see. As Ben Schmidt argues elsewhere in this volume, the making of knowledge always could also have a commercial agenda, a fact that Latour omits from his account.

In the field of museum studies the relation between visitors and objects has already been studied. Eilean Hooper-Greenhill has examined how museums shape knowledge as well as how the interpretation of objects has been shaped by the cultural context within which they are displayed.[5] Tony Bennet places museums at the centre of modern relations of culture and government and he interprets the museum as a reformatory of manners in which a wide range of regulated social routines and performances take place.[6] However, scholars in museum studies tend to write about museums as they emerged in the nineteenth century and they link their origins to processes of modernity. At that time, museums changed into disciplined places, where objects and the knowledge they represented were classified according to fixed principles with a clear educational aim.

By contrast, early modern cabinets of curiosities have often been treated as 'undisciplined' places aimed at a sensational rather than a rational and pedagogic effect.[7] This view, however, is too simple, as Hooper-Greenhill argues. She maintains that

> ... the cabinet [...] was one of the earliest and most comprehensive attempts in this constituting of the world as a view. The function of these 'cabinets of the world' were twofold: firstly, to bring objects together within a setting and a discourse where the material things (made meaningful) could act to represent all the different parts of the existent; and secondly, having assembled a representative collection of meaningful objects, to display, or present, this assemblage in such a way that the ordering of the material both represented and demonstrated the knowing of the world.[8]

In other words, early modern cabinets were focal points where knowledge was constructed and circulated, in much the same way as in early modern anatomical

4 Jim Secord has also drawn attention to audiences and readership in his appeal to examine science and knowledge production as a form of "communicative action". See: Secord, "Knowledge in Transit", 661-662. See also Topham, "Historicizing 'Popular Science'", 311-312.

5 Hooper-Greenhill, *Museums and the Shaping of Knowledge*.

6 Bennett, *The Birth of the Museum*.

7 See for instance Murray *Museums*.

8 Hooper-Greenhill, *Museums and the Shaping of Knowledge*, 82.

collections: objects not only represented but also constituted knowledge.[9] There was, however, one important difference between early-modern and modern collections. From the nineteenth-century, museum visitors "were subject to a new, strictly scopic regime, and the opportunity to experience the unruly sensations of the oral, tactile, and olfactory realms was restricted."[10] Early modern visitors of places such as the Leiden anatomical theatre, on the contrary, were explicitly invited to interact with the collections. Visitors were not silent, but invited to speak. They were not kept at a distance, but able to touch. They were not asked to be in awe, but encouraged to joke and laugh.[11]

If, in studying early modern anatomical collections, we want to speak about the circulation of knowledge, it is important to realize that audiences circulated too. Michelle Henning argues that today's visitors arrive at collections "with expectations and modes of attention shaped by the broader culture, and find... in the museum material with which to negotiate the world."[12] This was no less so for early modern visitors, for they actively moulded their experiences of preparations into their own worlds of experience and expertise. At the same time preparations were increasingly presented through the lens of their relationship to humans and in the process they were made intelligible and accessible.[13] Visitors' accounts, in other words, show that it does not do to ignore visitors (as if they were passive onlookers) in the making of collections and knowledge. On the contrary, they were of crucial importance in the making of the Leiden anatomical collections before the 1720s. To make this point this essay develops two foci: [1] storytelling as a way in which the visitor interacted with anatomical preparations and [2] the commercial agenda of anatomical collections and thereby the urge to make the collections visitor-friendly.

Before addressing these issues, however, a word must be said about what historians so easily call 'anatomical collections'. In Leiden anatomical preparations were to be found in three locations: in the botanical garden's repository, at the house of the late Professor Paulus Herman and in the anatomical theatre. Strictly speaking, however, only the collections in the anatomical theatre were

9 This has also been argued by Findlen. See: Findlen *Possessing Nature*.

10 Alberti, *The Musem Affect*, 393.

11 In recent years, museum policies have moved again towards interactive strategies to actively engage visitors with the collections. This is particularly the case in science museums. See for instance MacDonald, *Behind the Scenes of the Science Museum* and the essay by Tim Huisman in this volume.

12 Henning, *Museums, Media and Cultural Theory.*

13 Foucault already argued this in the 1970s, and the argument has recently been taken up again in museum studies. See Foucault, *The Order of Things*; Dicks *Culture of Display*, 2.

called 'anatomical', deriving their name from the place where they were stored and exhibited. They were collected and maintained by the professors of anatomy, which also gave them the status of 'anatomical collections'.

Yet, the category of 'anatomical collection' is problematic. The terminology seems to implicate (in Latourian terms) a collection of anatomical specimens, accumulated with the sole purpose of making anatomical knowledge. This understanding of 'anatomical collections', however, must be nuanced on two counts. First, when labeling an early modern collection 'anatomical', we must refer to what Andrew Cunningham has called 'old anatomy'. This was not, as the current edition of the *Encyclopaedia Britannica* defines it, about "the identification and description of the body structures of living things." Instead, Cunningham argues, it must be understood as "the premier investigative, experimental, discipline in the investigation of the phenomena of life." Old anatomy, in other words, was essentially about the functions of the (animal, vegetative and rational) soul. The anatomist investigated the parts and the organs of the body whereby the organs were seen as the instruments by which the soul carried out its actions in the body (be it human or animal).[14] By implication, anatomical preparations and collections were as much about the parts that constitute the body as about the often intangible nature and working of the soul. It almost automatically follows that old anatomy was embedded in the theological assumption that anatomy demonstrated God's divine handiwork as well as His provident hand in nature (via the working of the soul, God was directly in charge of the body's life and functioning). Cunningham argues that because of this reference to God, public anatomical demonstrations must be seen as 'sacred rituals'.[15] Thus, when studying early modern anatomical collections we must bear in mind that we are dealing with preparations that taught the beholder about the nature of the soul. And because "the soul" is inextricably bound up with cultural concerns, early modern anatomical preparations were focal points of material, theological, economical, philosophical and moral issues.

Second, the collections in the anatomical theatre were not only directed towards the advancement of old anatomy, they were also (public) collections of curiosities, lending status to the city of Leiden as protagonist of the arts and sciences.[16] When visiting Leiden the anatomical theatre was an attraction not to be missed. Travel guides praised the collections extensively and upon arrival in Leiden visitors were immediately confronted with signs on the quayside indicating

[14] Cunningham, "The Pen and the Sword," 52, 54, 57
[15] Cunningham, "The Pen and the Sword," 72.
[16] Rupp, "The New Science," 488-489.

the way towards the theatre.[17] The public character of the collections was rooted in a tradition of *vanitas* messages which reminded the visitor of the beauty of creation, the fragility of life, biblical stories, and the punishment of criminals.[18] For this reason the collections not only included human and animal anatomical preparations, but also medical and cultural items such as surgical instruments, mummies and foreign idols.

In line with my argument that anatomical preparations were polyvalent, I argue that they were so because of the very nature of the discipline of 'old anatomy'. They represented a kind of "useful" knowledge about the structure and working of the body as well as about methods of preparation. Yet, on another and perhaps more important level they represented the secret working of the soul and they visualized moral and biblical lessons – matters that were of concern not only to anatomists, but were relevant to the public at large. For instance the 'big mummy', collected by anatomy professor Otto Heurnius and a major attraction in the anatomical theatre, fulfilled at least the following three functions: it represented a method of preserving human remains, it signified the presumed medicinal virtues of embalmed bodies and body parts and it stood for the biblical story of Joseph's embalming in Egypt.[19]

In the following when speaking about anatomical preparations I refer to animal and human preparations. As mentioned above, these could be found in other Leiden collections as well, such as the collections in the botanical garden or the private collections of the botanist Paulus Herman. When speaking about the Leiden anatomical collections, however, I specifically refer to the collections in the anatomical theatre. As explained above, these collections, which were assembled by the professors of anatomy, not only housed anatomical preparations of the human body, but also items relevant to Leiden early modern culture at large.

Leiden's Anatomical Collections: Touristic Highlights

Of all the early modern Dutch towns, Leiden was perhaps most worth a visit. It was generally proclaimed "the pleasantest town in Holland".[20] For instance, the English tourist Thomas Nugent wrote about Leiden:

[17] All important Dutch towns were connected by rivers and canals and the usual and most convenient way of traveling was by canalboat.

[18] See: Heckscher, *Rembrandt's Anatomy*; Schupbach, "The Paradox of Rembrandt's Anatomy"; Rupp, "The New Science".

[19] See Genesis 50:26

[20] Poole, *Journey*, ii, 205

The esplanades are adorned with rows of trees, having the rampart on one side, and either gardens or meadows on the other. The buildings are very beautiful and magnificent, the streets broad, well-proportioned, and exceedingly clean, with canals in the middle of them planted with rows of trees, insomuch that they may be compared to so many alleys of a well-adorned garden.[21]

Although the many trees in the town centre were also criticized – it deprived the houses "of the comfortable light of the sun, and eclipsed them with a disagreeable gloominess" – early eighteenth-century travellers generally loved visiting Leiden.[22] They walked along the canals, they admired the view from the castle and they had a good look at the table of the legendary Anabaptist king Jan van Leyden. In the town hall they looked at Lucas van Leyden's painting "the Last Judgment" and the first copy of the Bible in the vernacular, the *Statenvertaling*. Most of all they admired the university with its libraries, laboratories, botanical garden, learned households and noteworthy collections.[23] The collections most worth a visit were the university's anatomical collections. Until well into the eighteenth century it was said that "even when one had a thousand eyes, a full day would not suffice to see all the mysterious and curious objects."[24] In other words, until well into the eighteenth century Leiden was a centre of cultural accumulation, attraction and authority. Not only could they boast of the "best" medical teachers of the time (among them Herman Boerhaave and Bernard Siegfried Albinus), but also of respected and representative (anatomical) collections.[25]

Among Leiden's best known early eighteenth-century visitors were Zacharias Conrad von Uffenbach, burgomaster of Frankfurt am Main and his brother Johann Friedrich von Uffenbach. For several years they travelled through the German countries, the Low Countries and England. Conrad meticulously kept a travel diary in which he not only noted down the places they visited, but also how they

[21] Nugent, *the Grand* Tour, 95. Nugent copied his description of Leiden from Denson, *New Travellers Companion*, 172-173.

[22] For a critical account of Leiden's over-shadowed houses see Poole, *Journey* ii, 75. Only a few decades later, because of the decline of trade, the perception had changed and Leyden became considered a dull place. See Peckham, *The Tour*, 50.

[23] Apparently the university was so well known that some travelers did not even want to spill ink and paper in describing it. Cayley, *A Tour*, 23.

[24] See: *Gotfr. Hegenitii itinerarium Frisio Hollandicum*. Leiden: Elsevier, 1630, quoted in Huisman, *The Finger of God*, 8.

[25] On the fame of Herman Boerhaave see my "Boerhaave at Leiden: Communis Europae praeceptor".

experienced particular sites and stories.[26] Because Conrad also wrote down the many stories attached to places and objects, his diary is an important source for my argument. We must of course be careful not to assume that one particular report – in this case Conrad's diary – represents everyone's experience. Yet, Conrad's impressions were by no means unique. Visitor's reports can be seen as hybrid – merging individual experience and generic conventions. In other words, they were not only the result of a conscious effort, but they were also related to a conventional use of language to communicate, which invariably relied on established tropes and discursive forms.[27] Tourists doing the tour of Leiden generally did the same thing: they walked the same walks, bought the same travel guides, followed the same guided tours and listened to the same stories. For this reason, we can assume that Conrad's account not only reflected his own experiences, but that it was also fairly representative of a culturally comparable visitor's view that was more broadly shared.

The Uffenbachs visited Leiden twice: first, a short visit of three days in May 1710 on their way to England and then a longer visit of nineteen days in 1711 on their way back home. Both times they stayed with a Mr Rips, who showed them around. Their trip was commonly called a *Bibliotheksreise* since the brothers were mainly interested in libraries and the purchase of books and manuscripts. In Leiden, for instance, they visited the university library almost daily. Once they even hurriedly left the tailors' guild where they were about to see the table of Anabaptist 'king' Jan van Leyden, because they heard that Wolferd Senguerd was in the library and they hoped they could perhaps persuade him to let them see the newly acquired Vossius collections.[28] Senguerd had already refused the brothers' request once because he did not want anyone near the books and manuscripts. On that occasion Senguerd only showed the catalogue, the *Codices Vossiani*. In the context of my story, the brothers' eagerness to see Leiden's book- and manuscript collections is of interest primarily because their search for rare and costly books led them to many noteworthy collections. In order to know where to go upon arrival in an unknown town, they would first make inquiries at the households of learned dignitaries and owners of (art) collections, bookshops and libraries. On

[26] In order to avoid confusion when speaking about Zacharias Conrad Uffenbach's diary, I shall refer to Uffenbach as 'Conrad'.

[27] See also: Carroll, "Natural History on Display", 272 and 279. See also Macdonald, *Behind the Scenes*, 220.

[28] Uffenbach, *Reisen*, iii, 455. In July 1690 the Curators of the University had bought the library, packed in thirty four cases, of Isaac Vossius (theologian and canon of Windsor, son of the well-known Gerard Vossius) for 33.000 guilders. Among the manuscripts was the famous medieval illustrated codex on surgery by Guy de Chauliac.

such occasions the Uffenbachs had plenty of opportunity to visit private as well as university collections.

Judging by the length of Conrad's descriptions of anatomical preparations (that is, human and animal preparations), the collections which housed them were of prime interest to the brothers, trumped only by book- and manuscript collections, as these were the main objective of the brothers' tour. The first time the brothers encountered anatomical preparations was in the botanical garden, which they visited on 16 January 1711. After looking at the plants, they went to the gallery at the left side of the garden where "strange things" were to be seen.[29] As they walked along the preparations, they discussed methods of preservation, the medical significance of the exhibits as well as stories attached to the preparations, thereby signalling the polyvalence of the preparations they studied. For instance, while commenting on exhibit "N. 122. *Skeleton humanum*," Uffenbach stated that it was "nothing special" (*nichts besonderes*). Skeletons, after all were a common sight at the time. This particular skeleton, however, was nonetheless worth seeing because of the sensational story attached to it. It had belonged to a Catholic soldier who tried to betray the city of Leiden during its siege in 1574.[30] When viewing the centre-piece of the exhibition, a stuffed hippopotamus, the brothers not only discussed how it was preserved, but they also considered how it had moved when alive. As if they were solving a riddle, they concluded that what they saw could only be the animal's skin, for they considered it impossible to transport the weight of an animal that was even bigger than a European ox. Moreover, they reckoned that if the flesh were inside, the place would have had a foul stench. In order to verify their conclusion they touched the beast and they found the skin very hard. They regretted that they were unable to feel what was underneath.

A day later, on 17 January, the Uffenbachs visited the collections of the late botanist Paulus Herman. These collections consisted mainly of plants and rarities collected in Ceylon where Herman had sailed with the Dutch East India Company from 1672 until 1677. After Herman's death, the university took only a few of the best pieces for which the widow received an annual fee of 300 guilders. She still had most of the remaining collections on display in her home. In his diary, Conrad described the most interesting animals and plants. He considered the preparation of a small animal that looked like a turtle very special – it was preserved in such a way that it could be studied from all sides. It was suspended in a bottle fastened on a thread that was fixed to a small wooden bar hanging down from the lid of

[29] Conrad speaks about 'fremden sachen'. Uffenbach, *Reisen*, iii, 404.
[30] Uffenbach, *Reisen*, iii, 407.

the bottle. Like many more of the exhibits, the preparation was extremely fragile which made the Uffenbachs concerned about the maintenance of the collections. They were particularly anxious because they noticed that Herman's widow was an alcoholic. Although Herman left his wife 40.000 guilders, she boozed it away and consequently lived in misery. The widow's drinking was of particular concern for the Uffenbachs. They saw that many of the spirits in which the specimens were preserved had evaporated and they concluded that Herman's widow, instead of filling up the bottles with brandy – presumably provided for this purpose by the university – drank the liquor herself. Conrad wrote that he hoped an auction would save the collections and he expressed his fear that otherwise they would be irretrievably lost, just like what happened to Herman's world famous herbarium (which apparently consisted of so many volumes that, if stacked on a cart, could not be pulled by a horse). When the Uffenbachs left they were extremely irritated. Not only were they worried about the collections, they were also annoyed with the widow because she refused to sell them a 'curious Indian dog', which was interesting because it did not have any hair, its skin was sky blue and it reminded the brothers of a sausage. As the widow did not have bread on the table, Conrad ironically asked if she could perhaps live on air.[31]

On 21 January the Uffenbachs visited the anatomical theatre for the first time. As more people wanted to see the collections, a woman (most likely the wife of Gerard Blancken, the anatomy servant) hurriedly showed them round so that they were unable to look around properly. Afterwards they agreed with the woman that they would return for a private visit and pay the sum of one guilder. They did so on 23 January. This time Gerard Blancken himself guided the Uffenbachs and his stories, jokes and discussions were carefully noted down in Conrad's diary.[32]

We have already seen that during their visits to the botanical garden's repository and the collection of Paulus Herman, the Uffenbachs examined the anatomical preparations as illustrations of a particular story (in the case of the skeleton of the Catholic soldier), as brainteasers (in the case of the hippopotamus) or as a cause for concern (in the case of the widow's alcoholism). Conrad's account of the anatomical theatre is even more explicitly directed at the narrative aspect of the preparations and serves as a perfect example of how the making of (in this case anatomical) collections depended on processes of local interaction and interpretation.

[31] For the visit of the collections of Paulus Herman see Uffenbach, *Reisen*, iii, 409-419.
[32] Blancken, *Catalogue*.

Storytelling and the 'Visitability' of Anatomical Collections

Stories made touristic sites what Bella Dicks has called "visitable" – that is "consumer friendly, accessible, interactive, performative and safe."[33] Dicks is speaking mainly about today's museums, but her analysis applies no less to the visitability of Leiden's early modern anatomical collections. Many preparations were accompanied by a story and these stories were often exciting or humorous – a touristic visit, after all, was meant to be a pleasurable affair. For instance, on 25 May 1710 the Uffenbachs visited the town's gates and noticed a 'bad' house (probably a brothel). Outside they saw a sign with a picture of a German with a drawn sword standing opposite a Dutch boatman with a knife. Mr. Rips told the Uffenbachs that the place was formerly called "the taunted Hollander," but that, after complaints of German students, the owner was advised to delete the first word so that the place was now called "the Hollander." As they walked on to the next site, the party laughed about this and the particular Dutch talent for self-mockery.[34] As we shall see, the stories attached to anatomical exhibits also revealed much of this Dutch idea of wittiness.

We have already seen that some of the anatomical preparations in the collections of the botanical garden and at the house of Herman were touristically attractive on account of their stories. Conrad's account of his visit to the anatomical theatre similarly shows how preparations interacted – and, as it were, came alive – through the stories and riddles attached to them. In fact stories were a key element in the survival of the theatre as a touristic attraction.

Some stories were briefly mentioned in the catalogue of the collections (the printing and selling of which was another lucrative business of the anatomy servant). Others were told as visitors walked along the preparations. The importance of stories was particularly relevant in the case of the skeletons towering above the circle of the theatre – after all, skeletons were a common sight in almost all collections. They became special only when brought into the context of an intriguing story. We have seen this already in the above mentioned case of the skeleton of a Catholic soldier – exhibit 122 of the botanical garden's repository. As such the Uffenbach brothers did not consider the skeleton as something extraordinary, but the political story attached to the soldier's execution appealed to their imagination and the skeleton became something more than just a skeleton – something to

[33] Dicks, *Culture on Display*, foreword. No doubt the reputation of a collection was also important in its 'visitability'. Here I do not intend to discuss this aspect of'visitability'.

[34] Uffenbach, *Reisen*, ii, 420.

pause for, to give a second glance. This is even more obvious in the anatomical theatre where about the circle of the theatre one could see:

a skeleton of an ass upon which sits a woman that killed her daughter; the skeleton of a woman of 17 years old who murdered her son; the skeleton of a gardmer [sic], that hang'd himself; the skeleton of a man, sitting upon an ox executed for stealing of cattle; a young thief hanged, being the bridegom [sic] whose bride stood under the gallows.[35]

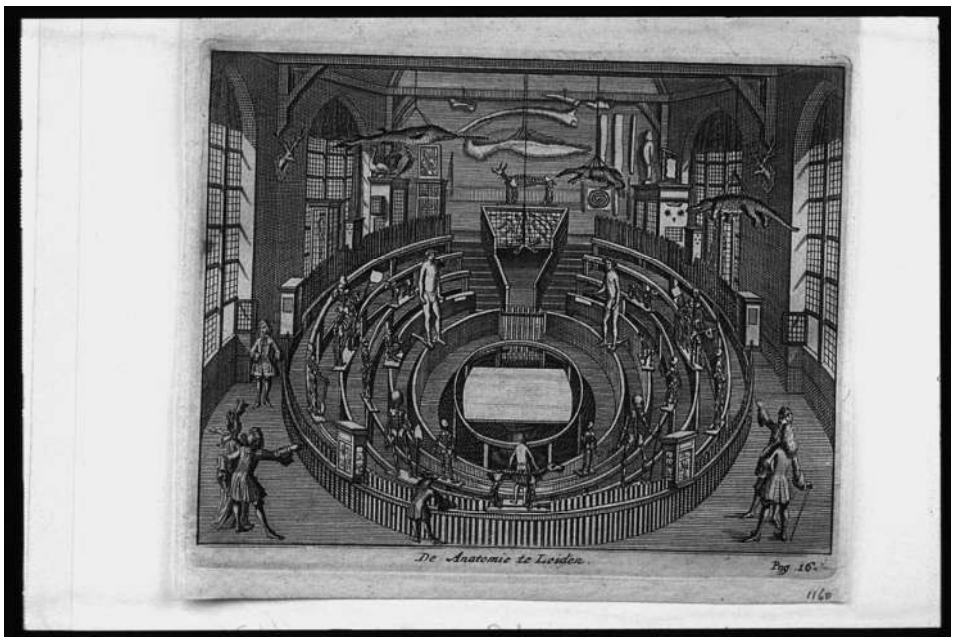

Illustration 1: The Leiden anatomical theatre around 1710, from Petrus van der Aa's Les Delices de Leyde. (Museum Boerhaave, Leiden) This engraving was made at about the same time the Uffenbachs visited the anatomical theatre and presumably gives an impression of the sight they encountered.

Most astonishing was "the skeleton of a woman called Catharine of Hamburg, strangled for theft." Conrad recounted the story of Catharine in his diary. At the market in Amsterdam, Catharine bought a piece of ribbon that measured the length from one ear to the other (a standard measure at the time). Afterwards she told the merchant that one of her ears was still nailed to the pillory in Hamburg. Conrad stated that the whole market stall pretended the story was true, but he maintained

[35] Blancken, *Catalogue*, 4, 5 and 10.

that the story must be a Dutch joke or fairytale.[36] Be that as it may, because of the tale, Catharine's skeleton attracted a lot of attention.

As in the case of Catharine, stories were entertaining (even we can't 'get the joke') – they made the anatomical preparation accessible and understandable.[37] Stories, in other words, invited the visitor to relate to the preparations on display. Even more, Conrad's retelling of the stories conveys the impression that the Uffenbachs' visit to the anatomical theatre was one of their most pleasurable visits in Leiden. In comparison, their visit to Frederik Ruysch's world famous anatomical collection in Amsterdam, two months later, seems to have been much less interesting to them. Conrad's account of the visit is very short and critical. He wrote that Ruysch had told them to come at eight o'clock in the morning. However, instead of being guided around the collections they were forced to listen to a "badly presented" lecture, meant for the eight students who had also turned up. Afterwards the Uffenbachs were given permission to look at the collection. Ruysch, however, was in a hurry (he had to go to a funeral) and did not have time to give the Uffenbachs a guided tour. The brothers admired the beauty of the preparations, which looked as if they were alive. Yet, at the same time they thought the preparations looked too artificial and they were inclined to agree with Leiden anatomy professor Rau that Ruysch painted his preparations.[38] All in all, Conrad was not as enthusiastic about Ruysch's collection as he had been about the anatomical theatre in Leiden. I suggest that for the Uffenbachs the collection was less 'visitable' because, to the brothers' great disappointment, Ruysch did not make much effort in guiding them around. There was not time for reflection and even less time for discussion. We might even ask if the Uffenbachs would have sided with Rau had Ruysch taken more time. As it was, the Uffenbachs were not invited to interact with the preparations, which left them disappointed.

In Leiden, however, they had both enough time and an excellent guide. Many anatomical exhibits were simply admired (as in the case of the Egyptian mum-

[36] Klaas van Berkel has argued that the Uffenbach's hardly ever believed the stories they were told. Berkel, *Citaten*, 107. Whether or not this was the case is not relevant for my argument. which focuses on the function of stories in the anatomical theatre.

[37] On the historical character of jokes and their significance for understanding the past, see Darnton,"Cat Massacre."

[38] The "artistic" representation of Ruysch' s preparations was a continuous point of discussion among anatomists. These discussions, which often ended in vile controversies, were mostly conducted in public. It is, therefore, no surprise that people visiting Ruysch's famous cabinets were reminded of the arguments – we can even say that the controversies added to the polyvalence of the anatomical objects, for visitors could judge the aesthetic qualities of the preparations and choose to support or be against Ruysch.

mies), other exhibits were treated as brainteasers and sometimes the party openly joked about anatomical preparations. The more mind-boggling or sensational a story was, the more its appeal expanded and the more 'visitable' the preparation was considered (although, as we shall see later, there was a limit to this as soon as the question of 'good taste' came into play). As a special treat Blancken showed the Uffenbach brothers the skull of a gypsy woman. They were puzzled by the state of her teeth, some of which were "worn out." After some guessing, they were finally told the story that the woman, when she was led to the gallows, was still smoking her pipe, and that at the moment of hanging, she must have bitten off her teeth. Also, exhibit 52 – "the bladder of a man containing four stoop (which is something above two English gallons) of water" – on the wall of the theatre excited the Uffenbachs' imagination. This time the exhibit appealed to the experience of their own bodies. They were struck by the size of the organ and they joked with Mr. Blancken that the man would have been able to urinate for an hour. Also the story reminded them of the mechanical working of the fountain at Leiden's castle – they compared the time needed for the man to empty his bladder to the time span water would daily spout from the well at the town's castle.[39]

Not only were preparations identified by stories, they were also connected to stories familiar to the visitor. It has recently been argued that "nineteenth-century museum visitors gave meaning to collected objects through forming complex associations between the objects themselves and a host of remembered facts and narratives that were seen to relate to them."[40] The same goes for early eighteenth-century visitors to the Leiden anatomical theatre. In all cases stories intensified the visitor's cultural experience; that is, preparations related to stories that were familiar, amusing or sensational (which mostly meant that they bordered on the unbelievable). Stories forced visitors to pause. They invited visitors to contemplate preparations and actively moulded preparations into the visitor's lived experience.

Conrad's detailed account of his visit to the Leiden anatomical theatre provides a case in point. Already among the first preparations they encountered in the entrance, the Uffenbachs were struck by the small size of the gullet of "the bone of the hinder part of the head of a large old whale."[41] Without thinking, they related what they saw to what they knew about whales – the biblical story of Jonah being swallowed by a whale and surviving in the stomach of the beast for three days.[42]

[39] Blancken, *Catalogue*, 6; Uffenbach, *Reisen*, iii, 440.
[40] Carroll, "Natural History on Display", 284.
[41] Blancken, *Catalogue*, 3.
[42] See the Old Testament book of Jonah.

They mused that if only church reformer Martin Luther would have seen the exhibit, he would not, in his vernacular translation of the bible, have called the large fish that swallowed Jonah a whale. [43] The Uffenbachs, in other words, viewed the anatomy of the whale's gullet and immediately placed it in a biblical context. This not only shows the scope of the Uffenbachs' store of remembered cultural experiences, but also that the story increased the brothers' interest in the preparation – they now considered the preparation interesting enough to note down.[44]

In visiting anatomical collections the importance of stories cannot be overestimated. Stories, which in almost all cases dovetailed with the visitor's cultural experience, made the anatomical theatre publically 'visitable'. In fact, stories were so important that in some cases they were represented without the preparations themselves being present. One of Leiden's remarkable pieces, also carefully examined by the Uffenbachs, was a signed document telling the story of the Prussian serf Andreas Grünheide, who had accidentally swallowed a knife. He had eaten too much after which he stuck the hilt of his knife in his throat in order to vomit. Doctors in Königsberg successfully managed to operate and remove the knife. Heurnius wanted the knife for the Leiden collections, but he was too late (the knife had already been sold to the king of Poland) and he only received a certificate, signed by the local magistrate, verifying the truth of the story, together with a painting of Grünheide.[45] More than any other example, the exhibition of the certificate and the painting show how stories and pictorial representations took the place of preparations and that visitors were happy enough listening to tales even without preparations being present.

The stories told in the Leiden anatomical theatre and jotted down in Conrad's diary exemplify the polyvalence of anatomical preparations in the Leiden theatre. Stories mediated between the preparations on display (or absent, in some cases) and the beholder (in this case the visitor). In fact, stories blurred the distinction between anatomical matter and the (popular) meaning attached to it. [46] They gave

[43] Uffenbach, *Reisen*, iii, 439.

[44] Visitors and collectors regularly related curiosities to biblical narrative. For instance Leiden collector Otto Heurnius collected and exhibited Egyptian objects with the particular aim to elucidate and teach biblical truths. Mummies were considered visual evidence of the story of Israel in Egypt. Hieroglyphs were telling the story of Adam, Eve, Noah and Moses. See Jorink, *Het Boeck der Natuere*.

[45] The issuing of certificates was more common practice. Well-known anatomist Frederik Ruysch also owned several such certificates corroborating the stories accompanying his anatomical preparations. See Knoeff, "Animals Inside."

[46] Loraine Daston has recently argued that 'objects are simultaneously material and meaningful'. See Daston, *Things that Talk*, 17. Mieke Ball has similarly pointed out that the activity of col-

the anatomical representations of body parts a familiar face, as it were. Although skeletons do not normally have ears, visitors hearing the story of Catharine of Hamburg could virtually see the incriminating ear on the skeleton's skull. And while joking about the large bladder, the Uffenbachs could almost see the man urinating. In other words, through the stories and jokes told or made up while walking along the collections, the anatomical preparations and the bodies they represented were made part of the visitor's living experience.[47]

A Commercial Agenda

Because the Leiden anatomical theatre was one of the town's most important tourist attractions, it was of crucial importance to maintain its 'visitability'. As mentioned above, not only did the theatre bring fame to the town and university (and we should not underestimate this), it also brought in a lot of money. The town itself indirectly profited from a steady stream of visitors, as did the university, but the person profiting the most was the anatomy servant.

In the 1620s anatomy professor Heurnius expanded the collections and decided to admit visitors when no anatomical dissections were taking place. The anatomy servant was to act as a tour guide and in return benefitted from the entrance fees. By the time Gerard Blancken was appointed servant of the anatomy theatre, this source of income was important. He earned a yearly wages of 200 guilders. By comparison, a professor in the medical faculty earned about 1000 guilders, and perhaps more if he negotiated well. If visitors paid 1 guilder for a private visit, as the Uffenbachs did, guided tours were a lucrative additional business. If Blancken did three guided tours a day, he would, on average, earn more than a university professor in a year. This does not even include the printing and selling of a catalogue of the collections which was another profitable business of the anatomy servant. Even the university authorities accepted that the role of guiding people through the theatre "was a major advantage of the job of anatomy servant."[48]

In light of the commercial exploitation of the theatre, it was essential to make the collections as 'visitable' as possible. We have already seen that the telling of stories was of crucial importance in doing so. Another way to make the collections worth visiting was to exhibit the most intriguing anatomical preparations – some

lecting can be studied in a narrative context. See Ball, "Telling Objects."

47 On the relation between visitor and object see also Albert, "The Museum Affect," Carroll, "The Natural History of Visiting" and Forgan, "Building the Museum."

48 Huisman, *The Finger of God*, 121.

of which went too far for the good taste of visitors. These preparations, bought from fishermen, presented by princes or made by the anatomy professors and servants themselves, became an integral part of the 'official' collections and were proudly shown to visitors. The Uffenbachs, for instance, investigated "the skin of a man dressed as parchment; a drinking cup of the skull of a Moor, killed in the beleaguering of Haarlem; the entrails of a man of which is made a shirt, a drinking-cup made of a tortice [sic] shell; a Hand of a meermaide, a foot of a sea monster, a pair of shoes made of man's leather; a cup made of a double braine-pan (made by Louis de Bils)."[49]

The making of domestic or other objects out of anatomical material was neither unusual nor shocking in itself. For instance in the house of the painter and collector Willem van Mieris, the Uffenbach's admired a 'fictitious dragon' made out of a thornback and they had already bought a similar object in Delft. In all cases, the Uffenbachs judged the preparations according to their aesthetic qualities, their usability or their moral consequences. They particularly admired the classical design of the drinking cup made of the skull of a Moor, but they thought that the shirt made of a man's intestines was too short.

However, when Blancken told them about a pair of slippers he had produced from a man's skin, the brothers were appalled. With gusto Blancken told them that for the sole he had taken a particularly thick piece of skin and that the slippers were so well made that he had used them a long time. This story (or perhaps it was also the boasting tone) went too far for the brothers' taste. They were reminded of the Latin saying *de alieno corio ludere* (to play for someone else's skin) and they were surprised the Dutch would let this pass. The conscience of a superstitious man, the Uffenbachs thought, would have more difficulties accepting the object (at the time superstitious people believed that human skin had healing powers).[50] Upon hearing their disapproval, Blancken ironically queried if it was not better for a man's skin to be worn out than to be eaten by worms. Notwithstanding Blancken's efforts, the reaction of the Uffenbachs shows that there was a limit to "visitability". Although the story was sensational enough, it clearly went against the brothers' good taste. Yet, it did not affect their stay in the anatomical theatre, for they continued their visit as before.

[49] Blancken, *Catalogue*, 6, 10, 11 and 12.

[50] Bohde, "Pellis Memoriae Peccatorum", 352-353. Robert Jütte has found an example of a man whose lame foot was healed after wearing slippers made from human skin. See: Jütte, "Die Haut als Heilmittel", 162, note 7.

Conclusion

By now it should be clear that the visitor's view mattered in the making, preserving and exhibiting of anatomical preparations and collections. It follows, then, that our understanding of "cycles of accumulation", as described by Latour, needs to be expanded. Latour first introduced his interpretation of the term in *Science in Action* with examples drawn from European voyages of discovery. Every time a ship returned from unknown lands it brought back new knowledge in the form of natural and handmade objects, drawings, journals and so forth. With every trip the things, people and events in distant places became more familiar – that is, the knowledge of unknown places grew through its organized accumulation. Latour concludes

> ... what is called 'knowledge' cannot be defined without understanding what *gaining* knowledge means. In other words, 'knowledge' is not something that could be described by itself or by opposition to 'ignorance' or to 'belief', but only by considering a whole cycle of accumulation: how to bring things back to a place for someone to see it for the first time so that others might be sent again to bring other things back.[51]

Latour argues that cycles of accumulation allow one point to become a *centre* (of scientific activity) by acting at a distance on many other points.

Is it possible to consider the Leiden anatomical theatre as a Latourian centre of accumulation? The 1698 Dutch edition of Blancken's catalogue begins with a presentation of the theatre as an edifying arena housing many items from all over the world. It invites visitors to the theatre stating

> ... so come! And spend your time here considering
> What Europe gave and every other part of the earth;
> From man or brute, in part or its entirety,
> A bone or bowel, or skin or other part.

The poem presents the anatomical theatre as a *centre of accumulation*. There is, however, an important difference with Latour's discussion. While he is mainly interested in centres and cycles of accumulation as far as they are about the standardization and stabilizing of "scientific" knowledge the poem praises the theatre as a *touristic* centre. And as we have seen the knowledge presented in the theatre was enlightening and entertaining as well as standardized and stabilized; standardized in terms of the stories and tours in which it was embedded, stabilized

[51] Latour, *Science in Action*, 220.

through both the (themselves increasingly standardized) processes of preservation and the moral economy which brought its embodiments and significance to life. An anatomical object was always polyvalent – it could mean different things to the same person at the same time. Thus, 'non-scientific' values (retrospectively seen) were equally important in the accumulation, circulation and calculation of objects and knowledge. In fact, as in the case of the Leiden anatomical theatre, experiences related to spirituality, curiosity and entertainment were crucial in the making, meaning and survival of anatomical collections. Often the story was the first reason for preserving a specimen (why else would the skeleton of Catharine of Hamburg have been included in the collection?). Also, the stories attached to anatomical preparations guaranteed a steady stream of visitors and therefore the survival of the collections.

The polyvalence of anatomical preparations also meant that the knowledge represented in the anatomical theatre could never be completely controlled, a point which can be made about knowledge generally. The relative stability of knowledge represented by the anatomical preparations depended on go-betweens who mediated between preparations and beholders as well as the ways in which visitors digested what they saw, heard and touched. Our story shows that the meanings of anatomical preparations were continuously challenged. Visitors coming into the Leiden anatomical theatre actively engaged with the preparations. They touched them, they reacted to stories, they made guesses about the origin and appearance of preparations and they even condemned some of them. Only through the intervention of a mediator, in this case the tour guide or the catalogue, could a kind of 'stable' knowledge be temporarily maintained. Gerard Blancken, for instance, often allowed the Uffenbach brothers to guess about the origin and appearance of preparations, but in the end, he would always steer their attention towards the accepted and broadly shared understanding of preparations (which, needless to say, was in all cases polyvalent).

In 1711, when the Uffenbachs visited Leiden the status of the anatomical theatre as an institution began to decline. Blancken was, at the time, continuously at loggerheads with Govard Bidloo, professor of anatomy, over the maintenance of the collections. A particular sore spot was that Bidloo often took specimens (which he claimed belonged to him) home for teaching and research purposes. Blancken complained to the curators that the exhibition in the anatomical theatre showed gaps and that he could not answer for the specimens which Bidloo had taken away. The conflicts between Bidloo and Blancken signalled the beginning of a rift between the anatomical theatre as a place for anatomical instruction and the anatomical theatre as a public museum – a separation which was complete

in the 1720s when professor of anatomy Bernard Siegfried Albinus conducted dissections in private (for teaching and research) and kept his anatomical preparations in the new Leiden anatomical cabinet. Albrecht von Haller visited both places in 1725 and distinguished the big public anatomical theatre, 'which no farmer's maid would leave unvisited' from Albinus's small *amphitheatrum* where he performed his dissections and exhibited his preparations.[52] It has been argued that from this time the professors of anatomy did not much care about the collections of the anatomical theatre, which became the domain of the anatomy servant who exploited them for guided tours.[53]

Yet, this does not mean that the visitor's view infused with moral, aesthetic and other values remained in the anatomical theatre, while Albinus began accumulating 'scientific' anatomical preparations and knowledge. Anatomical preparations were and continue to be related to the society which values and interprets them. Even if only because anatomical preparations touch the experience of our own bodies, they tend to be related to the story of a human life. The following is a twenty-first century account of a dissection performed by a group of physical therapy students:

> Our group is luckier than most, for our cadaver has an unmissable trapezius, the diamond-shaped muscle extending from the very top of the neck to the middle of the back and from shoulder to shoulder. It is so large and well developed, in fact, that the five of us wonder aloud what this woman could have done for a living. "Probably a nurse," offers Kristen, "you know, having to lift patients." "No, I'll bet she was a truck driver," muses Cheyenne in her *Fargo* accent. "Yeah, a truck driver," Kelly agrees, "and that might explain the stroke: too much fast food." This gets nods all around, though I am still wondering why no one has suggested *physical therapist*.[54]

As the Uffenbach brothers made guesses about the teeth of the gypsy woman or the large bladder, so the physical therapy students relate the outlook of the anatomical body to the kind of work the woman had done. Even more, by referring to the body's apparent consumption of fast food, they have included a moral lesson in their dissection, which, in principle, is not very different from the seventeenth-century *vanitas* messages of "old anatomy". Most importantly, the discussion at the dissection table shows that anatomical preparations, even nowadays, do not solely represent a Latourian form of standardized 'scientific' anatomical knowl-

[52] Lindeboom, *Haller in Holland,* 42, 99.

[53] Huisman, *The Finger of God*, 182. Otterspeer, *Groepsportret met Dame*, 128-129.

[54] Hayes, *The Anatomist*, 68. In order to research the life of nineteenth-century anatomist Henry Gray, Bill Hayes observed dissections and post mortems performed by students. His aim was to "coming to know Henry Gray by coming to know human anatomy."

edge.[55] Instead, we need to include audiences' experiences in the cycle that gives dynamic meaning to the making and communicating of anatomical knowledge.

[55] The hugely popular and controversial anatomical exhibition "Bodyworlds" (by Gunther von Hagens) is an outstanding example of how anatomical preparations are adapted to include the visitor's view: the anatomy of the muscles is represented in the figure of a 'runner', which at the moment is arguably the most popular sport; the anatomy of the brain and nerves is represented in the figure of a chess player, a thinker; and the danger of smoking is made visible in the exhibition of a blackened lung.

Drawings, Ships and Spices: Accumulation at the Dutch East India Company

Johan de Jong

On 14 April 1822, Amsterdam's largest storehouse collapsed. The *Zeemagazijn*, as it was known, had been constructed during the 1660s by the Dutch East India Company (VOC) on the artificial island of Oostenburg. According to experts at the time, the soil could not support the foundations of the building any more. Apparently, the original calculations had not incorporated the shifting demands of the early colonial era, and the amount of accumulation that had been (and was still) taking place. The VOC itself had collapsed more than twenty years earlier, on the very last day of the eighteenth century and had taken its shipbuilding activities at Oostenburg with it. However, after the Napoleonic wars, the newly constructed Kingdom of the Netherlands carried on with the trading activities of the former VOC – using its old storehouse – and turning the (Dutch) East Indies into a colony. This essay considers various processes of accumulation that took place in and around the VOC ships, shipyards and storehouses during the existence of the VOC. The VOC has been characterized in different ways such as the first multinational, the first company to issue shares, the largest technological and industrial enterprise in the Dutch Republic, an early example of a public/private enterprise and as a state within the state, formed by the confederation of semi-independent provinces that made up the Dutch Republic of the seventeenth and eighteenth century. Here the emphasis is on the VOC as a complex centre of accumulation regarding the design of its ships, its shipbuilding practices and its shipping operations.[1]

[1] Throughout this article, the acronym VOC will be used to denote the *Vereenigde Oostindische Compagnie*, i.e. the United (Dutch) East India Company. Re "multinational" Jan Lucassen, "A Multinational," 12; re "shares" J.R. Bruijn e.a., *Dutch Asiatic Shipping* (Part 1), 8-11, Femme S. Gaastra, *De Geschiedenis*, 21-29; re "largest company" Jan Nijman, "The VOC and the Expansion," 211, Lucassen, "A Multinational," 12; re "public/private" Bruijn, *Dutch Asiatic Shipping*

In 1701, a century after the creation of the VOC, Pieter Van Dam – *advocaat* (counsel) and fulltime secretary of the board of the VOC – finished the *Beschryvinge van de Oostindische Compagnie.* Apart from describing the history and the workings of the VOC, this book was also intended as a handbook for exclusive use by its board, the *Heeren XVII* (Gentlemen Seventeen). The VOC continued operating throughout the eighteenth century, reaching the height of its trading and shipping operations in the middle of that century. When writing about ships and shipbuilding, Van Dam pointed out that it took about twenty years after the inception of the company before the VOC started producing most of its ships on its own shipyards. By that time, each of the six chambers that made up the conglomerate of the VOC had its own yard, although quite different in size and capacity. This meant that not every yard was capable of building all three types (or 'charters' as they were called) of the large *retourschepen*. In total, at least 1461 ships (and probably some 120 more) were built on the yards of the VOC between 1602 and 1795. At the Oostenburg yard in Amsterdam, almost half of this number was built; the Middelburg yard in Zeeland produced about twenty percent and the smaller yards of the other chambers (Rotterdam, Delft, Hoorn and Enkhuizen) each built an equal share of the remainder. Amsterdam and Zeeland specialized in the building of ships of the first – that is, largest – charter. Apart from the building of new ships (in Amsterdam on average four ships every year, at the smaller yards approximately two ships every three years) repair and maintenance formed an important business. Upon return in *patria*, the *retourschepen* were inspected and a decision was taken as to whether the wear and tear caused by the trip to Asia and stay in tropical waters could be repaired or whether the ship had to be scrapped. In fact, quite a number of *retourschepen* managed to complete six or even more roundtrips, leading to an average lifespan of about fifteen years.[2]

The ships, shipping and shipbuilding activities of the VOC are interpreted in this essay as an intricate pattern of interactively linked centres of accumulation. The connection will be shown between the accumulation relating to the design and building of the *retourschepen*, the accumulation involved in the operation of

(Part 1), 7 & 14; re "state within state" Bruijn, *Dutch Asiatic Shipping* (Part 1), 6-7, Gaastra, *De Geschiedenis*, 21-23, Lucassen, "A Multinational," 13.

[2] *Retourschip* (plural: *retourschepen*) is the Dutch name given to an East Indiaman, signifying the return trips these vessels were specifically designed and built for. On the numbers built, see Bruijn, *Dutch Asiatic Shipping* (Part 1), ch. 3. On the number of trips, see Bruijn, *Dutch Asiatic Shipping* (Part 1), 95. A lifespan of fifteen years is mentioned at the website of the *VOC-Kenniscentrum*, a project by the *Koninklijk Instituut voor Taal-, Land- en Volkenkunde* (KITLV), affiliated to the *Koninklijke Nederlandse Akademie van Wetenschappen* (KNAW), http://www.voc-kenniscentrum.nl/vocschepen.html

these ships and the accumulation of the goods and persons that these ships carried to and from the East Indies. When looking at ship design and shipbuilding, a new design of the *retourschip* (introduced in the 1740s and composed of detailed, measured drawings) will be presented as an immutable mobile, or rather as a succession of immutable mobiles. The accumulation related to ships and shipping will be described by interpreting the *retourschip* as a mutable mobile, which played different roles when leaving Oostenburg on its outward journey and returning to Oostenburg on its homebound trip. This leads to a rethinking of the (im)mutability of mobiles, related to their construction, materialization and use.

Drawings and Ships: Accumulation at Oostenburg

1. Organization as accumulation

Oostenburg in Amsterdam was the largest shipyard of the VOC; between 1660 and 1799, about 500 merchantmen were produced at that site out of the total production of 728 ships by the VOC chamber of Amsterdam. It consisted of three artificial islands, on one of which imported goods from Asia were stored in the *Zeemagazijn*, along with nails, ropes and cables for the ships. On a second island were several workshops, where parts for ships were produced. The shipyard itself, with its three slipways, a forge, a steam kiln for bending timbers and some more workshops, was housed on the third island. Organisation and logistics at Oostenburg were as large-scale and complex as the yard itself. During the 1750s, the yard employed 1100 workers and 180 staff members, supervisors and commanders. They were divided over six main departments: administration, artisan departments, storage, transport, vessels and a security system. Other sources mention that in 1762 there were 156 staff and supervisors employed and shortly before 1791, the number of workers is given as 1319 of which 245 had been recently dismissed. If one considers that – until the beginning of the nineteenth century – an enterprise, employing a few hundred workers, was already very large, these numbers indicate that the Oostenburg yard ranked with the famous Venetian Arsenal as a huge industrial enterprise. The organisation as a whole displayed a pyramidal structure, with three *boekhouders* (financial controllers) at the top and tapering out towards an intricately structured base with – amongst others – fifteen separate artisanal production units. Other sources mention two *boekhouders*, one of which was also called *equipagemeester*. The *equipagemeester* was responsible for the production and fitting out of ships, both old and new. At the level of the workfloor, the shipyard can be interpreted as a system of horizontally organised, independent

and specialized units. We can see an example of its factory-like production system in the standardized and specialized production of masts. At least from 1697 onwards, the dimensions of the masts and yards to be used with the various charters of retourschepen were given in considerable detail, and if we consider that masts and yards were also shipped to Batavia on a regular basis, the conclusion must be that the numbers produced were such that the VOC was able to accumulate a permanent supply of standardized masts and yards.[3]

This fits with the description by the archaeologist Jerzy Gawronski of the organization at Oostenburg as "almost modern, in view of the standardized and efficient assemblage of mass-products in wood" in contrast to the oligarchic, hierarchical bureaucracy of the *Heeren XVII*. The use of the word 'modern' here probably refers to the way manufacturing became organised during the nineteenth century and it may also refer to the use of interchangeable parts. Apart from the shipbuilding operations (which will be discussed in more detail later) the yard employed specialized workmen for taking out the ships, for loading and unloading and for working on board of the yachts made available to the directors. The way the yard operated points to a rather sophisticated system of division of specialized labour, which was in operation quite some years before Adam Smith wrote *An inquiry into the nature and causes of the Wealth of Nations.* Smith wrote that "the division of labour, (however,) so far as it can be introduced, occasions, in every art, a proportionable increase of the productive powers of labour" even when such division could not be taken to such extremes as in his example of the pin-factory. Looking at the fact that the shipwrights at Oostenburg were capable of building a *retourschip* within six months' time suggests that the division of labour that was in place did indeed account for a short production time.

It is worth mentioning here that Smith focused on the accumulation of capital

[3] On the size of Oostenburg, see Jerzy Gawronski, "The Hogendijk Shipyard," 133-135. On the workshops, see Bruijn, *Dutch Asiatic Shipping* (Part 1), 28. On staff numbers, see Lucassen, "A Multinational," 19 and 29; also Gaastra, *De Geschiedenis*, 163 mentioning 600 employees for the shipyard in Middelburg (Zeeland) and between 150 and 200 for the yards of the smaller chambers and finally Bruijn, *Dutch Asiatic Shipping* (Part 1), 29 referring to ARA VOC 6846 (May 1762) which mentions "a list of qualified servants from 1762 giving an insight in the actual way labour was divided at Oostenburg." On the comparison with the Venetian Arsenal, see Lucassen, "A Multinational," 12. In addition, Robert C. Davis, *Shipbuilders of the Venetian Arsenal*, 12-13 gives the combined number of shipwrights, caulkers and mastmakers at the Arsenal as between 1000 and 1200 towards the end of the seventeenth century. On the artisan units, see Gawronski, "The Hogendijk Shipyard," 135. On the *boekhouders*, see ibid. and Bruijn, *Dutch Asiatic Shipping* (Part 1), 29. For the transport of masts and yards to Batavia, the VOC built and used specially equipped ships, for this see Bruijn, *Dutch Asiatic Shipping* (Part 1), 90 and Johan de Jong, *Standvastigheid*, ch. 3.1.2.

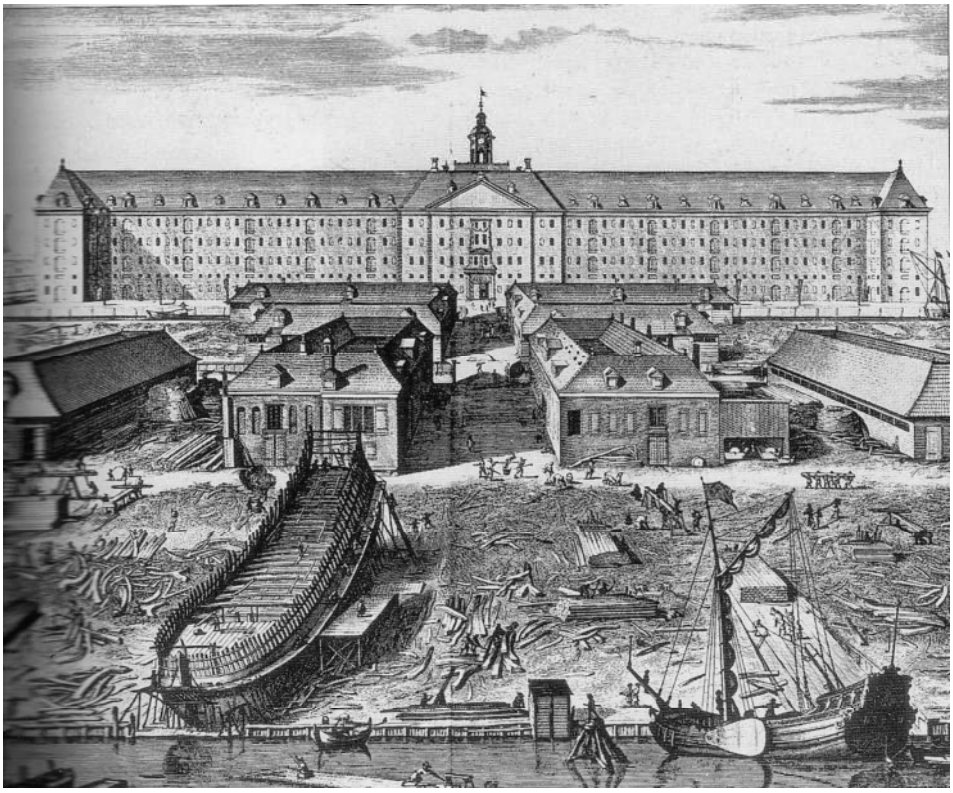

Figure 1 The yard Oostenburg of the VOC chamber Amsterdam at the turn of the 18th century. In the foreground a retourschip is being built, in the middle distance several workshops can be seen and at the far end the large Zeemagazijn is visible.

as the motor of economic growth, rating less important the role of accumulation of knowledge. Philosophers from Bernard Mandeville in the early eighteenth century until Karl Marx in the mid-nineteenth century stressed the role of accumulated knowledge, developed and handed down from one generation to the next. Despite Smith's approach being challenged by contemporary and later economic theorists, it provided the foundation for the dominant mode of economic thinking in the west well into the twentieth century. In the next sections, it will be argued that the accumulation of knowledge in interaction with other (non-capital based) accumulative processes, was instrumental in the developments regarding ship design, shipbuilding and shipping within the VOC.[4]

[4] Gawronski, "The Hogendijk Shipyard," 135. Gawronski goes on to say that "... the nineteenth century industrial technology of steam and steel would have fitted well with the eighteenth cen-

2. Accumulation of know-how

Since the days of Aristotle, the concept of knowledge (*episteme*) has been associated with the thinking mind of the philosopher while the concept of (technological) skill (*technè*) was linked to the tinkering hand of the artisan. This distinction lives on until the present day, as is shown by the popular view that formal, scientific knowledge is developed in the minds of scientists and that technology can be seen as the application (by technicians or engineers) of such knowledge. Whether such a distinction was justifiable in the days of Aristotle is certainly debatable, and few academic analysts are willing to defend this 'linear model' today.[5] A full discussion of this topic would carry us far beyond the scope of this essay, but here we should acknowledge that during the seventeenth and eighteenth century (between the so-called 'Scientific Revolution' and 'Industrial Revolution') the development of knowledge relied as much on the practicalities of experiments and material production as on theory and intellectual speculation or reasoning; activities that were often undertaken by one and the same person. This implies that we should read the term 'knowledge' (as mentioned in the preceding section) in a far less restricted way than is often the case and that we should realize that it overlaps with and is overlapped by what is commonly called 'skill'.[6]

If we look more specifically at the design- and building process regarding the VOC's eighteenth-century *retourschepen*, we come to realize that handy knowledge and mindful skills were intricately interwoven. A separation between the design phase and the building phase of ships only started to become visible during the second half of the eighteenth century, but even then, both processes were performed by (local) master shipwrights, with the finalization, adaptation and appropriation of the design taking place during the (local) building of a ship. In designing and building, shipwrights made use of the interwoven formal and practical aspects of what is here called 'know-how'. The use of this term frees us from having to refer to 'skill & knowledge', which still might unintentionally suggest that an absolute distinction can be historically detected between (practical) skills on the one hand and (formal) knowledge on the other hand. Therefore, we use the

tury production system of the VOC yard." On specialized workmen, see Bruijn, *Dutch Asiatic Shipping* (Part 1), 29. Smith's quotation is taken from Smith, *An inquiry*, 3. On capital as the motor of economic growth, see Smith, *An inquiry*, Book II. On the different approaches within economic theories, see Renee Prendergast "Accumulation," 1-7.

5 David Edgerton, "Linear Model."

6 In the "Preface" to *The Mindful Hand*, xiii-xxvii, Lissa Roberts and Simon Schaffer have written extensively on the practical inseparability of skill and knowledge.

term 'know-how' throughout this essay, as it encompasses both the more practical and the more formal aspects of 'knowing'.

In 1742, the English master shipwright Charles Bentam, who was employed at the yard of the Amsterdam admiralty, was asked to design and draw three new charters of *retourschepen* for the VOC. Through these designs, he connected the VOC-shipyards with the English naval design and shipbuilding network. He added foreign expertise and experience to the know-how that had already been accumulated within the VOC-network and added a layer of calculation that was used to work out the frames of his designs. Architectural technical (or measured) drawings were introduced into an existing and expanding network of accumulation.[7]

In the centre of the network several aspects related to the ship design had been accumulated, such as know-how on ship design and shipbuilding, know-how about nature in the regions where the ships had to operate, know-how about the purpose of the ship to be designed, financial constraints and requirements put forward by the *Heeren XVII* and/or the local VOC chambers. The accumulation of materials, needed to materialize the design at the shipyards (as will be discussed later) was informed by and dependent on the know-how of the master shipwrights, as is shown by remarks to be found in Van Dam. A set of three interrelated design drawings, inscribed on paper, formed the complete design. It was generated in the centre of the network and it was able to be spread outwards, at the same time immutable and mobile: immutable, because the designs were – for the first time in commercial Dutch shipbuilding – established as a paper artefact that might be kept unchanged for years and at the same time mobile, because it could easily be moved to other localities to be materialized. Spatially this meant a move to the six different shipyards of the VOC, and at each yard a move to the lofts where the templates were produced, followed by a move (accompanied by the templates) to the actual yard where the design was materialized into an artefact such as a 150 ft. *retourschip*. The network in which the design was inscribed turned into a constructive network, disciplined by the design itself, and relying on imported building methods, as will be described in a later section. Timewise, the mobile character of the drawings made it possible to use the design consistently during a timeframe stretching from 1742 to 1795. The *retourschip* technology remained fundamentally unchanged for over half a century, concerning both its basic design and its accompanying method of production. This means that what started out as an innovation in design and building methods was transformed – through

[7] The first charter had a carrying capacity of about 1150 tons (in modern terms), the second charter was capable of carrying 850 tons and the third charter could take a payload of about 600 tons.

its immutable and mobile character – into a technology-in-use that produced large numbers of highly standardized *retourschepen*. Before – and even after – the introduction of drawings, the VOC had a system of supervision in place whereby ships built at a certain shipyard were checked by other shipwrights after completion. That the new design and building procedures left little room for modifications during the building of the ships is borne out by the fact that one of these controlling shipwrights questioned whether it made sense to continue with this practice, writing that " (...) now one has so many moulds that it is impossible to make any mistakes". This suggests that the immutability of the design was effectively translated into an immutability of the artefact.[8]

3. Accumulation of materials

Oostenburg can be thought of not only as a production site, but it can also be interpreted as a junction of hundreds of supply lines, through which raw materials and goods were shipped in, accumulated, appropriated and transformed into complete merchantmen. The description of the ships of the VOC and details of their construction and the materials used is presented in Van Dam's *Beschryvinge* (chapter 17). As mentioned earlier, Van Dam's book was intended for use only by the *Heeren XVII* and it was kept under lock and seal at their offices. This might explain why the description is rather frank in places. In addition, it seems quite likely that most of the content of this chapter was written by the master shipwright at Oostenburg instead of by Van Dam, as the language used seems to be far more workman-like than the formal language used by Van Dam in the other chapters. These considerations make it very plausible that the description of procedures and of the (preferred) use of materials reflects what actually happened (or was meant to happen) at the shipyards of the VOC.[9]

As far as materials were concerned, wood was the most important raw material used in building ships. Oak for keels was imported from Berlin or Silesia, wood for stems, frames and the structural part of the stern came from Oldenburg or Münster. Heavy deck beams were made from Rhineland wood, lighter deck

[8] The quote has been attributed to the shipwright H.C. de Groot in a letter dating from 1742. In Dutch it reads *"(...) men nu soveel mallen heeft die beletten dat men met mogelijkhijt geen abuysen kan begaan."* The quote is given in A.J. Hoving & A.A. Lemmers, *In tekening gebracht*, 49. On the system of supervision, see De Jong, *Standvastigheid*, 21-22.

[9] See http://www.inghist.nl/Onderzoek/Projecten/DeVoc.BeschrijvingDoorPieterVanDam1693-1701. The issue of the 'workman-like' language is mentioned by the editor of the printed edition of Van Dam, *Beschryvinge*, 453, footnote 3, retrievable through http://www.inghist.nl/retroboeken/vandam/#1:492

beams from wood from Münster, or – if not available – from wood from Berlin or Rhineland. Wood from Berlin and Silesia was again used for the inner keel; knees were made of wood from the Weeser or Eyder area. Whales were made of Berlin wood, or – if not available in sufficient length – from Rhineland wood; the curved parts of the whales came also from the Rhineland. In general, wood from the Münster area was considered superior to that from the Rhineland area. All planks came from Berlin or Hamburg. Pinewood was used for masts, yards and decks, while cheaper fir was considered suitable for the galley, cabins and other accommodation. Oak kegs were manufactured in the Zaan area. The detailed descriptions in Van Dam's book concerning which type of wood should be used, and more specifically from which area, for certain parts of the ships suggest an extensive experiential know-how of the master shipwrights, built up and handed down over many years. In addition, there are suggestions regarding the best time to have the trees cut down, and on how to prevent rot setting in in tropical conditions.[10]

Not only wood had to be imported and stockpiled. Raw materials like iron, hemp and resin and products like sailcloth came mostly from abroad as well. In the case of iron nails, there was a preference for having them made locally from Swedish iron, which was considered much stronger and easier to handle than nails from Liège in the Southern Netherlands. Anchors were made from an alloy of Spanish and Swedish iron. Dutch hemp was used for making ropes; sails were constructed from Dutch or French sailcloth. Resin from France, mixed with sulphur from Sicily, was made into a coating as a remedy against shipworm. Tar for treating parts of the hull was imported from Russia.[11]

Therefore, prior to the construction of the ships that were to be used in the (pre-) colonial accumulation process carried out by the VOC, a knowledgeably informed material process of accumulation had to take place that relied heavily on the Dutch trade patterns that had been established during the sixteenth and early seventeenth century. The geography of material accumulation can be placed within the context of Dutch trading relations in general, of which the so-called *moedernegotie*, the trade through the Øresund with the Baltic formed the backbone. For instance, the depletion of forests in Western Europe necessitated a shift towards Northern and (in the case of the VOC) Eastern Europe. Trade with France and Italy belonged to the so-called *Westvaart*, which grew in importance during the seventeenth century; trading with Russia was carried out via the port of Archangel at the White Sea. In effect, it can be discerned that accumulating

[10] Van Dam *Beschryvinge*, 453-456.

[11] Van Dam *Beschryvinge*, 453-456 and S.C. van Kampen *De Rotterdamse*, 50-51.

sufficient materials of prescribed quality at VOC's shipyards depended heavily on an existing, extensive and expanding pattern of trade that existed alongside the VOC, and which was – looking at the volume of trade – always more important than VOC's trade with the East Indies.[12]

4. Accumulation of labour

In its construction, the *retourschip* was an international phenomenon, built by local Dutch shipwrights from foreign materials imported by the VOC, at a specialized VOC shipyard. Like the materials used to build the ships, sailors and soldiers employed by the VOC largely came from beyond the republic's borders (hailing predominantly from across north-western Europe). The shipwrights, carpenters and other workers at its yards, however, were recruited locally and their jobs were often handed down from father to son. Although the VOC was instrumental in creating an international labour market with possibly the early emergence of a proletariat, these aspects did not apply to the workforce at its yards. Even accounting for the highly organized division of labour at the yards, the high degree of organization through the guild and the political awareness that went along with it – to which one should add the continuing high demand for skilled shipwrights – made it possible for the shipwrights to retain a degree of control at their workplace. Members of the shipwrights' guild, whether boss or labourer, tended to act in a confident, self-assured way, because they were in a rather strong position: they had a reasonably well paid job for most of the year and could count on financial support during sickness and old age. Even with a subsequent separation in place between the design and the building of the *retourschip* (see below), the complexities of the building process itself still prevented a de-accumulation of know-how that would have led to a proletarization of shipwrights.[13]

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[12] On the importance of the *moedernegotie*, see Hans den Haan, *Moedernegotie*, ch. 2. He mentions the depletion of forests on p. 45. On the *Westvaart* and the trade with Russia, see ibid., 46-56. On the importance of tradepatterns, see Jan de Vries & Ad van der Woude, *Nederland 1500-1815*, 577. In the numbers they give in table 10.13, the financial gains from trading within the East Indies do not show up, which amounted to about 50% of VOC's trade within the Republic (cf. table 10.5 and 10.6). The absolute and relative importance of VOC's trade increased considerably during the course of the seventeenth and eighteenth century.

[13] Gaastra, *De Geschiedenis*, 81 gives the percentage of foreigners as 60% in the case of soldiers and 40% in the case of sailors. These numbers are an average over the lifespan of the VOC. The percentages tended to increase in the course of the eighteenth century, for 1770 the numbers are 80% and 50% respectively as mentioned in Lucassen, "A Multinational," 19. On the emergence of a proletariat, see ibid., 33.

The master shipwright supervised eleven foremen for the shipwrights and five foremen for painters, chip collectors, woodworkers, borers and plankers. In his supervision duties, the master shipwright could rely on the help of a foreman and an assistant. Other specialized branches at Oostenburg were supervised by the *equipagemeester*, again via foremen. This concerned specialist jobs such as mast making, small boat building, joining, block-making, sail-making, the smithy, the ropewalk and the gunnery. This demonstrates the horizontal division of the labour mentioned earlier, whereby the results of each specialized unit were ultimately accumulated into each single new *retourschip*.[14]

Working conditions at the VOC-yard in Amsterdam were relatively favourable compared to those at the many private yards in the city. During the course of the eighteenth century, the number of private shipyards was between thirty and thirty-five, the number of yards specializing in breaking up ships amounted to about ten, the number of yards building small boats was approximately fifteen and there existed about five yards specialized in the production of masts. Although the basic salary for VOC-shipwrights was slightly lower than for privately employed shipwrights, if one worked for the VOC one had the advantage of a secure job. Workers at the VOC yard could not be dismissed without a good cause, they were entitled to a good redundancy pay and they were paid a good pension during old age. Furthermore, VOC shipwrights were admitted to the shipwrights' guild even if they had not yet reached the status of master shipwright, an admission that gave access to the social security provided by the guild. About the smaller VOC-yards much less is known than about Oostenburg because of the loss of the resolution books of the four smaller chambers. Some details, concerning the yard at Rotterdam are known, and they suggest that organization, knowledge, materials, labour and methods were accumulated in much the same way as was the case at Oostenburg.[15]

[14] Bruijn, *Dutch Asiatic Shipping* (Part 1), 29.

[15] On the number of shipyards, see A.J. Deurloo, "Bijltjes en Klouwers," 9-10. On the old-age pension and the social security, see Lucassen, "A Multinational," 29. On the situation in Rotterdam, see Peter Grimm *Heeren in Zaken*, 17-23 and Van Kampen, *De Rotterdamse*, 105. Van Kampen carried out research in the Municipal Archives of Rotterdam (G.A.R.), especially in the so-called *Gifteboeken* and the *Archief Fabrieksmeesteren*.

5. Accumulation of methods

The original building method used at Amsterdam shipyards was the 'shell first'-method, as described by Nicolaes Witsen in *Aeloude en hedendaegse scheeps-bouw en bestier* (published in 1671/1690). It implied that first the keel was laid down and the stem and stern put into position. The next step consisted of fitting a number of timbers that were to form the bottom floor of the ship. The third step consisted of positioning a few low moulds on to floor to assist in constructing the transition from the bottom of the vessel to the bilges of the vessel. When that stage had been completed, preliminary frames were positioned on the bottom floor and between the bilges, outlining the vertical lines of the hull. Horizontally across these moulds, the planks forming the hull were fitted. Once the hull had been completed, the definitive frames were put in place, the form of which had to fit in with the hull as it had been created. These procedures offered the shipwrights, engaged in the building process, ample scope to (re)design a ship while building it.[16]

The new system of shipbuilding copied the building procedures in use at English naval shipyards. After the laying of the keel, the 'floors' of the frames were put in place. These floors conformed to the form of the complete frames. On top of these floors, the main frames (also called station frames) were put in place, in two halves. The two halves were linked and locked between the keel and a so-called 'chock' on top of the bottom of the frame. The floors and the main (or station-) frames had been constructed beforehand according to templates, derived from the technical drawings. That stage being completed, a few ribbands (small flexible planks) were mounted horizontally across the frames and then auxiliary frames were placed between the main frames; finally the planking of the hull was completed. In a sense, one could say that – within the building network – the main frames exercised control over the definitive form of the hull, as well as over the shipwrights. Working under the master shipwright, shipwrights were obliged to follow the new designs closely and to use the prescribed form of all main frames (depending on the size of the vessel, between sixteen and twenty-four) exactly as they were inscribed in the design, which led to a decrease in their independence. This shows that the English system of designing and building not only made it possible to control the building of the ship itself right down to the smallest details but also to "control the shipwrights right down to the smallest details." [17] A hybrid

[16] These building methods are described in Witsen, *Aeloude en hedendaagsche scheeps-bouw,* ch. 11 and Witsen, *Architectura navalis*, ch. 11.

[17] A.J. Hoving & Lemmers, *In tekening gebracht*, 33

network encompassed the constructors, the construction method relating to the artefact under construction and, most importantly, the artefact itself. In the original system of shipbuilding, with no drawings available to record accurately what happened (or should happen) during the building process, the building of a second ship of the same dimensions and for the same purpose invariably led to variations in the materialization. This was (to a large extent) solved by the introduction of the new system.

The historian of technology David McGee wrote that until the mid-nineteenth century, the use of 'architectural designs' in ship design was restricted to naval shipbuilding, and that such "plans were used almost solely for the construction of warships". Drawings were used in (naval) shipbuilding because "they promised to save money in construction". The same reasoning can be applied to the building of commercial vessels as well, if the number of vessels that was being built was large enough to offset the costs of the elaborate construction of the drawings. The VOC as owner and builder of (almost all) its own ships – in contrast to the English East India Company, which rented its ships from private ship-owners – can be thought to have had an interest in keeping down the cost of building its ships. This could be realized by a process of standardized production of standard ships. We may therefore suggest that the fact that the innovation of using technical drawings within commercial shipbuilding succeeded at the VOC was – at least partly – linked to its factory-like production of large numbers of similar vessels, making it worthwhile to invest in the time-consuming procedures of drawing measured plans. The obligation to use prescribed frames when building the ships made it almost impossible to deviate from the design, except when shipwrights explicitly started experimenting. The responsibility for controlling whether the master shipwrights followed the prescribed designs was to a large degree delegated to the design itself: inscription turned into prescription. Control over complying with the design changed from supervision carried out by other shipwrights after completion of the ship, to the impersonal frames prescribed by the immutable and mobile design during the actual building process.[18]

Therefore, the master shipwrights became subordinate to the design and – as a consequence of the new building methods – the shipwrights at the yard became subordinate not only to the master shipwright but also to the design. This could give the impression that the local master shipwrights at the six yards of the VOC

[18] On the use of architectural designs in naval shipbuilding, see McGee, "From craftsmanship", 222. On warships, see McGee, "Ships, Science", 35. On the saving of money, see McGee, "From craftsmanship", 226. The introduction of technical design drawings at naval shipyards in the Republic was less of a success-story, De Jong, *Standvastigheid*, ch. 2.

were reduced to just implementing given designs, suggesting that their know-how became less important. However, there is sufficient evidence that at least some of the master shipwrights were actively involved – both on a practical and on a theoretical level – in adapting the existing designs to local constraints (such as shallows), new requirements (such as safely navigating the South China Sea) and to new insights (experimental as well as theoretical) relating to ship design; this again shows the interdependence of mind and hand.[19]

6. Accumulation of immutable mobiles

Looking at the way in which the new design summarized – in a portable and succinct way – the accumulation of diverse modes of know-how and requirements, and disciplined labour and methods, we may interpret it as an 'immutable and combinable mobile', as proposed by Bruno Latour in *Science in Action*. In general, an immutable mobile contains descriptions of relevant know-how and procedures, either in the form of words, maps, templates, diagrams or drawings. Immutable mobiles are two-dimensional inscriptions that have the advantage of being mobile and immutable (while on the move). They are flat, their scale can be modified at will and they are reproducible. Immutable mobiles can be recombined with one another, they can be superimposed on one another, they can be made part of a written text and – as they are two-dimensional – they can be merged with geometry. The last point is especially important in the case of a ship design where three two-dimensional drawings are needed to form a three-dimensional design and to construct a three-dimensional artefact. In the case of the new manner of ship design and shipbuilding at the VOC, the new design reconfigured the relations between organization, know-how, materials, labour and methods and it forged a new and strong link between the six separate, local shipyards of the VOC. The inscription of the design onto paper translated accumulated know-how into an immutable mobile, and – using accumulated materials, disciplined labour and new methods – the design was then transformed into the ships themselves. An immutable mobile functions as an essential go-between in transforming know-how into artefacts. It transports the design (containing accumulated know-how) to various localities over time, it is mobile because of this ability to travel through time and space and immutable in the sense that it stays intact while being moved. However, once such a design has been inscribed, it turns out that details can be changed in a controlled way, producing an adaptation of the original immutable mobile, which may in

[19] De Jong, *Standvastigheid*, ch. 4.3.

due course again show its openness to flexibility. This was in fact shown by the changes (sometimes small and localized, sometimes more far reaching and of a general nature) that local master shipwrights of the VOC introduced to the original design. Although the possibility to adapt the design may seem at odds with the adjective 'immutable' we can already detect a degree of flexibility within Latour's own introduction of the concept, and within the examples he gives. So while an inscription on paper may indeed be considered immutable, it is not set in stone or carved in wood. [20]

The presence of technical design drawings of ships, dating from the eighteenth century, in a library in the twenty-first century signifies both their mobility and their immutability. But then again, this does not imply that designs are immune to modification or re-interpretation. On the contrary, precisely the fact that the design was inscribed made it possible to write comments in the margin and change details as a result of changing requirements or experiences of users, leading to a (re)new(ed) immutable mobile. (This very essay shows how such an inscription can be used in a way totally unforeseen by the original producer.) Therefore, a degree of flexibility is inherent to an immutable mobile. Realizing that such flexibility exists when moving from one manifestation of an immutable mobile to the next, it feels appropriate to use the word immutable to describe that within a given set of inscriptions the content is indeed unassailable. As far as the adjective "combinable" is concerned, Latour points to the combination of several separate immutable mobiles but in the case of technical drawings for a ship design, combinability is an essential part of the design itself. The three two-dimensional drawings that make up each design need to be combined to produce the three-dimensional artefact. The immutable mobile made it possible to better master the design and the underlying know-how, helping to "accelerate the accumulation cycle".[21]

Latour writes that calculations relating to an immutable mobile are performed in a specific centre of calculation, that such calculations are additional to an already existing immutable mobile and that they belong to the next degree of abstraction. Although Latour implicitly acknowledges that some calculation could

[20] The 'immutable and combinable mobile' is introduced in Latour, *Science in Action*, 227. Latour abbreviates the phrase to 'immutable mobile'; see also Latour, "Visualisation", 7-13, 18-24. On the merging with geometry, see Latour, "Visualisation", 18-20. For Latour's example of the construction of the map of Sakhalin, see Latour, *Science in Action*, 215-219. His example of preprinted observation forms, supposedly used by Tycho Brahe, has been challenged by Gorman http://www.stanford.edu/group/STS/immutablemobile.htm

[21] Regarding the flexibility of the immutable mobile, in another context, the term "fluid mobile" has been coined by M. de Laet & A. Mol, "The Zimbabwe Bush Pump". The aspect of acceleration is mentioned in Latour, *Science in Action*, 228.

already be needed in the construction of the immutable mobile itself, when he writes on the modification of the scale of inscriptions, he seems to overlook the possibility that – once an original immutable mobile has been established – further calculation could be needed on the path towards producing an artefact on the basis of this immutable mobile. So while Latour is engaged in describing a process of increasing abstraction, taking his immutable mobile as his point of departure, the process of constructing artefacts with the help of immutable mobiles – and in doing so, being engaged in a process of increasing concretization – is missing in his reasoning.[22]

In the particular case of ship design we can already discern a process of calculation in the scaling down of the dimensions of the proposed ship to make it fit on a conveniently sized piece of paper, and we can imagine the mathematical calculations that are needed to design the mainframes in such a way that the three separate two-dimensional drawings fit seamlessly together into a three-dimensional artefact. The actual building of the ship entailed another stage of calculation, performed at a local (and not at a central) centre of calculation, i.e. the local loft where the design was faithfully enlarged to its proposed dimensions and made into templates that could be used over and over again. We may interpret these templates as other examples of an immutable mobile, although in a sense more artefactual and less flexible, as they were no longer written or printed on paper but were made of wood to render them more durable. Their immutability was therefore increased and their flexibility decreased while their mobility was limited to the yard itself. That means that on the one hand there is a movement within a centre of calculation towards more abstract (and in the case of ship design) scaled-down immutable mobiles, moving away from the actual artefacts, and on the other hand there is also a movement back to the work floor where the design is being transformed into a ship. It is interesting to note that in addition to the flat, two-dimensional design drawings each shipyard of the VOC was also supplied with scaled-down three-dimensional models of the design. This suggests that the transformation from drawings on paper to a ship built of wood may have been considered as not completely straightforward.[23]

In the case of the design of *retourschepen*, we can therefore discern immutable

[22] On centres of calculation, see Latour, *Science in Action*, 232-237; on the modification of the scale of inscriptions, see Latour, "Visualisation", 19.

[23] Two of these models – made by Bentam – survive in the collection of the Rijksmuseum at Amsterdam, one of a 150-ft. charter (MC 502) and one of a 120 ft.-charter (MC 503). (A.J. Hoving & Lemmers, *In tekening gebracht*, 41-42). MC 502 is currently at display at the Amsterdam Historisch Museum.

mobiles on three levels of abstraction; the most abstract and most universal of which is the original two-dimensional drawn paper design, which was translated into scaled-up wooden templates to facilitate the construction of the three-dimensional artefact, a transformation that was assisted by a three-dimensional scaled-down model. This last immutable mobile can be considered as being the most immutable, the least flexible and the least mobile. In contrast to Latour's rather strict definition of what constitutes an immutable mobile, which he applies to explain 'science in action', it seems to be more appropriate here to introduce a continuum between the 'ink-on-paper' immutable mobile proper and a more experiential immutable mobile (such as the templates) leading up to the final artefact. It was in fact this more experiential mobile (and the mainframes derived from it) that was instrumental in disciplining the shipwrights engaged in the building process. These layers of mobiles may also be more in keeping with Latour's concept of hybrids, hybrid networks and quasi-objects, concepts that – through circulation and negotiation – link non-humans and nature with humans, culture and society. In this particular case, they refer to the gradual process that started with the drawing and calculating of the design, led to the building of a vessel and culminated in the different roles that a *retourschip* played.[24]

Ships and Spices: Accumulation on Board

1. The retourschip as an accumulated hybrid

The design and building of a *retourschip* as described before, shows the workings of the VOC as a large (technological and proto-capitalistic) enterprise within the Republic, in its accumulation of know-how, its use of foreign materials, of prefabricated parts and of a local workforce, resulting in a single, complicated artefact based on the immutable mobile of its technical design drawings. We can see a *retourschip* as an outcome of an extensive network, a network that is hybrid in character because it contains both human actors and non-human actants, none of which were fully subservient to the others.

The *retourschip* itself was hybrid in character as well. We can see these ships as 'quasi-objects', implying that they were neither objective things-as-such because they were produced through hybrid networks, nor were they the shapeless results of social categories because they possessed definite thing-like qualities.

[24] On the disciplining of drawings, see also Ken Alder, "Innovation", 282-283. The concepts of hybrids, hybrid networks and quasi-objects are introduced in Latour, *We have never been modern.*

Figure 2 The yacht of the VOC chamber Rotterdam greets a retourschip of the chamber Rotterdam and an man-o-war at the roadstead of Hellevoetsluis (appr. 1790). The retourschip is the vessel in the middle of the picture. Painting by Jacob van Strij (1756-1815).

These quasi-objects (the result of the interconnectedness of nature and society) moved seamlessly between the poles of nature and society, or – to use a different phrase – they continuously connected these poles by connecting the Dutch Republic with the East Indies, negotiating the high seas and serving the commercial interests of the VOC. In the way the *retourschip* fulfilled its role, it showed itself to be a mutable mobile; mobile because – on average – it travelled for years halfway across the globe, mutable when we consider the difference in what was accumulated in its hold on the outward and on the homebound journey, and mutable also when we see how different routes were chosen on the outward and homebound voyage, how its crew differed on the way out and on the way back, and mutable in the different purposes it served going and coming. It was this mutability, housed in a ship whose design was (as we have seen) immutably flexible – in a dynamic balance between innovation, standardization and adaptation – that allowed for the very circulation by which the VOC (as a centre of accumulation served by its ships) could become strong.[25]

A *retourschip*, as was usual in the case for large ships, had two complete

[25] On thing-like qualities, see Latour, *We have never been modern*, 55.

decks, the lower of which was called the *overloop* (orlop or gundeck) and the higher *verdek*. The lower hold, below the *overloop*, was used for stowing goods and provisions, the space between the *overloop* and *verdek* contained accommodation for sailors and soldiers. On top of the *verdek*, another deck was constructed in two parts, the front part at the stem called *bakdek* and the rear part after the mainmast called *halfdek*. On this *halfdek*, the cabins for the officers, merchants and passengers were located near the stern of the ship. The lower part in between these decks was called the *kuil* (waist). In the late eighteenth century, this deck in two halves was turned into a complete deck, called *bovendek* (upper deck). This adaptation came about through a negotiated change to the original design, introduced by a local VOC master shipwright who used the flexibility in the original plans. The sailing plan was made up of a three-mast configuration, the masts being high to take as much advantage of the light winds in the tropics as possible. The yards carried high and rather narrow sails. Only the foresails and the mizzen sail were of a fore-and-aft configuration, the main sails being square.[26]

Every *retourschip* carried building blocks for the construction of an empire, both outward bound toward the East Indies and homeward bound back to the Republic. On the outward journeys, actual building blocks were quite often transported, because the ballast on these trips was made up of large quantities of bricks, ordered by the VOC's officials in Batavia to build the company's premises overseas. However, other materials, goods and persons can be interpreted as (metaphorical) building blocks as well. Precious metals, soldiers and sailors carried on the way out, and spices, coffee, tea, textiles and porcelain carried on the way home, all contributed to the building of the VOC's empire. The interactive roles played by the *retourschip* within the VOC will be discussed in this section.[27]

2. Outward-bound accumulation

Before a *retourschip* could set sail, it had to be completely manned, equipped and stocked up for the journey to the East. In addition, navigational tools had to be made available. These tools included navigational instruments such as octants

[26] On the negotiated change, see B.E. van Bruggen, "Schepen", 32 and De Jong, *Standvastigheid*, 104-107. On the configuration of sails, see Van Bruggen, "Schepen", 42-44.

[27] In the local museum in Geraldton (Western Australia), the original prefabricated, classicistic gateway can be seen that was carried as ballast in the bilges of the retourschip Batavia. In the maritime museum in Fremantle (Western Australia), the reconstructed original stern of the retourschip Batavia sits on yellow cobblestones, also carried as ballast. See also Mike Dash, *Batavia's Graveyard,* 69.

(imported from England), maps that were supplied by the cartographic department of the Amsterdam chamber of the VOC and extensive and detailed route-descriptions. The VOC committee for secret affairs was entrusted with the task of determining and prescribing the best sailing routes for the fleets. These routes were dependent on the time of departure and on the direction of travel; they were based on the accumulation of know-how and experiences of the skippers of the VOC. Skippers were obliged to keep an extensive log and, upon his return, every skipper was obliged to hand in his log. These logs served two purposes: firstly they could be used to see whether skippers had stuck to the prescribed rules and regulations, and secondly their experiences found their way into the descriptions and onto the maps produced by the VOC.[28]

A result of this accumulated know-how can be seen in the detailed description of the outward route from the Republic to Batavia. After travelling either through the English Channel or around the north of Scotland, the *retourschepen* had to follow the so-called *wagenweg/karrepad* (cart track), a route that guided them across the equator in the Atlantic Ocean. After rounding the Cape of Good Hope (where a stopover became obligatory from 1616 onwards), skippers were then obliged to steer an easterly course towards *Hollandia Nova* as the west coast of Australia became known at that time. This route (prescribed from 1617 onwards) was based on the discovery of Hendrick Brouwer, who explored it on a voyage to the East Indies in 1610 when he discovered the westerly trade winds between latitudes 35° and 40°S. These strong and constant winds could save considerable time in comparison with the more westerly routes which were previously used. Having sailed a sufficient distance (approximately 4000 nautical miles) eastwards, the ships then had to change to a northerly course to arrive at the island of Java.[29]

On its outward voyage, a *retourschip* carried large amounts of silver and gold (both as coins and in bullion) to be traded for spices, coffee, tea, textiles and porcelain. The important position of Amsterdam in the international silver and gold trade was of great assistance in the accumulation of these precious metals, which points again – just as in the case of the *moedernegotie* that was mentioned earlier – to the interconnection of different patterns of trade. Each ship also carried

[28] On the import of instruments, see Gawronski, "The Hogendijk Shipyard", 135. The committee for secret affairs is mentioned in Bruijn, *Dutch Asiatic Shipping* (Part 1), 16-17. On surviving maps, see "VOC-glorie: stug, verbleekt en overal gaatjes", newspaper article in NRC-Handelsblad 29 June 2010

[29] On the wagenweg/karrepad, see W. Voorbeijtel Cannenburg, "Het karrepad", 467-471 and Bruijn, *Dutch Asiatic Shipping* (Part 1), 64-66. On Brouwer's route, see Bruijn, *Dutch Asiatic Shipping* (Part 1), 70-72 and http://www.nla.gov.au/exhibitions/southland/Trade-Seynbrief.html

food and drink for several months, calculated to be sufficient for an extended journey to the next port of call, which was usually the Cape of Good Hope. This food (including salted meat) was stored at Oostenburg, where a slaughterhouse existed at the *Zeemagazijn*. A standardized amount of ammunition, related to the number of cannons aboard, had also to be loaded; this ammunition was stored at Oostenburg as well.[30]

In addition to its load of precious metals, supplies and ammunition, a *retourschip* also transported dozens of soldiers and was manned by far more sailors than were actually needed for its voyage. A typical *retourschip* of the largest charter carried up to 120 soldiers and about 160 sailors on its outward voyage. On the return voyage however, it hardly carried any soldiers at all and the number of sailors on board was reduced to less than 110. The soldiers materialized the powers that were bestowed on the VOC by the States-General to act as a state overseas, and these soldiers were obliged to stay in Asia for at least five years. The power embodied by the soldiers was vulnerable, though, through their high mortality in the East Indies, and therefore new soldiers had to be shipped out on a very regular basis. The surplus of sailors on every outward voyage made it possible that sufficient crewmembers would be left for a competently manned return voyage because sailors were almost as vulnerable as the soldiers. As far as sailors were concerned, the inevitable death toll on the way out and the probability that some of them would desert during the outward journey had to be taken into account. Even more important was the fact that almost all ordinary sailors had to stay in Asia to serve a three-year contract by operating ships in the intra-Asian traffic, an occupation they might not survive. Sailors therefore contributed to the building of VOC's commercial empire in the East Indies, not only by operating its *retourschepen* to and from the Republic, but also by contributing to the operation of the local intra-Asian fleet that linked the various factories of the VOC. For the shipping operations in the East Indies, non-*retourschepen* were sailed across with the intention of operating in the East on a permanent basis; the same happened to old *retourschepen* that stayed in the East after several return-trips and even *retourschepen* might have to serve in the intra-Asian traffic in between outward and homebound voyages. In fact, this last use of a *retourschip* highlights another aspect of its mutability, accumulated aspects of which were embodied in the artefact.[31]

[30] For more on the role of precious metals, see Gaastra "De Verenigde Oost- Indische Compagnie"

[31] Numbers of sailors and soldiers given refer to the *Castricum*, a typical example of a large *retourschip*. It was built at the Oostenburg yard for the chamber Amsterdam in 1722, its tonnage being 1150 tons. It made seven return trips to the East, stayed in Asia after its eighth out-

It is possible to see the people, accumulated on board the *retourschepen*, as belonging to two different classes, a class of dispensables (such as soldiers and ordinary sailors) and a class of indispensables (such as merchants, ships' officers, artisans and VOC officials). The rate of return for officers varied between 70 and 80%. In order to be appointed as a ships' officer, one needed to have certain qualifications although the rules were quite different at the six chambers of the VOC. For instance, from 1619 onwards a prospective ships' officer had to pass an exam before he could be employed by the Amsterdam chamber, but it took until 1737 before a similar rule was applied by the Rotterdam chamber. Over time, the content of these exams became increasingly difficult. It took until 1751 before prospective skippers had to sit for a formal exam; before that time skippers just rose through the ranks of officers. In order to pass these exams, one needed to show that one was an experienced seafarer, and that one possessed sufficient (theoretical and practical) know-how regarding navigation. Especially theoretical know-how could be gained by studying books on navigation or by attending classes given by private teachers.[32]

The class of dispensables can be considered as an early example of a national, international and even global proletariat, as these dispensables were not only recruited from rural districts of the Dutch Republic, northwest and central Europe, but – during the latter decades of the eighteenth century – also from Asia. No qualifications were needed if one was to be employed as an ordinary sailor or soldier. Estimates suggest that the VOC – during the two centuries of its existence – recruited half a million sailors and soldiers from the rural districts of the Dutch republic and half a million foreigners. The dispensability of the dispensables is shown by their rate of return, which was between 19 and 30% as far as soldiers were concerned, and between 40 and 60% for ordinary seamen.[33]

During the voyage, both outward bound and homebound, the person ultimately in charge of the *retourschip* was not the skipper but the upper-merchant and his deputy, the under-merchant. While the skipper was still responsible for

ward voyage in 1736, and it was laid up in Batavia in 1743 (http://www.inghist.nl/Onderzoek/Projecten/DAS/voyages?clear=1\&field_voynameship=CASTRICUM.)

Bruijn, *Dutch Asiatic Shipping* (Part 1), 161-167 gives a rate of mortality of between 7% and 15% on the journey from the Republic to Asia, well above the rate of mortality of 4% that was to be expected in the Republic. Bruijn, *Dutch Asiatic Shipping* (Part 1), 169-172 estimates that between half and two-thirds of those staying in the East Indies to serve their contracts, died before they could return.

[32] Gaastra, *De Geschiedenis*, 91.

[33] On these numbers, see Lucassen, "Immigranten", 14-15, Lucassen, "A Multinational", 16 and ibid., 20-24.

matters of navigation and sailing, the merchants could order the skipper to stay in port or to make sail when the interests of the company required. This arrangement of the way the *retourschip* was actually operated mirrors the impression that profitable trade was the first and utmost consideration as far as the VOC was concerned.[34]

3. Homebound accumulation

On the return voyage the *retourschepen* were heavily loaded, if not overloaded with spices and other merchandise. Moreover, ships could be in poor condition because of their stay in the tropics, especially if they had been used for traffic within Asia between their outward bound and homebound journey. Quite remarkably, no major repairs were carried out in Batavia. As mentioned earlier, the homebound crew was much smaller than the crew on the outward trip. The combination of a smaller crew and heavily loaded ships in a rather poor state of repair made the homebound voyage much more dangerous; the number of ships that perished on the voyage home was at least twice the number of the ships wrecked on the outward voyage. In addition to diseases such as scurvy and typhus that were rife on both the outward and homebound voyage, tropical diseases such as beriberi and malaria exacted an extra toll on the homebound voyage. On these voyages, the *retourschepen* sailed from the Sunda Strait (between Java and Sumatra) towards the east coast of Madagascar, taking advantage of the prevailing south-easterly winds, and then on to the Cape of Good Hope. Because of the winds and currents along the western coast of Africa, the ships were then able to follow the African continent more closely than had been possible on the outward leg of the journey, as had been borne out by the accumulated know-how based on earlier voyages.[35]

On the outward voyage the *retourschip* acted as a building block for the construction of the VOC's empire overseas. On the homeward voyage the *retourschip* was a floating, overloaded warehouse full of spices, coffee, tea, textiles and porcelain promising large profits for the company and in that way again acting as a building block for the construction of the VOC's empire in the Republic. While on the outward journey the ships acted as people carriers (apart from their ballast and a considerable amount of precious metal), for the homebound voyage the ships changed character and turned into cargo carriers, manned by as minimal a

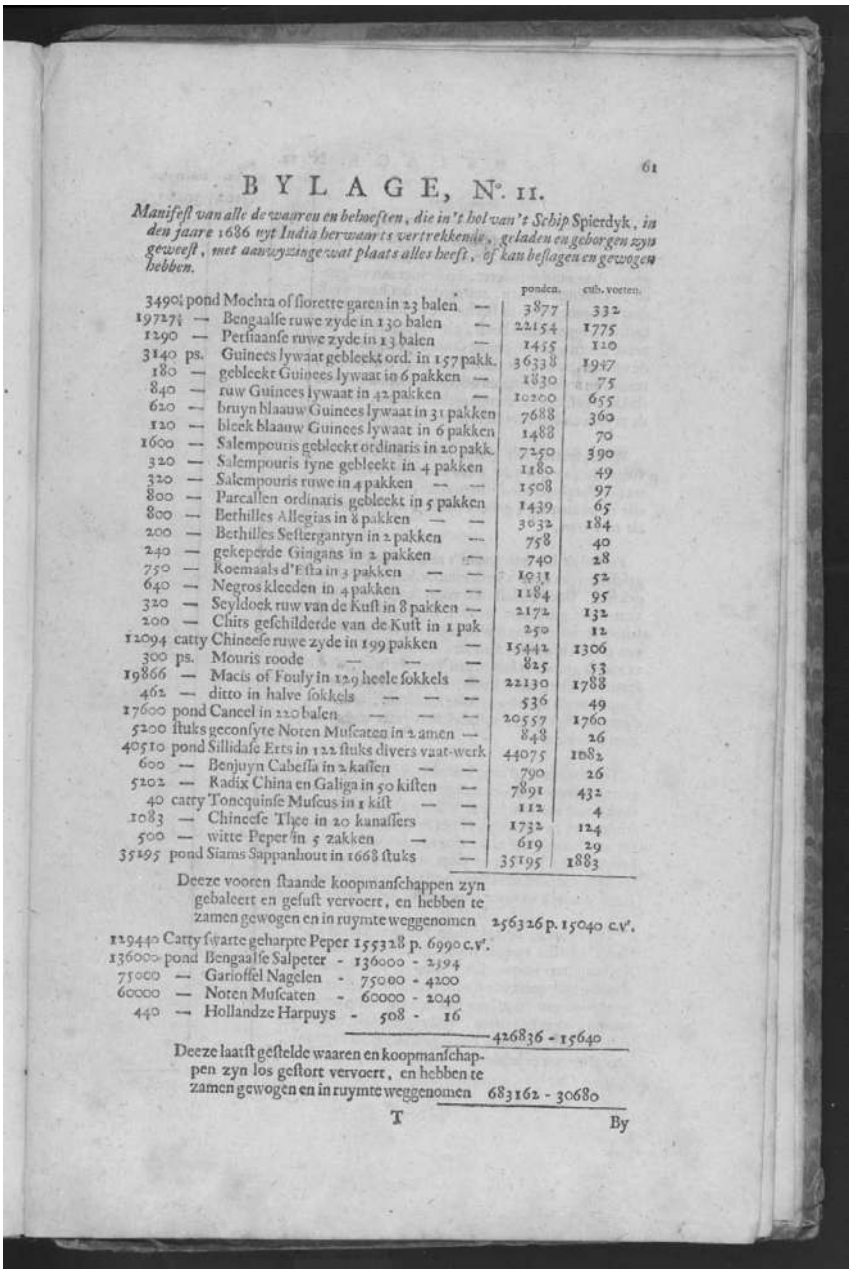
[34] Dash, *Batavia's Graveyard,* 3-4.

[35] On repairs, see Bruijn, *Dutch Asiatic Shipping* (Part 1), 90. For actual numbers regarding the risks on the homebound journey, see Bruijn, Dutch *Asiatic Shipping* (Part 1), 75 (Table 13) and 91 (Table 22).

crew as possible. This change in character shows a significant mutability of the ship as a mobile construction, a mutability that was closely connected with the different character of what was accumulated below decks in the *retourschepen*. However, in addition to the carrying of cargo, during the late eighteenth century the retourschepen started to export people from the East Indies as well. A rising death toll occurred among Europeans in the East Indies during the course of the eighteenth century, and this not only made the employment of Asian seamen a necessity on the ships working the intra-Asian traffic of the VOC (apart from the already large numbers of local ships and skippers employed in that traffic), it also led to the employment of Asian seamen on the *retourschepen* bound for the Republic. These seamen then returned on the next outward-bound fleet. Upon arrival in *patria*, the value of the cargo was almost three times as valuable as the amount of precious metal and other goods shipped out. An example of such a cargo is given in figure 3, which shows a list of the cargo in the hold of the vessel *Spierdijk*, on its trip from the East Indies back to Republic to the value of 329,500 guilders (as valued at the time).[36]

After the return of the *retourschepen*, another phase in the accumulation process got underway: the cargo was transferred to the *Zeemagazijn* (and the smaller storehouses of the other chambers) while waiting for the auctions to take place. The incoming cargo was the result of a complicated and extended ordering process that had begun three years earlier. Each year in spring, the *Heeren XVII* would make a preliminary decision on the number of ships to be dispatched in the coming shipping season. In late summer or early autumn, the returning fleet appeared in the roadsteads and in September the *Heeren XVII* decided upon the auctioning of the goods in the six chambers, concerning both dates and conditions. They also made a final decision on the number of ships, the number of personnel and the amount of goods that were to be sent out during the coming shipping season (i.e. from September of that year until June of the next year). In doing so, they responded to information that had just come in from Batavia. At the same time, they would also settle provisionally the value of precious metal that should be sent over, what goods should be ordered from overseas and in what quantities they should be ordered. Final decisions on these matters were taken after the results of the auctioning became known, which was usually not before November. However, during the eighteenth century it became increasingly the case that the Heeren XVII made a final decision on goods and quantities during the next spring. This meant that the time between the ordering of goods and the arrival of these

[36] Lucassen, "A Multinational", 20-24.



61

BYLAGE, N°. II.

Manifeſt van alle de waaren en beloeſten, die in 't hol van 't Schip Spierdyk, *in den jaare 1686 uyt India herwaarts vertrekkende, geladen en geborgen zyn geweeſt, met aanwyzinge wat plaats alles heeft, of kan beſlagen en gewogen hebben.*

			ponden.	cub. voeten.
3490½ pond	Mochta of ſiorette garen in 23 balen	—	3877	332
19727½ —	Bengaalſe ruwe zyde in 130 balen	—	22154	1775
1290 —	Perſiaanſe ruwe zyde in 13 balen	—	1455	110
3140 ps.	Guinees lywaat gebleekt ord. in 157 pakk.		36338	1947
180 —	gebleekt Guinees lywaat in 6 pakken	—	1830	75
840 —	ruw Guinees lywaat in 42 pakken	—	10200	655
620 —	bruyn blaauw Guinees lywaat in 31 pakken		7688	360
120 —	bleek blaauw Guinees lywaat in 6 pakken		1488	70
1600 —	Salempouris gebleekt ordinaris in 20 pakk.		7250	390
320 —	Salempouris fyne gebleekt in 4 pakken		1180	49
320 —	Salempouris ruwe in 4 pakken	— —	1508	97
800 —	Parcallen ordinaris gebleekt in 5 pakken		1439	65
800 —	Bethilles Allegias in 8 pakken	— —	3032	184
200 —	Bethilles Seſſergantyn in 2 pakken	—	758	40
240 —	gekeperde Gingans in 2 pakken	—	740	28
750 —	Roemaals d'Eſta in 3 pakken	— —	1931	52
640 —	Negros kleeden in 4 pakken	— —	1184	95
320 —	Seyldoek ruw van de Kuſt in 8 pakken	—	2172	132
200 —	Chits geſchilderde van de Kuſt in 1 pak		250	12
12094 catty	Chineeſe ruwe zyde in 199 pakken	—	15442	1306
300 ps.	Mouris roode	— — —	825	53
19866 —	Macis of Fouly in 129 heele ſokkels	—	22130	1788
462 —	ditto in halve ſokkels	— — —	536	49
17600 pond	Cancel in 220 balen	— — —	20557	1760
5200 ſtuks	geconſyte Noten Muſcaten in 2 amen	—	848	26
40510 pond	Sillidaſe Erts in 122 ſtuks divers vaat-werk		44075	1882
600 —	Benjuyn Cabeſſa in 2 kaſſen	— —	790	26
5202 —	Radix China en Galiga in 50 kiſten	—	7891	432
40 catty	Toncquinſe Muſcus in 1 kiſt	— —	112	4
1083 —	Chineeſe Thee in 20 kanaſſers	—	1732	124
500 —	witte Peper in 5 zakken	— —	619	29
35195 pond	Siams Sappanhout in 1668 ſtuks	—	35195	1883

Deeze vooren ſtaande koopmanſchappen zyn gebaleert en geſuſt vervoert, en hebben te zamen gewogen en in ruymte weggenomen 256326 p. 15040 c.v'.

129440 Catty	ſwarte geharpte Peper 155328 p. 6990 c.v'.			
136000 pond	Bengaalſe Salpeter	- 136000	- 2394	
75000 —	Garioffel Nagelen	- 75000	- 4200	
60000 —	Noten Muſcaten	- 60000	- 2040	
440 —	Hollandze Harpuys	- 508	- 16	
			426836	- 15640

Deeze laatſt geſtelde waaren en koopmanſchappen zyn los geſtort vervoert, en hebben te zamen gewogen en in ruymte weggenomen 683162 - 30680

T By

Figure 3 List of the cargo, carried in the hold of the retourschip Spierdijk, as published in Hendrik Decquer, Middelen om uit te vinden de ware ladinge der Scheepen na hare grootte (Amsterdam(?), 1688/1690). Collection of the Universiteitsbibliotheek Amsterdam (UvA) Bijzondere Collecties (OTM OF 63-315)

goods could easily be more than two years. If a request for goods could be made in the autumn of any given year, than the ships carrying the order would arrive in Batavia between August and September of the next year, which made it possible to send the requested goods to the Republic with the fleet that left from November onwards, arriving back in *patria* in the late summer or the early autumn of the year after. This meant that it took at least two years at a minimum before an order arrived back in the Republic. However, sending definite orders in spring meant that the ships carrying the orders would arrive in Batavia as the returning fleet was about to leave, implying that the dispatch of these orders had to wait for the returning fleet of the next year. This meant that it took about two and a half years before the ordered goods were received. These complicated and time-consuming processes meant that accumulation and storage on a large scale had to take place within the *Zeemagazijn* at Oostenburg and within the smaller storehouses of the VOC to be able to satisfy customer demand, an accumulation that in due course turned out to be too much for both the *Zeemagazijn* and the VOC.[37]

Drawings, Ships and Spices: Accumulation Through (Im)mutable Mobiles

In the section on 'Drawings and Ships', the use of technical drawings – introduced at the shipyards of the VOC during the 1740s – was interpreted as the culmination of the processes of material, experiential and intellectual accumulation that had been going on for decades. These drawings for a new design of *retourschip* were interpreted as an immutable mobile, or in fact as a succession of three immutable mobiles. When following the route from 'scaled-down two-dimensional design on paper' through 'real-size two-dimensional wooden templates' towards 'scaled-down three-dimensional wooden models', it was argued that an increase in immutability and inflexibility went along with a decrease in mobility. However, flexibility inherent in the character of an immutable mobile granted local shipwrights space and opportunity to adapt the existing design to changes in requirements, constraints and insights, and to embody these changes in the immutable mobile of the design. When looking at the *retourschip*, constructed with the help

[37] On the value of cargos, see Gaastra, *De Geschiedenis*, 137 (Tabel 19) and 147 (Tabel 21). The list, as depicted in figure 3, was published by Hendrik Decquer, *Middelen*. Details on this trip of the *Spierdijk* can be found through http://www.inghist.nl/Onderzoek/Projecten/DAS/detailVoyage/96735. From the 1750s onwards, preliminary decisions on numbers of ships were referred to a committee (the *Haags Besogne*) meeting in The Hague in spring. For more details on the timeframe of the ordering process: Gaastra, *De Geschiedenis*, 151-155.

of these sets of immutable mobiles, it was shown that the artefact itself was to a high degree immutable and at the same time displayed a high degree of mobility.

In the section on 'Ships and Spices', it was argued that a *retourschip* can also be seen as a mutable mobile. Each part of a roundtrip displayed a different character. On the way out, these ships carried an accumulation of building blocks of three different types: physical building blocks, precious metal and (probably most importantly) dispensable persons needed to maintain the VOC's monopoly overseas and to run its overseas shipping operations. Therefore, on the outward journey a *retourschip* can be characterized as being predominantly a people carrier. On the way home, each *retourschip* carried a complicated accumulation of highly diverse goods, products and produce to serve the interests of the company in the Republic. Room to transport this merchandise was created by running the ships with a minimal crew, which had the added bonus of requiring fewer supplies than on the way out. Rather cynically, we might say that the death toll that occurred among the (dispensable) common seafarers while they were serving their contracts with the VOC was quite convenient in this respect. The possibility to operate these ships with a (relatively) small crew was built into the original design, again showing the intricate connection between human actors and non-human actants. On the homebound voyage the character of the ships thus changed into that of a cargo carrier, manned by as small a crew as possible.

When trying to square the paradox of immutability and mutability residing in the same artefact, a solution lies in interpreting the *retourschip* as a quasi-object, thereby making use of its hybrid character. In fact, the retourschepen are in a double sense hybrid, both as artefacts brought forth through the collaboration among human and non-human actors and also in terms of the hybrid activities in which the ships engaged. This leads to a re-considering of the (im)mutability of mobiles, related both to the construction and to the use of the ships. Combining the thing-like qualities of the ships with the VOC's demands for standardized ships required immutability. At the same time, the comings and goings of the *retourschepen* as mediators between the poles of nature and society depended on the artefact's essential mutability. Of course, they had to be sturdy, seaworthy, innovative and standardized, but such qualities were not ends in themselves. To fulfil the roles appointed to them, they needed to change character between outward voyage and homebound voyage; to put it in other words, they showed different aspects of the hybrid character with which they were endowed. The immutable and mobile character that the *retourschip* displayed as a constructed artefact was complemented by the mutable mobile character of its use: mobile in the sense that it sailed back and forth between the Republic and the East Indies, mutable in the sense that to

fulfil its role it had to change the character and the content of the accumulation that took place below decks between the outward bound journey and the homebound journey. In its mutable mobility, the quasi-object *retourschip* displayed its second level of hybridity, through which it could connect the Republic and the East Indies in different capacities, going and coming.

The *retourschip* mirrors the activities of the VOC in a dynamically interactive way, linking two networks of accumulation. On the one hand, it occupied pride of place in the centre of a constructive network through the immutable mobile of its design that was in turn inextricably linked with the building methods and the accumulation of materials and know-how centred on Oostenburg. On the other hand it was the centrepiece of a extensive and complicated trading network through the mutable mobility on its journeys, leaving Oostenburg with people, ballast and precious metals and returning to Oostenburg with an impressive array of Asian produce and goods, to be accumulated again in the huge storehouse that had contained most materials for its inception and equipment before it took to the seas.

Mennonite Centres of Accumulation: Martyrs and Instruments

Ernst Hamm

Mennonites Accumulate

In its Golden Age the Dutch Republic, especially Holland, was *the* great centre of global accumulation; yet as the essays in this volume show, the Low Countries were a globally important centre of accumulation throughout the early-modern period, composed of and networked with a broad variety of more specific centres of accumulation and exchange. A group that stands out in this history, both in terms of setting accumulation in a context of material and cultural growth (and decline too) and in terms of pondering its religious and moral dimensions, is the Dutch Mennonite community. Mennonites were highly successful in manufacture and trade, and they made use of the advantages afforded by technological innovations. Mennonites also made important contributions to Dutch cultural and intellectual life, especially in the eighteenth century, through their sponsorship of improving societies, their work in the book trade, by building gardens, and endowing a major museum. Despite the challenges they faced as a dissenting minority in a predominantly Calvinist country, they were deeply entwined in Dutch economic developments and Enlightenment culture.[1]

This essay considers two centres of Mennonite accumulation, one from the pinnacle of the Golden Age, the other from the second half of the eighteenth century. The first is an accumulation of Anabaptist martyrs, the *Martyrs' Mirror*, originally published in 1660. The second, the eighteenth-century centre, was until very recently wholly forgotten, though in its time it was well-known and more recently has been brought to the attention of historians of science: it is a collection

[1] See the references to Mennonites in Jacob and Mijnhardt, *Dutch Republic*; the essays in Hamilton et al., *From Martyr*; on wealth see Sprunger, "Waterlanders"; on the book trade Visser, "Blasphemous" and Visser, "Redelyke regtzinnigheid"; on gardens De Jong, "Nature and Virtue;" on the major museum Sliggers et al., *De idealen* and Teylers Stichting, *Teylers*.

of scientific instruments assembled at and for the use of the Mennonite Seminary in Amsterdam.[2]

What could a book, a compilation of accounts of people who died for their faith possibly have in common with a seminary's cabinet of scientific instruments, many of which were specially manufactured by the most skilled instrument makers from Amsterdam and London, save that they were both assembled by Mennonites? Despite their very different purposes, origins and trajectories, both of these centres of accumulation are valuable for understanding Mennonite attitudes to and worries about accumulation; they are also telling of broader Dutch concerns about accumulation. These centres are revealing about the way knowledge circulated, found some stability, and how and why a centre of accumulation dissolved—for the *Martyrs' Mirror* is still very much with us, but the cabinet of scientific instruments assembled by the Seminary has been gone since the early nineteenth century. Finally, a focus on accumulation and centres of accumulation can be useful for historians who wish to avoid the distortions that may accompany reading the past through the prism of post-Enlightenment (or Enlightenment) categories which sunder all too sharply the activities of seventeenth and eighteenth-century Mennonites (or Calvinists, or Catholics, or any other confession) into sacred, theological, confessional on the one hand and secular, economic, scientific on the other. Rather we should look at the period and the events in question as part of larger historical processes that ultimately created dichotomies such as 'science' and 'religion', 'economy' and 'society'.

Mennonites, *The Bloody Theatre*, Accumulation, Legitimation

Mennonites have their origin in the Anabaptist movement, sometimes known as the radical or left wing of the Reformation, in early sixteenth-century Switzerland. Early Anabaptism was a highly differentiated movement that rapidly spread to various parts of the German-speaking world and the Low Countries, where in 1536 a Dutch Catholic Priest, Menno Simons, converted and became an important early Anabaptist leader, hence the name Mennonites. From the start Anabaptism in its various forms was something other than a creedal faith and any attempt to create an idealized version of Anabaptism against which all the variants can be compared is bound to fail, but some unifying threads did emerge: Biblicism—in the absence of a common body of inherited dogma the Bible was authoritative; pacifism (Matthew 5: 43-44) was not universal among early Anabaptists, but it was prominent among many and eventually spread through the movement; the refusal to take

[2] Zuidervaart, "Meest alle van best mahoniehout vervaardigd."

any kind of oath (Matthew 5: 33-37); adult baptism only for those who chose it. The refusal to take oaths amounted to a rejection of the authority of the state. The rejection of infant baptism represented a strong voluntarism that was also evident in the absence of a church hierarchy among Mennonites; it also amounted to a rejection of the authority of those churches (Protestant and Catholic) that invested the temporal powers with transcendent authority. This was not lost on the authorities, some of whom considered Anabaptism at best suspicious, at worst seditious. Mennonites had the distinction of being a Christian group that was persecuted and kicked out, or kept out, of any number of Christian states (one of the few things early to mid sixteenth-century Catholics, Anglo-Catholics, Calvinists, and Lutherans could agree on was the danger of Anabaptists). By the mid 1570s, after some decades of very intense persecution, the United Provinces tolerated Anabaptists, Mennonites or *Doopsgezinde* (literally, baptism-minded, as they eventually came to be known), who were quite happy to accept the accompanying prohibition on holding administrative and judicial offices and political and military functions.[3] Many settled in rural areas and took up agriculture; others settled in cities and took to commerce, which turned out to be fortuitous, given the winds of capitalism were beginning to stir and would by the seventeenth century be filling the sails of the Dutch Republic.

It was just at the point when the Golden Age was in full sail that we see the appearance of the *Martyrs' Mirror*, a work that has without contest become the most important and well-known Mennonite book. Its author-compiler-editor, Tieleman Jansz van Braght (1625-1664), was a cloth merchant, preacher, church elder and vigorous debater who made his career in Dordrecht, where he was a member of the so-called Flemish Mennonite church. The long title of the first edition of the work, published in Dordrecht in 1660, is *The Bloody Theatre of Baptism-Minded and Defenceless Christians Who Suffered and Were Killed for the Testimony of Jesus Their Saviour, from the Time of Christ until the Present: Together with a Description of Holy Baptism and Other Articles of Faith as Practiced Throughout that same Time*.[4] Weighing in at roughly 1300 large quarto pages, the *Martyrs' Mirror* is divided into two parts: the first treats the period from Jesus through the fifteenth century; the second much larger part (890 pages) covers the sixteenth

[3] The three terms are not fully synonymous, though Anabaptist is the most general and *Doopsgezinde* the most specific. See Visser, "Mennonites and Doopsgezinden."

[4] *Het bloedigh tooneel der Doops-Gesinde, en wereloose Christenen: die, om het getuygenisse Jesu hares salighmaeckers, geleden hebben, en gedoodt zijn, van Christi tijdt af, tot dese onse laetste tijden toe: Mitsgaders, een beschrijvinge des h. doops, ende andere stucken van den godsdienst, door alle de selve tijden geoeffent*.

and seventeenth centuries and presents what amounts to a history of Anabaptist martyrs. The crucial changes of the second edition, published in 1685 in Amsterdam, lie not in the text (essentially the same as the first save for small additions at the end of Part Two and concerning persecutions of Swiss Anabaptists in 1671), but in the addition of 104 copper-plate etchings by Jan Luyken (1649-1712), the noted Amsterdam illustrator, engraver and poet. The etchings, a number of which do not spare graphic detail, were an important way of making the book more accessible, of marketing it to a wider public. Finally, the title by which the book is now known comes from the subtitle of the 1685 edition: *The Bloody Theatre: Or Martyrs' Mirror of Baptism-Minded and Defenceless Christians...*[5]

Numerous editions followed, many of them making liberal use of the Luyken etchings. Abridged editions appeared in 1699, 1722, 1736 and 1769. The ever-entrepreneurial Leiden printer Pieter van der Aa published an edition of the Luyken etchings with captions in French and English in 1712 (see the discussion of Van der Aa's geographical publishing in Benjamin Schmidt's contribution to this volume) and an Amsterdam edition of the prints appeared in 1738. Dutch editions tapered off in the eighteenth century, just as they began to gather steam elsewhere, especially in North America. The first German language edition, the product of several years of work in Pennsylvania, appeared in 1748: at some 1500 folio pages the *Martyrerspiegel* is alleged to be the largest publishing project in the history of the thirteen colonies. The German edition was the basis of the first English translation, also published in Pennsylvania, in 1837. Many German and English editions followed the first translation, including in 1886 an English version based on the 1660 Dutch edition. The 1886 version has, in turn, served as the basis for subsequent English editions (there are at least a dozen), the most recent of which is currently in print and readily available. By my count there are fifteen German editions, the latest published in 2005 in Canada. The most recent Dutch edition appeared in 1984, a reprint of the 1685 edition on the occasion of the 200th anniversary of the Haarlem Mennonite Church. Since 1984 excerpted or brief abridged editions have been published in Russian, Spanish, French, Chinese and Hungarian. The complete English edition is available online. The book is also the subject of a museum exhibit, "The Mirror of the Martyrs," that has travelled to scores of North American Mennonite centres and is now housed in the Kauffman Museum in North Newton, Kansas. The core of the exhibit is thirty of the original copper etchings by Luyken, found in southern Germany in the 1970s and purchased after long negotiations and, presumably, no small expense by a "group of

[5] *Het Bloedig Tooneel: of Martelaers Spiegel der Doops-Gesinde of Weereloose Christenen...*

friends of the *Martyrs' Mirror*." In 2010, the 350th anniversary of its publication, the *Martyrs' Mirror* was the subject of an academic conference.[6]

Van Braght surely succeeded in his aim of writing "a perpetual remembrance of the steadfast and blessed martyrs."[7] A compilation of the accounts of some 4000 people who were drowned, burned at the stake, hanged, beheaded, buried alive, crucified, left to rot in dungeons or tortured in innumerable ways, it is a most stark reminder of the high price many early Anabaptists paid for their faith, and one need not spend much time browsing through the *Martyrs' Mirror* to understand its longevity among Mennonites. But we should not assume remembrance was the sole concern of Van Braght, and keep in mind that collections and centres of accumulation are polyvalent things (as Rina Knoeff's contribution to this collection shows), a point to which I shall return.

The publishing history of the *Martyrs' Mirror* could be the subject of a substantial article, but that is not the aim here. This gesture to the accumulation of editions, practically all of which were published in places with concentrations of Mennonite populations (the only exceptions are those editions published in England), is telling of the importance that this book has had, and continues to have, among Mennonites. That said, it needs to be understood that Van Braght did not manufacture or market Mennonite martyrology, rather he was working from and, quite literally, accumulating and compiling the work of his sixteenth and early seventeenth-century predecessors, and numerous earlier sources. The *Martyrs' Mirror* is not the work of someone who went through a university apprenticeship typical of early modern scholars, but it is surely a scholarly work and Van Braght's knowledge of Latin, Greek, Hebrew, French and German and his deep erudition proved essential for compiling the accounts of martyrs from earlier sources (many of which were more or less cut and pasted). One cannot expect a work of the sixteenth-century to fulfil the standards of later eras, but the general reliability of the *Martyrs' Mirror* is not in doubt.[8]

The tradition of Anabaptist-Mennonite martyrology goes back to *The Sacrifice Unto the Lord*, a collection of martyrs' letters and songs first published in

6 I have not handled all of these editions, but quite a few, including the first and second Dutch editions, the first German and English editions, the first English translation based on the Dutch and numerous reprint editions. For additional information I have relied on the catalogues of Conrad Grebel University College Library, the University of Amsterdam Library, and Worldcat. The conference, "Martyrs' Mirror: Reflections Across Time," was held at Elizabethtown College, Pennsylvania, 8-10 June 2010.

7 Van Braght, *Martyrs' Mirror*, 13. All quotations are from the 11th English edition (1977).

8 Cramer, "De geloofwaardigheid"; Cramer, "Nogmals de geloofwaardigheid"; see also Gregory, *Salvation at Stake*, 22-23, 355-357.

1562-3; by 1599 eleven editions had been published. As the editions accumulated so did the accounts of the martyrs: the first had twenty-one, the last thirty-three; the first songbook names 135, the last 179. This was not simply a matter of finding more material, for historical analysis of the various editions makes it clear that the editors of *The Sacrifice Unto the Lord* had polemical purposes—not against the Catholics or Calvinists, but against other Mennonites. The split between the Waterlander and all other Dutch Mennonites in 1555-1557 and that between the Frisian and Flemish Mennonites in 1566-67 manifested themselves by the exclusion of Waterlander and Flemish martyrs by the Frisian editors of *The Sacrifice Unto the Lord*.[9] For all that *The Sacrifice Unto the Lord* was primarily a devotional work, written for those who might have to endure suffering and persecution. The last execution of a Mennonite in the northern Netherlands was in Leeuwarden in 1574; in the southern Netherlands the last execution was not until 1597 in Brussels. It was a tiny book, duodecimal in its first edition and easily small enough to be carried with a person. (For the significance of book size, see Arjen Dijkstra's essay in this volume.)

Years after the need for clandestine gathering and worship had ended, the publication of martyrologies continued. Hans de Ries (1553-1638) compiled his *History of the Martyrs or Genuine Witnesses of Jesus Christ*, published in Haarlem in 1615. With over 600 martyrs and 1000 quarto pages it was far more comprehensive than *The Sacrifice Unto the Lord*. De Ries worked against the increasing fragmentation of Dutch Mennonites (by 1600 there were a number of distinct groups: Waterlanders, Old Frisians, Young Frisians, Frisians, Old Flemish, Young Flemish and High Germans, as well as smaller splinter groups) by including a broader perspective of Anabaptist martyrs. His inclusiveness inspired those with a narrower perspective to compile their own martyologies. In 1631 De Ries published his final (rejoinder) edition under the title *Martyrs' Mirror*, with the purpose of showing that the differences between Mennonites were less important than that which they shared and which distinguished them from other Protestants and from Catholics, a position pithily summarized by the historian Brad Gregory: "Anabaptist martyrs belonged to churches that were always oppressed, not to churches that legitimated persecution."[10] For Part Two of the 1660 *Martyrs' Mirror* Van Braght

[9] In the earliest known edition the letters appear in 1562, and the songs 1563, both bound together. For a very helpful discussion of the character of *Het Offer des Heeren*, and for the possibility of a 1561 edition of the work see Gregory, *Salvation at Stake*, 225-235, and 457, n. 149. The terms 'Flemish' or 'Frisian' did not necessarily reflect the geographic location or origins of those variants of Mennonites. For number of martyrs in *Het Offer* see Hege and Van der Zijpp, "Offer des Heeren."

[10] Gregory, *Salvation at Stake*, 243; on distinct groups of Mennonites see Israel, *Dutch Repub-*

acknowledged that he had simply adopted De Ries's 1631 martyrology, adding prefatory material, numerous additional martyrs and corrections.

Besides its comprehensiveness, the innovation that distinguished Van Braght's book from those of his predecessors is Part One, which recounts martyrs from the first through to the fifteenth centuries. The *Martyrs' Mirror* was no longer simply a story of Anabaptists, but an account of their suffering as the most recent chapter in the much longer history of Christian suffering, indeed of Biblical suffering and martyrs, for according to Van Braght the entire Bible, "especially the Old Testament, seems to be almost exclusively, a book of martyrs." The *Martyrs' Mirror* recounts the stories of martyrs, but its purpose was far from singular, for it also speaks to Anabaptist practices and beliefs. In this respect Van Braght expanded on the inclusive approach of De Ries and included martyrs from all the Mennonite and practically all Anabaptist groups. Above all, he gave adult baptism a central place, which is why I have chosen to translate the *Doops-Gesinde* of his title literally, rather than its more typical rendering as 'Anabaptist' or 'Mennonite'. Part One of the *Martyrs' Mirror* is organized century-by-century, beginning with an "Account of Holy Baptism" followed by an account of martyrs for each century. Part Two, concerned almost wholly with sixteenth-century martyrs, follows the same pattern, though in this case the account of baptism appears but once, for the century, as it were, and is accompanied by a lengthy confession of faith dating from about 1600. In fact, the *Martyrs' Mirror* is as much about "holy baptism and that which pertains to it" as it is an "historical account of the holy martyrs who suffered on account of baptism, or, generally, for the testimony of Jesus Christ."[11]

In one very important respect the *Martyrs' Mirror* is concerned with legitimation, a purpose common to many centres of accumulation, be they private assemblages, museums, or histories. Although adult baptism and the concomitant rejection of infant baptism appeared to be sixteenth century novelties, Van Braght argued they had a "succession" (a very Catholic concept) traceable through the entire history of Christianity, capped by the fact that the Bible offers no clear support for infant baptism, but many examples of adult baptism. Adopting a kind of Augustinian argument, Van Braght presented Anabaptists and the practice of adult baptism as part of the "true church," the church "of God and from heaven" and never to be confused with the church "of Satan and from the earth."[12]

The *Martyrs' Mirror* also emphasizes the non-violent character of Anabap-

lic, 395-398; on De Ries see also Gregory, "Anabaptist Martyrdom," esp. 496-501; Gregory, "Persecutions," 272-275.

[11] Van Braght, *Martyrs' Mirror*, 13, 15.

[12] Van Braght, *Martyrs' Mirror*, 21.

tism, and of the "true church," and this is no less a kind of legitimation, though here the inflection was somewhat different than in the case of baptism. Ever since the terrible persecution (or prosecution, from the perspective of the state and the state churches) of Anabaptists in the wake of the Peasant's War of the 1520s and the disastrous occupation of Münster, Mennonites had sought to distance themselves from the so-called Münsterites such as Jan van Leiden (ca. 1509-1536), who wielded the sword and died by it. Some version of the formula 'Mennonites are not Münsterites' appears again and again in Mennonite literature of the seventeenth and eighteenth centuries, and it is hardly surprising that Münsterites (who also tried to take Amsterdam by force and encouraged practices such as polygamy and the communal ownership of goods), found no place in either the *Martyrs' Mirror*, the most inclusive of all Mennonite martyr books, or any other martyrology.[13] Van Braght vigorously rejected any association with "the Münsterites... whose fabulous faith, life and conduct, the true Anabaptists have never recognized." Van Leiden and his ilk were among those who "sanction war and claim that one must propagate and defend his religion with the sword," whereas "true Anabaptists" and Mennonites "speak against it with heart, soul and mind."[14] Over the past several decades historians have challenged the clear-cut distinctions apparent in the historiography of Van Braght. Only by applying retrospective standards of what Anabaptism eventually became can one draw a sharp distinction between early Anabaptists who were willing to use the sword for religious ends and those who were not.[15] In all likelihood it was the hazy and fractious history of very early Anabaptism, and a keen awareness of the fragmentation of seventeenth-century Dutch Mennonitism (and perhaps the fact that Anabaptism remained a capital crime in the Holy Roman Empire, though not enforced as such), that drove Van Braght to make the case, through his accumulation of martyrs, that Mennonites were united by a common history of martyrdom and an Anabaptist identity that rejected violence.[16]

Van Braght also had a polemical purpose that would have been evident to seventeenth-century Amsterdammers, who would have recognized the *Martyrs' Mirror* as a volley in the so-called 'War of the Lambs' (*Lammerenkrijgh*), a dis-

[13] Gregory, *Salvation at Stake*, 216-217.

[14] Van Braght, *Martyrs' Mirror*, 17.

[15] The literature on this is large, with much important work by Hans-Jürgen Goertz and James M. Stayer. For recent work on the relationship between Anabaptists and the Peasant's War see Goertz, "Karlstadt, Müntzer"; Snyder, "Swiss Anabaptism"; Stayer, "Swiss-South German Anabaptism," esp. 83-5; on Münster see Klötzer, "The Melchiorites and Münster."

[16] On Anabaptism in the Holy Roman Empire see Driedger, "Anabaptists," 530-531.

pute within the Amsterdam United Mennonite Church 'bij het Lam' in the 1650s and 1660s between the 'Lamists', who had a broad understanding of their faith and placed more emphasis on practices (such as adult baptism) than confessions, and the more exclusive 'Zonists', who were dedicated to specific 'confessions' that delineated Mennonite faith and practice. As Mennonites assimilated into the mainstream of urban life, 'confessionalism', the making of confessions, became a strategy for maintaining a distinct identity. The Zonists may have felt this need for identity, for they were fully engaged (as were the Lamists) with the larger world through their participation in Dutch commercial life. Van Braght's preface and introduction to the *Martyrs' Mirror* are an exemplar of confessionalism, for they make use of confessions of faith just as the bulk of the work does martyrdom: to place Mennonites in a direct line with the early church, before it became the Church of Rome. This emphasis on confessions was implicitly exclusive, and among those left on the outside was the Lamist Mennonite Galenus Abrahamsz de Haan (1622-1706), who was also an important figure in Collegiantism, a movement that practiced adult baptism, rejected military service, and believed the Gospel should find expression in a life of charity and simplicity. Collegiantism placed no emphasis at all on the various confessions of faith that sought to delineate Anabaptism (and that had such a prominent place in the *Martyrs' Mirror*). Many Mennonites were active in Collegiantism and many Collegiants were involved in Mennonite churches. Despite the emphasis Van Braght placed on a common Anabaptist heritage shared by Mennonites, his emphasis on confessions contributed to a prominent schism in the Amsterdam Lamist church.[17]

Finally, the *Martyrs' Mirror* was intended to serve yet another purpose, one that was clearly aimed at the Golden Age—for the fact is Van Braght had never witnessed a martyrdom and did not claim Mennonites were about to enter another age of persecution; he was fully aware that life in the Netherlands had become "quieter and more comfortable" than it had been. Yet, he insisted, "These are sad times, in which we live; nay, truly, there is more danger now than in the time of our fathers, who suffered death for the testimony of the Lord." Then, he launched into a Jeremiad: in the past "Satan came openly, through his servants, even at

[17] On confessionalism, identity and *Lammerenkrijgh* see Driedger, *Obedient Heretics*, esp. 51-60; the two confessions of Amsterdam (1627 and 1630) and that of Dordt (1632), are reprinted in their entirety and prominently in the preface of Van Braght, *Martyrs' Mirror*, 27-44; on confessionalism and Galenus see Voolstra, "The Colony of Heaven," 22-29, and Meihuizen, "Galenus"; on Galenus's views more generally, Fix, *Prophecy and Reason*, chapter 4. Lamists and Zonists had much in common when compared to Old Flemish Mennonites, see Visser, "Redelyke regtzinnigheid," 216.

noon-day, as a roaring lion"; now he reveals himself "as an angel of light... [and] like a wolf in sheep's clothing, robbing the innocent lambs of Christ of their precious faith."[18] More than ever before, men and women were being deceived by "the lust of the flesh, the lust of the eye, and the pride of life," threefold evils manifested in "corroding and cankering luxury." There is little doubt that Van Braght was attacking overseas trade with the Indies, "that vast and shameful commerce which extends far beyond the sea into other parts of the world" and associating it with the worst sorts of exploitation, hinting at the slave trade: "others defrauded, and they themselves, both in soul and body, stripped and robbed of their possessions." Meanwhile, in the Netherlands people built "[n]umerous, large, expensive and ornamented country houses of splendid architecture... parks magnificent as a paradise." This was undoubtedly a reference to Mennonite country estates along the Vecht and Spaarne Rivers, or the Mennonite houses on Amsterdam's grandest canal, the Herengracht. The problem facing Golden Age Mennonites was not persecution, but accumulation itself.[19]

Instruments and Accumulation

Accumulation, of the very sort Van Braght decried, is not without relevance to early modern and Enlightenment natural knowledge. The tradition variously linking religion (usually some form of Protestantism), the rise of capitalism, and early modern science is long and venerable, represented by Max Weber, Ernst Troeltsch, R.H. Tawney and Robert Merton, among others. Most recently Harold Cook has explained the making of early modern medicine and science with reference to more general Dutch accumulations and circulations. The commercial economy and the exchanges it facilitated between the Indies and Europe via the Low Countries were intimately tied to the taste for new kinds of consumables and collectibles, to art and the appreciation for art, to connoisseurship and accumulations of all sorts: "The intellectual activities we call science emerged from the ways of knowing valued most highly by the merchant-rulers of urban Europe."[20] Cook has little patience with the argument that Calvinism, or any form of Protestantism or Christian practice, played a significant part in making early modern science; the very taste for luxury condemned in the *Martyrs' Mirror* was one of the

[18] Van Braght, *Martyrs' Mirror*, 8.

[19] Van Braght, *Martyrs' Mirror*, 8-9. On Mennonite country estates see De Jong, "Nature and Virtue." On Mennonites in the Dutch East India Company see Sprunger, "Waterlanders," esp. 137-141; whether or not Mennonites were directly involved in the slave trade is an open question. For depictions of mansions along the Vecht see Anon., *De Zegepraalende Vecht*.

[20] Cook, *Matters of Exchange*, 40, 84, 132.

engines driving new ways of describing and knowing about the world. However, despite being associated with a 'plain life' that made Dutch Calvinists look extravagant, Mennonites were active in an economy that thrived on a taste for luxury and connoisseurship. One need only consider the key role that a number of Mennonite families in Amsterdam, Haarlem and Utrecht played in the famous tulip trade of the 1630s.[21] Notwithstanding a sixteenth-century heritage of persecution and harassment, and some continuing marginalization in the seventeenth and eighteenth centuries, Mennonites had become fully integrated actors in Dutch commercial life. In the process some had become an urban elite that would flourish through the eighteenth century. Cook occasionally adopts too sharp a dichotomy between, on the one hand, "Protestant clerics," "rational dogmas" and "the study and worship of God and his ways," and, on the other, "natural knowledge," "the new values of commerce" and "pursuing the facts." Such an approach may appeal to current sensibilities, but it jars against those of the seventeenth and eighteenth centuries. More compelling is Cook's emphasis on "a culture of religious piety rather than doctrine and of excellent educational institutions cheek by jowl with intense commercial activity"—a reference to Carolus Clusius (1526-1609) that also applies to Mennonites who, despite all their many internal disputes, agreed on the need for a pious life and saw no general conflict between piety, commerce and learning.

It was precisely within this context that the second centre of accumulation under consideration in this essay came into being: a cabinet of physical instruments housed in the Mennonite Seminary of Amsterdam. Officially founded in 1735, the Seminary began in 1761 to amass a substantial number of instruments for teaching experimental philosophy (*proefkundige wijsbegeerte* or *proefkundige natuurkunde*). This cabinet did not find its way into a nineteenth-century museum; its best trace is its auction catalogue. Until very recently this catalogue languished, even though it was archived and listed in a published inventory available for well over a century.[22] The catalogue lists all manner of air pumps, magnets, electrical generators, Leiden jars, telescopes, microscopes, optical instruments, balances, and much accompanying paraphernalia, as well as lathes and a variety of mechan-

[21] For a diagram of some of the Mennonite connections in the tulip trade see Goldgar, *Tulipmania*, 152.

[22] 'Catalogus van eene uitmuntende'; first listed in Hoop Scheffer, *Inventaris der Archiefstukken*. Huib Zuidervaart and I consulted it, independently of one another, in the fall of 2005 and early in 2006 respectively; the most complete account of the instruments is Zuidervaart, "Meest alle van best mahoniehout vervaardigd." I am grateful to Zuidervaart for a number of helpful discussions and for his cooperative approach to this material.

ical devices. There was also an actual cabinet for the cabinet and it too was up for auction.

This was not the only seminary with a cabinet. The Quebec Seminary, founded in 1663, began teaching natural philosophy with instruments (that belonged to the instructors) later in the eighteenth and began collecting more systematically in the early nineteenth century, and in 1806 opened a 'museum' that became a physics laboratory. The Jesuit Seminary of Nobles in Madrid began teaching natural philosophy in 1755 and it too had a physical cabinet, one that likely predates the Mennonite one by a few years, but Madrid Jesuits were a long way from Amsterdam Mennonites in all sorts of ways, even if the connections between science in Iberia and the Low Countries are stronger than one might expect.[23] I have not found evidence of any other Dutch seminary of any denomination with a physical cabinet. Given that most eighteenth-century cabinets were in private hands and that professors teaching at universities were generally expected to amass their own instruments for use in teaching, it is not surprising that only a handful of Dutch universities had physical cabinets: Groningen, Franeker, Leiden and Utrecht.[24] All this begs the obvious question: why did the Mennonite Seminary see the need to accumulate a physical cabinet?

Contrary to what one might expect, there is little evidence that physico-theology or natural theology had a prominent place or any formal place at all in the Mennonite Seminary. The author of a study of the examinations written by the seminarians in the eighteenth century was surprised to find no more than a handful of students who took up physico-theological questions.[25] As much as one can distinguish between physico-theology and natural philosophy in the eighteenth century, one searches in vain in the catalogues of the Seminary library for titles that clearly fall in the former category, such as the well known work of Johannes Florentius Martinet, *Katechismus der Natuur* (4 vols., Amsterdam, 1777-1779). Considering that Martinet was writing from within Calvinism, a tradition that treated Anabaptists as unbelievers in need of conversion, it is not surprising to find it absent.[26] On the other hand, outstanding natural philosophers were well-represented: works by Isaac Newton, Gottfried Wilhelm Leibniz, Georges-Louis

[23] For Quebec Seminary see Galarneau, "Demers, Jérôme"; for Madrid see Navarro Brotóns, "Science and Enlightenment," 392-95; a recent international workshop considered the connections: Iberian-Netherlandish Knowledge Exchanges, Barcelona, 27-28 November 2009. See also the contribution by Karel Davids in this volume.

[24] Zuidervaart, "Meest alle van best mahoniehout," 88.

[25] Wit, *Aantekeningen*, 202-203. For a brief discussion of the Mennonite Seminary in the context of the argument from design see Van der Wall, "Newtonianism and Religion," 501.

[26] I thank Rina Knoeff for this observation.

Leclerc de Buffon, Willem Jacob 's Gravesande, Nicolas Malebranche, Christiaan Huygens and René Descartes were all there, as were more contentious works by Thomas Hobbes, Bernard Mandeville and Baruch Spinoza, along with many others.[27]

To understand better why the Mennonite Seminary might have accumulated instruments we need to consider first why there was a seminary at all. Dutch Mennonites grew rapidly in number until the mid-seventeenth century. By the late seventeenth century, when many were settling into something approaching mainstream life, their numbers began to decline. Unlike Portuguese Jews, German Jews, Lutherans, Catholics and other religious minorities in the Netherlands, Dutch Mennonites had no outside group they could draw upon for their preachers and teachers. The need was pressing, especially as Mennonites were ever more following the practice of the Calvinist majority of paying their preachers, who were expected to have some sort of training in their art.[28] A seminary was needed and it was Galenus Abrahamsz de Haan who turns out to be its unofficial *Urvater*. Perhaps the earliest mention of the need for a seminary is in the archives of the Amsterdam United Mennonite Church, dated 5 December 1689 (long before the Seminary's official founding in 1735), where it states that Galenus was to teach youths for the purposes of serving the church as preachers. It is noteworthy that this brief entry is explicit that students from their own and other congregations would be taught "our common moderate Mennonite foundations" (*onze algemeene Moderate Doopsgezinde gronden*).[29] Even in its earliest instantiation the Mennonite Seminary was explicit in its fundamental values, both in its choice of teacher and in its stated aim of inculcating a cohort of future teachers in a moderate form of Mennonite or *Doopsgezinde* faith that did not wish to erect a wall between itself and surrounding Dutch society.

There is no question that Galenus had an inclination, through his education and chosen profession, to pursue natural knowledge. Born in Zierikzee, Zeeland, in 1622 Galenus studied medicine at Leiden and in 1646 began practice as a physician in Amsterdam (his faith would have barred him access to studying theology in any Dutch university) and in 1648 was elected as preacher of the Amsterdam

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27 See "Catalogus Librorum"; and Muller, *Catalogus*.

28 On paid preachers see Voolstra, "The Hymn to Freedom," 196. At their high point in mid-seventeenth-century there were 75,000 Mennonites in the Republic, by 1600 there were 60-65,000, by 1809 the Kingdom had just under 31,000, see Israel, *The Dutch Republic*, 398 and 1029; Zijlstra, *Om de ware gemeente*, 431-432; Groenvald, "Doopsgezinden in tal," and Knippenberg, *De religieuze kaart*, 51-54.

29 "Klapper op de notulen."

church "bij het Lam." He maintained his physician's practice alongside his role in the church and pursued alchemy for a complex blend of commercial and theological reasons.[30]

Galenus was but one among many of his co-religionists who were drawn to natural philosophy, natural history, astronomy, medicine and other branches of natural and experimental knowledge. There are notable examples of Mennonites involved in natural philosophy of one sort or another already in the seventeenth century, and among these few could be more intrinsically fascinating than Dirk Rembrandtszoon van Nierop (1610-1682), the cobbler turned mathematical wizard, heliocentrist and Cartesian—entirely self taught and the author of numerous almanacs, works in the aid of navigation, calculation tables and works in natural philosophy. René Descartes marvelled at Van Nierop's qualities and on the general level of intellectual life of the villages in that part of Holland, which were "as fecund in philosophers as the great commercial cities."[31] Govard Bidloo (1649-1713) managed to overcome the prohibition against Mennonites teaching at universities and held the chair for anatomy and medicine at Leiden. Rina Knoeff has shown that Bidloo's famed anatomical atlas bears the marks of a distinctly Mennonite motivation: the virtues of suffering exemplified by Mennonite martyrs as they were depicted by the etchings of Luyken in the 1685 edition of the *Martyrs' Mirror*.[32] Nicolaas Bidloo (1670-1734), nephew of Govard, became court physician to Peter the Great. Galenus was not unusual in practicing medicine and serving as preacher; medicine offered a living for lay ministers and was a useful body of knowledge for those who would link a healthy body to a sound moral condition. There were also those who studied medicine as a means of pursuing natural knowledge more broadly, such as Martinus Houttuyn (1720-98), who had studied at Leiden and was registered as a physician in Amsterdam's medical guild, but spent most of his time as a natural historian, assembling a significant cabinet and publishing widely, most notably a massive thirty-seven volume natural history based on Linnaean classification (sometimes mis-catalogued as a Dutch translation of Linnaeus's works). Much of Houttuyn's work was published by his indefatigable cousin Frans Houttuyn (ca. 1719-1765), Mennonite owner of the 'Isaac Newton' bookshop.[33]

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30 Lambour, "De alchemistische wereld."

31 Vermij, "Correspondence," 50. For a brief overview of Mennonites and science see Shank, "Sciences, Natural."

32 Knoeff, "Moral Lessons."

33 Houttuyn, *Natuurlyke historie*; Boeseman and Ligny, *Martinus Houttuyn*; Sprunger, "Frans Houttuyn."

The involvement of Mennonites in the Amsterdam book trade, both as publishers and booksellers, put them in an important position in the promotion of science and enlightened values more generally. Consider, for example, some of the Mennonites involved in the Collegiant movement, besides Galenus. The most renowned person associated with the Collegiants was, undoubtedly, Spinoza who, after he was thrown out of the Portuguese synagogue found important support, financial and otherwise, from Mennonite Collegiants. Jarig Jelles (d. 1683), Amsterdam Lamist, Collegiant and prosperous grocer financed the publication of Spinoza's commentary on Descartes; Jan Rieuwertsz (1616-1687) published his posthumous works, to which Jelles wrote the foreword; Simon Joosten de Vries (1633/4-1667) gave him a stipend; Jan Hendrik Glazemaker (1620-1682) translated a number of Spinoza's works, as he did all the major works of René Descartes.[34] All of these developments were part and parcel of a movement if not fully into the mainstream—a place from which they were closed off so long as they were forbidden to hold public office—then certainly a path away from isolation and into engagement with natural knowledge. Galenus, Bidloo, Martinus Houttuyn and Frans Houttuyn, and the others might be treated as individuals, but they need to be seen as more broadly representative of the direction of a Mennonitism that participated in the moderate Enlightenment of the Netherlands and that was part of an urban, non-aristocratic, commercial elite that cut across religious divisions and embraced the goals of moral, social and economic improvement.[35] The numerous independent societies for the promotion of natural knowledge that populated the eighteenth-century Dutch landscape were an important part of these improving tendencies, and Mennonite participation in eighteenth-century knowledge making—even in the Seminary—should be considered in such a context.[36]

A very direct Mennonite engagement with a particular kind of natural knowledge found expression in 1718 when a group of Amsterdam Mennonites hired Daniel Gabriel Fahrenheit, recently arrived in the city and originally from Gdansk, to instruct them in experimental philosophy, with the benefit of demonstrations. In a letter to Herman Boerhaave, Fahrenheit mentioned that he had recently be-

[34] On Spinoza, Collegiants and Mennonites see Fix, *Prophecy and Reason* and Kolakowski, *Chrétiens sans église*, relevant excerpts of which are translated from the original Polish in Kolakowski, "Dutch Seventeenth-Century."

[35] For a sampling of recent scholarship on the Dutch Enlightenment see the papers in Jacob and Mijnhardt, *The Dutch Republic*.

[36] For independent scientific societies see Roberts, "Going Dutch"; on improving impulses in another educational setting see Roberts, "Instruments."

gun a series of lectures for a group of "Mennonite devotees" (*liefhebbers*).[37] A detailed set of lecture notes in the special collections of Leiden University show that they were concerned with optics, hydraulics and hydrostatics, topics typical of eighteenth-century lecture demonstration courses.[38] More broadly such lecture demonstration courses dealt with "mechanics, magnetism, astronomy, hydrostatics, pneumatics, heat, optics, electricity and chemistry"—a range of topics described as "remarkably consistent throughout the eighteenth century."[39] The prospectus for Fahrenheit's 1720-21 Mennonite lectures set Willem Jacob 's Gravesande's *Physices Elementa Mathematica* (2 vols., Leiden, 1720-1721) as textbook.[40] In his *Mathematical Elements of Natural Philosophy* (translated from Latin by Desaguliers in 1720) 's Gravesande adopted a method, explicitly attributed to the English, of using machines "for making the Experiments" that demonstrate the principles of natural philosophy. Mathematical demonstrations are abstract and difficult, he noted, but experiments put conclusions "before one's Eyes."[41]

A consideration of the notes of Fahrenheit's lectures in light of 's Gravesande's textbook makes it easy to see why such a combination would have appeal to Mennonites of a moderate sensibility, many of whom were active in the commercial life of Amsterdam and moved in circles where it was not uncommon to have a sound or even excellent grounding in various branches of natural knowledge, such as medicine, natural history or natural philosophy. Experimental philosophy could appeal to those who were versed in mathematics and no less to those who were not mathematically inclined, revealing the regularities God inscribed upon nature. This was knowledge useful for an appreciation of divine wisdom; useful also for harnessing these regularities to improve the conditions of everyday existence. The former is a more explicitly theological form of utility, and as one might expect it finds direct expression in the preface to *Mathematical Elements*; but the latter is no less theological, for it is concerned with the providential arrangement of the natural world for human benefit. Fahrenheit's optical demonstrations offered a way of gaining a better understanding of vision, which itself was often connected to wisdom and insight.

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37 Star, *Fahrenheit's Letters*, 104 (18 January 1720), and see the reference to Fahrenheit's lectures in another letter to Boerhaave, Star, *Fahrenheit's Letters*, 120 (20 March 1729).

38 Fahrenheit, "Natuurkundige Lessen."

39 Turner, "Eighteenth-Century Scientific Instruments," 521.

40 Cohen and Cohen de Meester, "Daniel Gabriel Fahrenheit."

41 's Gravesande, *Mathematical Elements*, xvii-xviii; see also the discussion of 's Gravesande in Roberts, "Mapping Steam"; see also Vermij, "Formation of the Newtonian."

His hydrostatic and hydraulic demonstrations turned to more mundane matters, though ones of obvious relevance to the Dutch, namely "the principles of suction and pressure pumps, siphons, artificial water fountains, [and] waterworks."[42] It took nerve to tell the Dutch about the principles of waterworks, but then Fahrenheit came from Gdansk, a region that Dutch Mennonites had settled in and drained in the mid-sixteenth century, so the importance of such things was not lost on him. This was knowledge that was useful in life-altering ways in the Netherlands, especially in Holland. In a more unexpected way it was useful for highlighting the social and moral values of wealthy Mennonites involved in commerce and industry. Eighteenth-century waterworks technologies, including steam, also contributed to the creation of elaborate and expansive gardens of well to do Dutch. These "Arcadian landscapes" found spectacular expression in *Zijdebalen* ('Silk Bales'), the garden of the Mennonite silk manufacturer David van Mollem (1670-1746), whose home and silk factory near Utrecht on the Vecht River was part of the region nicknamed 'Mennonite heaven' due to its many estates owned by wealthy Mennonites. Jacob van Mollem (1623-1699), David's father, had purchased the site of the estate because it had the advantage of water power for running his silk mill, which was built on site and made use of a machine he had invented for unrolling bales of raw silk, a previously labour intensive process. David continued running the mill, but he also spent very large sums to build an elaborate garden in the first decades of the eighteenth century. The walkways, grottoes, ponds, orangery, bridges, pavilion and theatre of this garden—all geometrically arranged with the help of perspective to give the illusion of even greater size—amounted to a spectacular display that integrated natural history, biblical imagery and industrial technology. The waterworks were an especially striking artifice, driving large fountains, a relative rarity in a country where water pressure was hard to come by.[43] These gardens were also a spectacular display of something else about which Dutch Mennonites, and their Calvinist kin, seemed little embarrassed: accumulation. In the context of bourgeois accumulation, commercial culture and a keen sense of utility (both industrial and theological) Fahrenheit's lectures on experimental philosophy look very much akin to the "public science" and its improving tendencies so aptly described by Larry Stewart in his account of "Newtonian Britain."[44]

Bearing all this in mind, and that some if not most of the people attending

[42] Fahrenheit, "Natuurkundige Lessen," 99.

[43] On "Arcadian" see Roberts, "An Arcadian Apparatus"; the best discussion of Zijdebalen is De Jong "Nature and Virtue."

[44] Stewart, "Entrepreneurs of Science."

Fahrenheit's lecture's would have been members of the Amsterdam Lamist congregation, we might say a few more things about the formal founding of the Mennonite Seminary in 1735. It was hardly the first instance of Mennonites seeking some form of higher education or improvement; it was not an institution created by a church that was isolated from broader streams of urban life; it was created in order to satisfy a very specific need, the need for preachers who were trained in the foundations of "moderate" Mennonite beliefs. The founding documents of the Seminary are explicit that its sole purpose was to prepare youths for preaching in Mennonite congregations, a claim that was repeated on several occasions well into the nineteenth century.[45] The Seminary was created to serve Mennonites from anywhere in the Republic (presumably elsewhere too, if there was call for it), but in the eighteenth century it was wholly funded by the Lamist United Mennonite Church of Amsterdam, the place of worship of many prosperous Mennonite merchants; it was also the church in which Galenus was active and which had many Collegiant connections. There were other Dutch Mennonite churches in Haarlem, Utrecht and elsewhere that might be described along the same general lines, but due to the Seminary the Amsterdam church was able to have a much broader influence on Dutch Mennonite life than any other church. It is also quite clear that many Amsterdam Mennonites were broadly interested in natural philosophy and some took the trouble to pay for specialized lectures in experimental philosophy. It may be coincidental, but it is worth pointing out that Fahrenheit's lectures began the same year that natural philosophy stopped being taught at the Atheneum Illustre, forerunner of the University of Amsterdam (the subject was not taught there between 1717 and 1779).

Indeed, given Mennonite participation in medicine, natural history, natural and experimental philosophy one can well ask why some kind of natural knowledge was not taught at the Seminary right from the start. Part of the answer may well be that Fahrenheit's lectures were the beginning of regular natural philosophical meetings that took on a quasi-institutional character. There is no clear evidence to show that the meetings were continuous from the time of their start in 1718, but in 1759 a Swedish observer in Amsterdam observed that Mennonites gathered on Monday evenings to discuss natural philosophical topics, and that the evening he attended a local Mennonite preacher, Klaas de Vries, gave an optical explanation of vision.[46] As long as these regular lectures were held it may not have been a priority to offer natural philosophical instruction at the Seminary.

[45] See "Reglement voor't Kweekschool," and "Reglement, 24 April 1827"; for histories of the Seminary see Muller, "Geschiedenis," and Brüsewitz, "Tot de ankweek."

[46] Zuidervaart, "Meest alle van best mahoniehout," 84.

The change came in 1761, when De Vries (the same of the optics lecture) was appointed on a part-time basis by the Seminary to teach not natural history, medical subjects, or any kind of natural philosophy, but specifically "experimental philosophy." To support this enterprise a group of eighteen well to do members of the Amsterdam United Mennonite Church pledged as "voluntary gifts" either 300 or 600 gulden each, for a total of 8,100 gulden, to buy instruments for the "teaching of experimental philosophy" (*Collegium Physicum Experimentale*). We do not know how this sum was arrived at, if there was simply a general request for funds, a request for a specific amount, or if the benefactors themselves—each signed the document in his or her own hand—took the initiative. A small handful of the benefactors possessed cabinets of their own and all were members of prosperous families or connected to them by marriage. Most were merchants, silk merchants, bankers or traders; some of the families owned very large houses on Amsterdam's Herengracht or on the Vecht or Spaarne rivers. So far as I have been able to determine, none made their living in direct connection with any kind of natural science or medicine; it is altogether possible that some were informed on these matters and possibly very well informed about particular kinds of technologies associated with their commercial activities.[47] De Vries taught experimental philosophy until 1766, the year he died; the subject was then taught by Heere Oosterbaan from 1766-86, Jan van Swinden from 1786-1800 and again from 1811-1823, and Gerrit Hesselink from 1800-1811.

As for the instruments themselves, they accumulated quickly. The account books of the Seminary show that in 1762 over 4000 gulden were spent on instruments, far more than any subsequent year. Instruments were purchased from the well-established Amsterdam instrument maker Adam Steitz, from Jan Paauw Jr. of Leiden, or from John Cuthbertson, the distinguished English instrument maker who lived in Amsterdam in 1768 until the 1790s. Oosterbaan showed good judgment in commissioning Cuthbertson to build an early model of one of his soon to be renowned electrostatic generators, the most famous of which was the gigantic one constructed for Teyler's Museum in Haarlem. Nothing is more revealing of the Seminary's dedication to experimental philosophy than its physical cabinet, which was without equal in Amsterdam and likely equalled or surpassed by only a handful of university cabinets, the most renowned being that of the University

[47] For the signatories, which included well known Dutch Mennonite families such as Van Lennep, De Neufville, Straalman, Van Vollenhoven and De Clercq, see "Intekenlijst"; for biographical details see Zuidervaart, "Meest alle van best mahoniehout," 109-110, and the family name entries in *Global Anabaptist*.

of Leiden, though the instrument collection of the Hague orphanage supported by the Foundation Van Renswoude may not have been far behind that of Leiden.[48]

The Seminary accumulated instruments, but this was not accumulation for its own sake. Presumably students of the Seminary would upon graduation go out to Mennonite congregations throughout the Netherlands with some knowledge of experimental philosophy, spreading the word of a natural knowledge at once useful for understanding the God-given regularities of nature and for exploiting those regularities by mechanical means to carry out the divinely ordained task of loving one's neighbour and increasing the general welfare. Or this was knowledge that would give Mennonite preachers and teachers some appreciation for the mundane necessity of making a living with the possibility of generating considerable wealth, also for the common good. There is reason to believe some of those things were taking place, and in some instances perhaps all of those things were taking place. The accumulation of scientific instruments was connected to the accumulation that was part of bourgeois life, and of a rural life that practiced an intensive and industrialized (think of the mills and water management) agriculture, but all this leavened by the values of moderate Mennonite belief.

One might ask what it was about the cabinet or the experimental philosophy taught at the Seminary that was specifically Mennonite. But the question is wrong-headed, just as it is wrong-headed to ask what was Catholic about the instruments of the Quebec Seminary—its microscopes, telescopes, polarimeters and balances are in principle and practice indistinguishable from those in other cabinets. I have not seen any of the instruments of Seminary of Nobles in Madrid, nor any reproductions or inventory list, but would be surprised indeed if the instruments had peculiarly Catholic traits. The general aims of the Madrid institution, as outlined in its 1755 Constitution, were to provide instruction in philosophy "in such a way that it be useful to the public."[49] These were common aims of Enlightenment, even in different settings. To look for something Mennonite in the instruments is to chase after a phantom. Nor should one expect to find something peculiarly Mennonite in the way experimental philosophy was taught in the Amsterdam Seminary. Jan van Swinden, an outstanding figure in Dutch natural philosophy, was a metrologist not a Mennonite.[50] Van Swinden may well have had

[48] On disbursements on instruments see "Kasboek"; Zuidervaart, "Meest alle van best mahoniehout," pp. 88-89, 111; on Cuthbertson see Wiesenfeldt, "Politische Ikonographie"; on Cuthbertson, Paauw and Steitz see Turner, "Eighteenth-Century Scientific Instruments," 529-532; on Van Renswoude see Roberts, "Instruments."

[49] Navarro Brotóns, "Science and Enlightenment," 393.

[50] van Hoorn, "Swinden."

natural theological views, but the grounds for his appointment were his knowledge of experimental philosophy (and the attraction for him was access to the cabinet). So there was nothing inherently peculiar about the instruments or their employment in the framework of experimental philosophy. It was the Mennonites who were peculiar in having decided to make such instruction integral to training preachers. For a number of years the Seminary may have been the best place to learn experimental philosophy in Amsterdam, but it was primarily a place to teach people how to preach. Lest there be any doubt, experimental philosophy was decidedly not a subject pursued by the official church. It was not until the 1920s that the Calvinist "Free University" of Amsterdam, an institution whose statutes prescribed "that all research and teaching should be based on Calvinist, biblical principles" would hire its first natural scientists.[51]

So why were Mennonites of the moderate sort so keen on natural philosophy? There is no point in looking for an explanation in a particular confession, such as the Dordt Confession of 1632. True, this was the first Mennonite confession to begin with God the creator and the creation of all things, but to have it explain events that took place much later would be to give it an agency beyond anything its authors might have imagined. It makes even less sense as an explanation given that the United Mennonite Church of Amsterdam and the first teacher in its unofficial seminary were famous for their eschewal of confessions of any sort. The Seminary's physical cabinet and the experimental philosophy it sustained need to be understood as part of a much broader tendency of improvement, be it economic or oeconomic (an antique but useful term in this context) among eighteenth-century Dutch Mennonites and their fellow citizens.

In order to understand better the improving tendencies among Mennonites we need to consider how the larger context of eighteenth-century decline specifically relates to their circumstances. When Fahrenheit gave his lectures in Amsterdam, the "hallmarks of Dutch society" were "novelty, innovation, cleanliness, prosperity, the magnificence of its towns, and relative absence of poverty compared to neighbouring countries", and the Netherlands "was still the world's technological showcase." Nowhere would this have been more on display than in the Zaandam in North Holland, a region dense with wind-driven lumber, flour and paint mills, a region Jonathan Israel describes as "Europe's first real industrial zone, in the sense of being an area where industry was overwhelmingly the main activity." In the 1720s, 1730s and 1740s Amsterdam's prosperity dipped; the Zaan's took

[51] Flipse, "Against the Science-Religion Conflict."

a nosedive.[52] The shipbuilding, whale oil, lumber, sail-making and rope-making industries of the Zaan were all in decline. All this would have been keenly felt by Mennonites (though perhaps no more so than any other Dutch citizens) who in 1742 made up nearly twenty percent of the population of Zaandam, East Side and West Side (allegedly 2468 out of a total 12,736), and who are alleged to have owned "most" of the industry of Zaandam from the seventeenth through to the nineteenth centuries.[53] Hardship was also felt in agricultural communities, particularly among cattle farmers who endured terrible bouts of cattle virus that hit the Netherlands in the eighteenth centuries: the first from 1713 to 1719, the worst from 1744 to 1765 (Friesland, the home of many Mennonite farmers, lost 135,000 cattle in this period), and again from 1768 to 1786.[54] The erosion of wealth in the 1740s was so acute that the Netherlands saw a rise in radicalism at this point, culminating in the Orangist Revolution of 1747-1751. In 1748 a Mennonite clergymen led a meeting of three hundred deputies of cities and county districts (*grietenijn*) in Leeuwarden, the capital of Friesland, demanding freer trade and the abolition of tax-farming, among other things. The Haarlem firebrand Hendrik van Gimnig agitated for applying the findings of "scientific academies" to the problems of industry.[55]

These improving tendencies were cultivated, as were natural philosophical, medical, technological, natural historical knowledge, in any number of independent eighteenth-century societies. Mennonites and other dissenters were not exactly welcomed into established learned societies such as the Haarlem's Holland Society of Sciences or The Zeeland Society of Sciences, so they formed alternatives of their own. Mennonite merchants dominated the membership of Haarlem's "Natural Philosophical College" (*Natuurkundig College*, 1737-1788), a society aimed specifically at natural and experimental philosophy.[56] The Patriotic Association for Shipping and Trade (*Vaderlandsche Maatschappij van Reederij en Koophandel*) was founded in 1777 in the West Frisian town of Hoorn by the Mennonite leader Cornelis Ris (1717-1790), who was joined by Jacob Houttuyn (1711-

52 Israel, *Dutch Republic*, 998-1000, quotations on 998 and 999.

53 Van der Zijpp, "Zaandam"; even if there are reasons to doubt the accuracy of Van der Zijpp's specific figures, he is surely right that the Zaandam had a very substantial number of Mennonites. As late as 1777, the Danish Astronomer Thomas Bugge, on a tour of Holland (taking every opportunity to visit demonstration lectures) was awestruck by the "almost unbelievable amount of windmills, saw, flour, oil, tobacco, chocolate, tan-mills" of the Zaan, Bugge, *Journal*, 43.

54 Israel, *The Dutch Republic*, 1004.

55 De Jongste, "The Restoration," esp. 44-45 and 54-55.

56 On the Zeeland Society see Mijnhardt, "The Dutch Enlightenment," 216; twelve of the nineteen members of the Haarlem college were Mennonites, Sliggers, "Honderd jaar," 97.

1789) and Adriaan Houttuyn (ca. 1700-1777), the merchant brothers of the publisher Frans Houttuyn. Above all was the Society for Public Welfare (*Maatschappij tot Nut van 't Algemeen*) founded in 1784 by the Utrecht Mennonite preacher, Jan Nieuwenhuizen (1724-1806) and his physician son Martinus (1759-1793). This society aimed at improving literacy and educating the lower classes in virtue and Christian citizenship through founding public libraries and publishing school textbooks aimed for the common people, and it soon had branches in most Dutch towns of any size. By the early nineteenth century the work of this society resulted in the revamping of the Dutch educational system.[57] Some societies existed more to help their own members rather than others: Felix Meritis of Amsterdam, founded in 1784 had departments of commerce, drawing, music, letters, and natural philosophy.[58] Though not founded by them it seemed to attract Mennonites who might wish to cement their status in the metropolitan commercial and cultural elite. The oldest museum in the Netherlands, Teylers Museum in Haarlem, was associated with two societies, one for theology and the second for the promotion of science and the arts; the museum and associated societies were the founded by the bequest of the Mennonite financier, Pieter Teyler van der Hulst (1702-1778).[59]

The societies I have mentioned are not, in the first instance, and in many cases not at all, concerned with physico-theology, but that is not to say that the Mennonite improving zeal had no theological connection. It was profoundly theological. The Mennonite Seminary's engagement with experimental philosophy was part of the more general concern with social well-being that manifested itself in publishing and independent societies for oeconomic improvement. Experimental philosophy was readily adapted to an ethos that looked to the world as something that could be manipulated and changed for the better. These were ideas that filtered their way through Mennonite churches, as is evidenced by Mennonite catechisms of the second half of the eighteenth century, which show that commitment to a moderate Enlightenment was an expression of a theological commitment to change the world or realize the kingdom of God.[60] Experimental philosophy revealed a *nature* so ordered that it could be manipulated to enhance the human condition—this was a voluntarism that stood in very stark contrast to Calvinist

[57] See Mijnhardt, *Tot Heil*, for a general treatment of eighteenth-century Dutch independent societies; on Amsterdam see Reitsma, "De belangrijkste."

[58] Judging by Van Swinden's speech inaugurating the new building, natural philosophy was the dominant department, Swinden, *Redevoering*.

[59] Sliggers et al., *De idealen* and Teylers Stichting, *Teylers*.

[60] For catechisms see Van Wijk, *Plicht tot leren*, 1: 410-414. On pedagogy and its importance in late eighteenth century Dutch society see Hake, "Between Patriotism," and Hake, "The Pedagogy."

views of *human* nature. Experimental philosophy was a means for directing accumulation to the greater public good, to the good of the Republic, and the Seminary's accumulation of instruments was a means of demonstrating the importance of experimental philosophy to Mennonite preachers.

Conclusion

Such an attitude of concern for the greater good, of faith revealing itself in deeds, was deeply embedded in Mennonites. It ran counter to the notion that the secular world of commerce, industry and trade could be strictly separated from the sacred life of a church. To be sure, Mennonite churches placed little restriction on trade and large profits, but bankruptcies were very much frowned upon, as they were evidence of possible underhandedness or dishonesty. But the railings of Van Braght against the rich overseas trade serve as a reminder that Mennonites were far from wholly uncritical of the United East India Company (*Vereenigde Oost-Indische Compagnie*). Practically all Mennonite groups in the Republic forbade members from owning (partially or wholly) or working as skippers of ships armed with cannon. It seems to have had some effect, as a number of Mennonites did withdraw from their involvement with the VOC.[61] It is an irony that Van Braght, despite his lament on the accumulation of wealth and all that came with it, endorsed the 1632 Confession of Dordt, which could be interpreted as a license for Mennonites to be involved in trade of (almost) all sorts and to concern themselves with the prosperity of the Republic. In his introduction to the *Martyrs' Mirror* Van Braght reprints in its entirety the Confession approved at Dordt, the thirteenth article of which concerns "The Office of the Secular Authority." Anabaptists are here told to be "ready for all good works, especially in that which is not contrary to the law, will, and commandment of God… [to] pay custom, tribute and taxes, and to render unto [the secular authorities] their duties." Lest there be any doubt, the Confession adds:

> we, moreover, must constantly and earnestly pray to the Lord for them and their welfare, and for the prosperity of the country, that we may dwell under its protection, earn our livelihood, and lead a quiet, peaceable life, with all godliness and honesty; and, furthermore, that the Lord would recompense unto them, here and afterwards in eternity, all benefits, liberty and favor which we enjoy here under their praiseworthy administration.[62]

[61] Sprunger, "Waterlanders," esp. 138-141.
[62] Van Braght, *Martyrs' Mirror*, 42.

This view, wholly endorsed by Van Braght, is not so different from the attitudes underlying the eighteenth-century Mennonite concern with the common good. The publication of the famous second edition of the *Martyrs' Mirror* and its magnificent etchings by Luyken (who like Van Braght, had never witnessed a martyrdom) also suggests something else, namely that Dutch Calvinists were more than happy to cooperate and work with Mennonites. That edition was conceived, funded, promoted (primarily to a very select group of Mennonites—those who were rich enough to afford it) and published by a group of ten Amsterdam booksellers, none of whom, so far as we know, were Mennonites; the four key individuals involved were definitely Calvinist and so likely were all the others.[63]

Commitments to social improvement were also a way for many Mennonites to finally establish their credentials as full members of Dutch society. This was a struggle with deep roots, traces of which can be found as early as1574 when Mennonites gave a substantial sum of money to William of Orange, no doubt in the hope that a victorious revolt against Spain would mean the end of the worst of their persecution.[64] In the early 1670s Mennonites raised large amounts of money in support of the Dutch war(s) with England. In Friesland, in particular, Mennonites financed the war effort with large loans (accepted at a favourable rate of 4%) at the moment when "the Amsterdam exchange was paralysed, the normal money market had dried up, and it seemed that the Republic itself might soon be overthrown."[65] One could reasonably ask, and perhaps some did, whether or not this was in keeping with a deep commitment to non-violence. Mennonites were keenly aware that the Netherlands, though hardly perfect, offered them more freedom than anywhere else.

By the eighteenth century, participation in the forefront of a moderate Enlightenment offered a way of changing Dutch society in keeping with broadly Mennonite aims. Buying or loaning favour was less and less acceptable in such a context, especially if one entertained notions of citizenship. Restrictions on Mennonites had become relatively modest and one might reasonably ask if they were in fact marginalized. But marginalization is very much a felt thing and by the 1780s many Mennonites, inspired by events in America and France, were prepared to abandon non-violence and join the Patriot movement and its militias to topple the self-appointed Reformed elite. In 1796 the long awaited constitutional

[63] The four were Hieronymous Sweerts, Jan Bouman, Daniel van Dalen and Jan ten Hoorn; the "fine paper" edition sold for 15.75 gulden, the "common paper" version for 10.50 gulden, see Visser, "De pelgrimage van Jan Luyken," esp. 167-170.

[64] Van der Zijpp and Brüsewitz, "Netherlands."

[65] Israel, *Dutch Republic*, 654.

separation of church and state had come to pass: Mennonites had become full Dutch citizens and at no small cost. For secular citizenship carried with it certain ideas that undermined some fundamental premises of Anabaptism, notably the idea that religious expression becomes part of the private sphere, not public life. Experimental philosophy could well be adopted within a Christian framework of moral and economic improvement, a framework that saw faith expressing itself in good works. But commercial and civic culture was (and still is), not easily regulated. Mennonites had, by the nineteenth century become fully a part of the Dutch social fabric; their numbers continued to shrink through that century, though their participation in Dutch civic, cultural and scientific life remained strong.

The *Martyrs' Mirror* has persisted as a centre of accumulation precisely because it can be read and appreciated without knowledge of the particular polemical context in which it was made. The accumulation of experimental philosophical instruments by the Mennonite Seminary would have been readily understood *in the eighteenth century*, in a time when demonstration lectures were a widespread, shared medium for communicating natural knowledge. The very absence of any documentation (at least not any that has yet been found) explicitly stating the relevance of such an accumulation of instruments for the Seminary suggests that an understanding of their relevance and importance was widely shared and understood. We live in a world that has long considered it a commonplace that "popular" science is somehow distinct from that done by "professional" scientists. But such a distinction is very much a nineteenth-century creation, one quite distinct from the world of eighteenth-century Dutch Mennonites.

Layers of Meaning, from Scientific Instrument to Exhibition at the Museum Boerhaave

Tim Huisman

Scientific instruments are not the first thing many people think of when they hear the word 'museum object'. This comes as no surprise; after all, scientific instruments are generally not designed to be put on display in a public space. They are tools designed to do scientific experiments, or to demonstrate laws of physics, and spend their lives away from the general public in laboratories or lecture rooms. [fig. 1] Yet the Museum Boerhaave, the Dutch National Museum for the History of Science, is filled with these arcane machines, which have obviously been turned into museum objects.

Using a centrepiece from the Museum Boerhaave – an ensemble of early modern physics apparatus known as the Leiden Cabinet of Physics – as a case study, I want to describe in this essay how scientific instruments can evolve from practical objects ('tools') to objects in a museum presentation by accumulating different layers of meaning. How has this process changed the perception of these objects by the public? Which meanings were added to the objects in the 300 years of their existence, by whom were these meanings added, and why? Finally I will take a little peek into the future: will the process of adding layers of meaning continue the same way as it has during the last three centuries, or are we on the brink of something new?

A Living Organism

On 5 July 1931 the Dutch National Museum of the History of Science opened its doors to the public. Although it was located in Leiden and most of the objects in its collection came from the estate of Leiden University, the ambition of this museum went beyond that of a mere university museum; it aimed to be an institution presenting the historical achievements of Dutch scientists as a whole.

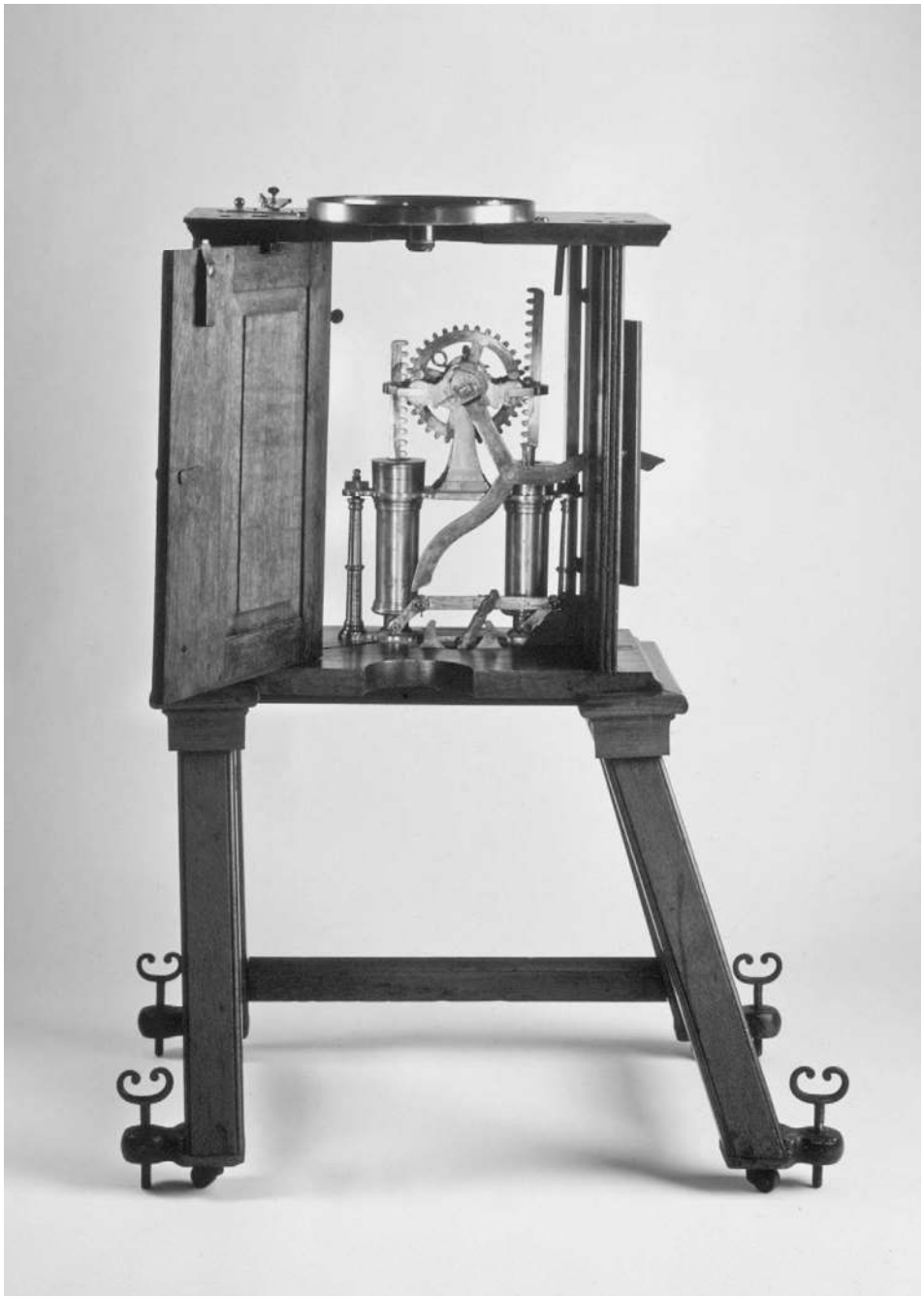

Fig. 1 Double barrel air pump from the Leiden Cabinet of Physics built in 1722 by Jan van Musschenbroek for Willem Jacob's Gravesande (Museum Boerhaave)

Fig. 2 Claude August Crommelin (Museum Boerhaave)

In his opening speech the director of the museum, Claude August Crommelin, stated that his institution should present the history of the natural sciences as a part of the history of culture as a whole. [fig. 2] It would provide the public – scientists, but also "the generally cultured part of the population and the inquisitive youth" – with a historical perspective on science.

> . . . all these [scientific] objects, we may well call them relics, are displayed in the museum and are accessible to the reverent and admiring eye of the investigator of nature as well as the layman [. . . .] thus the spirit of our great countrymen will continue to speak to us, their admiring posterity.[1]

In a brochure about the museum, published in the previous year, Crommelin also stipulated that the museum should not be "a collection of [scientific] instruments to be dusted off once a year and be the object of the fleeting admiration of a farmer's family every now and then." Crommelin envisaged his museum as a "living organism, a centre for the practice of the history of science, where lectures will be held, which in turn will lead to tours through the museum, and where research will take place, which will lead to publications."[2]

A museum like the Dutch National Museum for the History of Science was a bit of an eccentric institution as museums go. Science museums already existed in Europe, of course. They were often established in the nineteenth century or the first decade of the twentieth century – the London Science Museum (1876, separate status 1909) and the Deutsches Museum in Munich (1906) spring to mind – and were part of nationalist programmes to present a country's achievements in science and technology, as well as educating the public in the exact and technical sciences. Generally these museums had an explicit mission as institutes propagating and promoting modernisation and industrialisation. Historical objects were shown as ancestors of the modern achievements in science and technology.[3]

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1 C.A. Crommelin, "Toespraak gehouden bij de opening van het Nederlandsch Natuurwetenschappelijk Historisch Museum" in: *Physica, Nederlandsch Tijdschrift voor Natuurkunde,* 157.

2 C.A. Crommelin, *Het Nederlandsch Natuurwetenschappelijk Historisch Museum*, 5.

3 Walther von Dyck, "Chronik" (preface) to *Deutsches Museum, Führer durch die Sammlungen* (1906), 7: "Möge das Deutsche Museum zu allen Zeiten Rückblick und Ausblick darbieten auf die Entwicklung in Naturwissenschaft und Technik [. . . .] Möge es immer eine Statte ernster Arbeit sein, welche die beste Kräfte der Nation in gemeinsamem Schaffen [. . . .] an eine grosse Sache vereint." ("May the Deutsches Museum at all times offer a look back and a look ahead on the development of physics and technology [. . . .] may it always be a place of serious work, which unites the best forces of the nation in the common creation of a great cause"). In the Introduction to *Handbook to the Special Loan Collection* (1876), the forerunner of the Science Museum which included a large portion of historical scientific instruments in its displays, we read (p.X): "Their Lordships stated their conviction that the development of the educational and

The situation was somewhat different with Crommelin's museum. The Dutch Museum of the History of Science was also established with nationalistic motives in mind: it was to celebrate historical achievements by Dutchmen in science, allowing 'the spirit of our great countrymen to speak to us'. But it did so by primarily presenting the glorious past; scientific instruments from the seventeenth and eighteenth century were exhibited as scientific monuments, as inspiring 'relics' through which the great achievements of the historical heroes of Dutch science would come to life for the public.

The Leiden Cabinet of Physics

Centre stage in the National Museum of the History of Science would be taken by a collection of old physics apparatus, collected by Leiden University between the late seventeenth and early nineteenth centuries and kept in an attic at the physics laboratory since its redundancy in the late nineteenth century. The Leiden Cabinet of Physics, as this collection was known, consisted of collision apparatus, air pumps, apparatus demonstrating mechanics, hydrostatics and optics, electrical generators, as well as models of applied technology like windmills and steam engines. This large ensemble was brought together by succeeding professors of natural philosophy from de Volder (1643-1709) through Simon Speyert van der Eyk (1771-1837), to be used during lectures. The most important contributions to the collection were made by Willem Jacob 's Gravesande and Petrus van Musschenbroek, champions of Newtonian physics in the eighteenth century.[4]

Saving this Cabinet of Physics from the threat of dispersion or even destruction was one of the most immediate reasons for founding a museum for the history of science in Leiden. But to make this collection radiate the greatness of the historical heroes of Dutch science in a way that would convince a museum audience would be no small achievement. Many of the 'scientific relics' were not very impressive or aesthetically pleasing to look at. They were tools, practical objects devised to perform a certain function such as demonstrating centripetal force, evacuating air from a glass bell, and showing the impact of bodies on each other. In contrast to many contemporary scientific instruments aesthetic visual qualities do not seem to have been an important point of consideration when the apparatus of the Leiden Cabinet of Physics were designed and built in the seventeenth and eighteenth centuries. This lack of aesthetic qualities, however, would pose a prob-

certain other departments of the South Kensington Museum [. . . .] would lead to the advancement of science, and be of great service to the industrial progress of this country."

4 Cf. De Clercq, *The Leiden Cabinet of Physics. A Descriptive Catalogue*, 9

Fig. 3 Willem Jacob 's Gravesande, engraving by Jacob Houbraken (Museum Boerhaave)

lem when they were to be put on display in a national museum some 150 to 200 years later. Other qualities had to be found and presented within these objects to convince the general public of their museum 'worthiness'.

How then did Crommelin, and the other people responsible for founding the National Museum of the History of Science in the late 1920s, adapt the status of these objects which until a few decades earlier were seen as objects of utility (in some cases even decrepit objects which had outlived their utility) into objects of historical and cultural value? How did Crommelin enable these objects to accumulate a meaning and a status beyond that which they originally had?

The Rise and Fall of 'A Perfect Collection'

First, let us try to ascertain the status the Leiden Cabinet of Physics had before it was incorporated in Crommelin's museum. I will undertake this survey along the lines suggested by Samuel Alberti in his 2005 essay entitled "Objects and the Museum."[5] As mentioned above, the Cabinet of Physics was a part of the university's inventory since the late seventeenth century, and certainly enjoyed fame as one of the 'must sees' for educated travellers visiting Leiden during the eighteenth century, although it is mentioned less frequently in travelogues than the anatomy theatre. (See Rina Knoeff's essay in this volume.) Conrad von Uffenbach mentioned the Leiden 'theatrum physicum' in his diary, but was not very impressed by it; he called it "a rather small room [. . .] which, unusual for Holland, was rather untidy" and remarked that many of the instruments were dirty and broken.[6]

Uffenbach, however, visited the Physics Cabinet in 1711, before Willem Jacob 's Gravesande took over responsibility for the collection. In 1724 Albrecht von Haller had a higher opinion of experimental physics at Leiden University, based on his esteem for 's Gravesande and his private collection of scientific instruments.[7] Later visitors' accounts of the Physics Cabinet also identify it with the figure of 's Gravesande, whose private collection of physics apparatus was incorporated posthumously in the Cabinet. [fig. 3] Generally these later accounts are quite positive.[8] The Swede Bengt Ferrner, visiting Leiden in 1759, marvelled at the extensiveness of the instrument collection. He heard lectures by professors

5 Alberti, "Objects and the Museum."

6 "Ein gar nicht grossen Zimmer [. . . .] das sonderlich vor Holland nicht gar sauber ist." Uffenbach, *Merkwürdige Reisen*, 425-6.

7 E. Hintsche (ed.) *Albrecht Hallers Tagebucher*, 80: "Sein bestes sind die Experimente, die er wegen seinen schönen Werkzeugen sehr just und sehr haüfig tut."

8 Cf. Sander, *Beschreibung seiner Reisen* (2 dln), Leipzig 1783-84, 529. "[. . .] die physicalischen Maschinen von 's Gravesand bekam ich [. . . .] alle zu sehen."

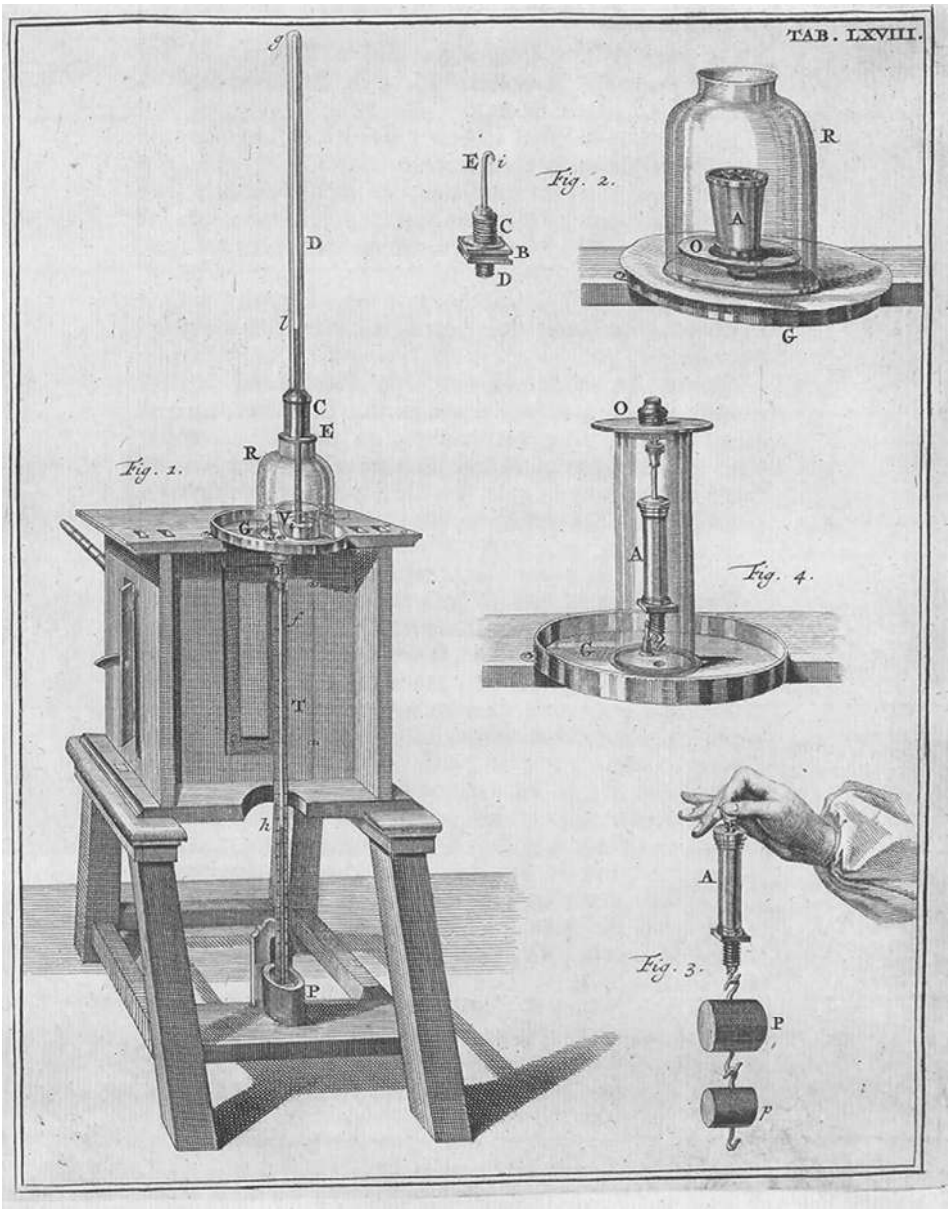

Fig. 4 Experiments in a vacuum, plate LXVIII from 's Gravesande's textbook Physices elementa (Leiden 1720)

Van Musschenbroek and Allamand and was impressed by the way the instruments were used to illustrate their lectures:

When one has such a perfect collection, one can give lectures that are as agreeable as they are useful to young men, for whom it is very exciting to be able, as it were, to touch with their fingers that which they have learned in theory.[9]

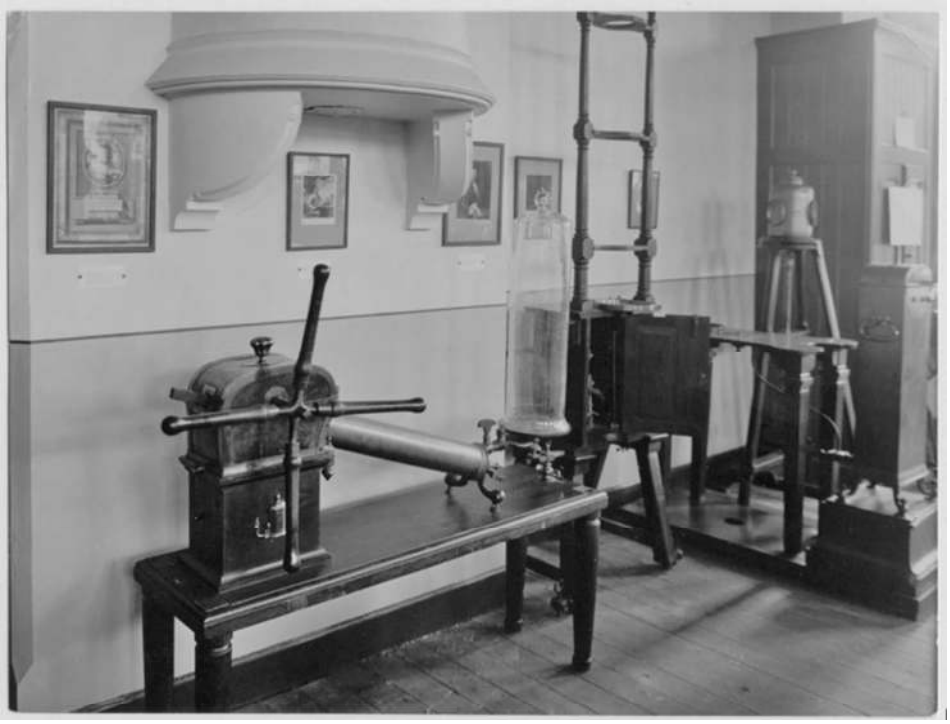

Fig. 5 Air pumps from the Leiden Cabinet of Physics ca. 1931 (Museum Boerhaave)

Demonstrations of physics phenomena with instruments from the *theatrum physicum* remained a regular feature of lectures in Leiden well into the nineteenth century. [fig. 4] The collection, however, began to lag behind developments in physics by the end of the eighteenth century. By the early decades of the nineteenth century reports about the "pitiful and very backward state of the collection of physical implements at the University of Leiden" and complaints about the

[9] Kernkamp (ed.) *Bengt Ferrner's dagboek*, 480 "Wanneer men een zoo volkomen verzameling heeft, dan kan men tegelijk aangenaame en nuttige colleges geven aan de jongelieden, voor wie het buitengewoon opwekkend is, wanneer zij het geen zij uit de theorie hebben geleerd als het ware met de vingers kunnen tasten."

premises of the Cabinet at the Nonnensteeg which were causing "almost everything [to be] spoilt by the dampness of the [... .] location" began to appear.[10] In 1859 the instruments were moved – after sharing an intermittent location with stuffed animals from the Natural History Museum at the Rapenburg – to the new physics laboratory on the Steenschuur. There they were still used as education tools, and the physics professor Pieter Leonard Rijke (1812-1899) praised them in 1879:

> I can testify that they were sound, as they are just as good to use now as when 's Gravesande took possession of them a century and a half ago; and that they served their purpose is shown by the fact that most of them in the Leiden Cabinet have not been replaced by others of more recent design.[11]

If Rijke was not the last person to sing the praise of the Leiden Cabinet of Physics, he was the last to sing its praise as a useful ensemble of practical and sturdily built demonstration apparatus. Up until the 1870s the instruments of the Cabinet functioned as educational tools. After 1882 however, when Rijke was succeeded by HeikeKamerlingh Onnes, the active life of the instruments was over. Under Kamerlingh Onnes' leadership the Leiden physics lab changed from a rather sedate educational institution to a dynamic 'factory for research'. In this new state of things there was no practical use for the old demonstration apparatus. How then, did the Leiden Cabinet of Physics succeed in acquiring a new status, which enabled it to survive its redundancy?

Nationalism and History

The first sign of interest in the Leiden instruments for reasons other than their usefulness dates from their last days as practical demonstration apparatus. In 1876 a selection of the instruments was sent by Rijke to the South Kensington Museum, where they were shown in a historical section of a large international exhibition on (modern) scientific apparatus. This exhibition, called the Special Loan Collection and generally considered as the start of the Science Museum, showed new as well as historical instruments from all over Europe and was intended to promote and stimulate an industry of scientific apparatus production in Britain.[12] The historical

[10] Quotes from a report to King William I in 1825 and a memorandum of professor Speyert van der Eyk from 1807 respectively, in de Clercq, *The Leiden Cabinet*, 10.

[11] P.L. Rijke, "Levensschets," 76.

[12] Cf. Museum Boerhaave, *Het koperen kabinet*, 13-14, and *Catalogue of the Special Loan Collection*.

instruments were included in this context to show how the modern production of scientific instruments in the contributing countries was rooted in a national tradition of science and instrument making.

In 1907 the instruments of the Leiden Cabinet of Physics – by now no longer in practical service – were once again included in a historical exhibition, this time at Leiden University. And just like the South Kensington exhibition thirty years earlier, the Leiden Historical Exhibition on Science and Medicine was not without its nationalistic motives. Along with hundreds of other historical documents and instruments, the apparatus from the Leiden Cabinet of Physics contributed to giving "an impression of the important part played by our forbears in the development of the natural and medical sciences."[13]

Enter Crommelin

Around this time of nationalist flavoured historical interest in science, Claude August Crommelin entered the scene.[14] Crommelin was a physicist, working in the laboratory of the famous Leiden professor of physics and Nobel Prize winner HeikeKamerlingh Onnes. From 1907 until 1924 he was curator of the laboratory and in this job, as in his next job as vice director of the laboratory, the laboratory instruments were his responsibility. In 1925 he became lecturer of physics.[15] Crommelin was also closely involved with the Leiden instrument makers' school, an institution organised by Kamerlingh Onnes to train young technicians to become specialist makers of scientific apparatus; in 1938 Crommelin even became its director.[16]

As curator of the instruments of the physics laboratory, Crommelin was also responsible for the instruments it had inherited from the past. [fig. 5] He appreciated the historical value of these discarded instruments and set up a sort of antiquities room on the top floor of the laboratory building.[17] However, historical activities did not have a high priority in Kamerlingh Onnes' research laboratory,

[13] E.C. van Leersum in the catalogue of the *Geschiedkundige tentoonstelling van genees- en natuurkunde*, Leiden 1907, XI.

[14] For biographical detail on Crommelin cf. J. van den Handel, 'Claude Auguste Crommelin', in: *Biografisch Woordenboek van Nederland* I, 125-126.

[15] Crommelin was appointed in 1924 and began his lectorship in 1925.

[16] On the Leiden Instrumentmakers' School: Dirk van Delft, *Heike Kamerlingh Onnes*, 298-313 and Ivo Pommerel, *Een eeuw precies,* passim .

[17] Entry in the Leiden University Yearbook from 1916 quoted in De Clercq, *The Leiden Cabinet*, 11: "... the room on the top floor contains among other things, 's Gravesande's famous collection of instruments and other historical apparatus such as the Van Musschenbroek pumps."

Fig. 6 A heliostat, ingenious piece of the instrument maker's craft (Museum Boerhaave)

which probably accounts for the fact that Crommelin's first publication explicitly dealing with the instruments of the Leiden Physics Cabinet – a transcript of his speech on the *Art of Instrument Making and Experimental Physics*, rendered on the occasion of his appointment as lecturer of physics at Leiden University – did not appear before 1925.[18]

In this speech Crommelin stressed the importance of the instruments of the Leiden Cabinet of Physics as material witnesses of the co-operation between the instrument maker and the physicist, in this case the Van Musschenbroek workshop and Willem Jacob 's Gravesande, and to a lesser extent his colleagues Burchardus de Volder and Wolferd Senguerd. Crommelin drew a picture of how the technical skills of the specialist instrument maker – in metal working, glass blowing and lens grinding – made it possible for the scientist to do his research and observations, and for the professor to teach his students. At the same time the natural scientist's questions and assignments to the instrument maker allowed the latter to develop his skills, make new inventions and bring technology to a higher level. This message of the mutual fruitfulness of the collaboration between scientist and instrument maker, was for Crommelin one of the most important meanings of the Leiden Cabinet of Physics; an interpretation of the historical apparatus that was very much influenced by his involvement with the Leiden instrument makers' school and his activities at the physics laboratory. [fig. 6]

A year later Crommelin published his *Descriptive catalogue of the historical collection of the physics apparatus at the physics laboratory of Leiden University*.[19] In his introduction to this book, Crommelin provided information about the provenance of specific parts of the collection. He also, for the first time, offered an attempt at chronology, often based on what he knew about the provenance of the different parts of the collection. But above all this catalogue, just like the apparatus it describes, was intended by Crommelin as a homage and a testimony to the greatness of the instrument makers responsible for producing these objects.

In his inaugural speech and descriptive catalogue, Crommelin – probably the first historian of Dutch science to do so – offered biographical details of the three instrument makers of the Van Musschenbroek dynasty – Johan, Samuel and Jan – who were responsible for many of the apparatus acquired between 1670 and 1750.[20] He also retrieved instrument makers such as Jan Paauw and John Cuthbertson from obscurity. Thus he introduced the instrument makers as a part of the whole ensemble of forces responsible in shaping the scientific instruments.

[18] C.A. Crommelin, *Instrumentmakerskunst*.
[19] C.A. Crommelin, *Beschrijvende catalogus*.
[20] de Clercq, *At the Sign*.

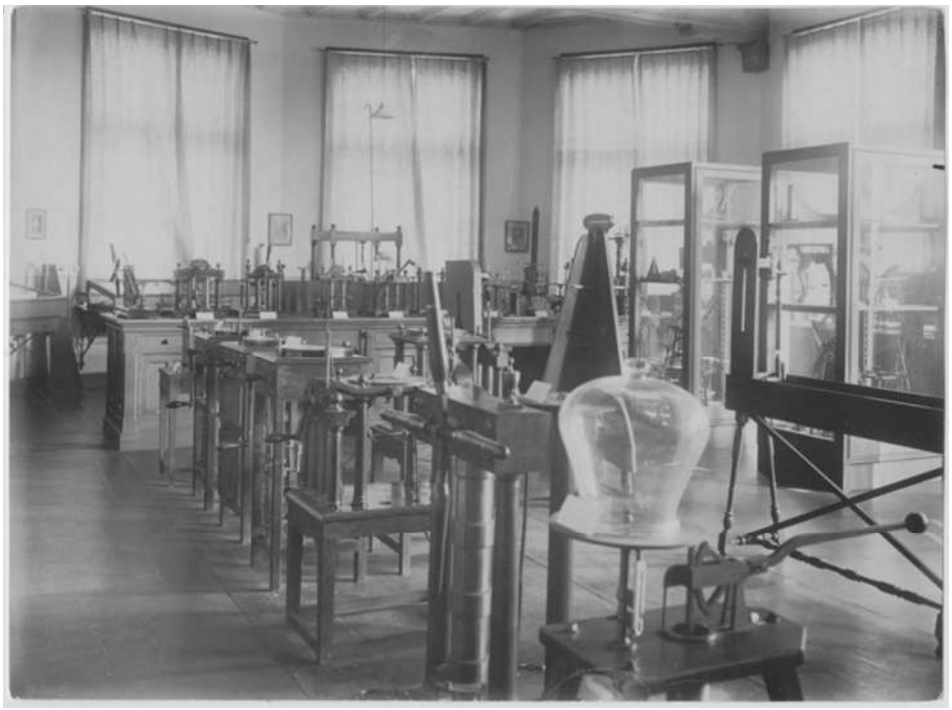

Fig. 7 Assorted air pumps in the National Museum of the History of Science, 1931 (Museum Boerhaave)

Probably because of Crommelin's focus on instruments and instrument makers, the lay out of the catalogue is not chronological. The collection is divided according to types of instruments: air pumps and other pumps, microscopes, telescopes and other optical apparatus, the 's Gravesande – Musschenbroek collection of physical demonstration apparatus (which for Crommelin was the most important part of the Cabinet), thermometers and hygrometers, and so forth . . . Within these categories there is a chronological order, but the question why certain sets of instruments were incorporated in the Cabinet at a particular period was clearly not at the foundation of this catalogue.

Crommelin's Museum

Five years after the publication of Crommelin's catalogue, the Leiden Physics Cabinet could be admired by the public in the new museum of the history of science. As Crommelin stated in his opening speech, the museum should present the history of science and in particular the role the Dutch played in the history of

science. It should also present the history of science as a part of cultural history. Particularly because of its intention to present the history of science as a part of cultural history, one would perhaps expect the museum to show its objects in one sweeping chronological display. This would allow the visitors to match the scientific apparatus with their own general knowledge of history. In keeping with the lay out of his catalogue however, Crommelin chose to present the exhibits in a thematic order. There was a room displaying air pumps, a room for telescopes and microscopes, a room with electrical generators, and a gallery dedicated to the instruments collected by 's Gravesande and Petrus van Musschenbroek and made by the Van Musschenbroek workshop. [fig. 7] In this way the emphasis was more on the internal development of the various scientific disciplines and the development of the scientific instruments used in these disciplines, and less on science as a phenomenon in a cultural context.

Fig. 8 The 's-Gravesande-Musschenbroek room' in the Museum Boerhaave, 1991 (Museum Boerhaave)

What the public was shown in the museum was firstly the development of these different types of instruments through time. It was much more difficult for

the visitors to create a picture for themselves of the context of these instruments, of the role they played in the intellectual atmosphere of the Enlightenment, for example. What the objects did acquire through Crommelin's instrument-based approach was a status as concrete products of a branch of handicraft and industry. By linking the instruments with the names of their instrument makers, and not just with the names of the famous and less famous physicists who ordered these instruments to be made, Crommelin gave them a status which to a certain degree was analogous to the status enjoyed by products of artisans, like the work of goldsmiths, potters and furniture makers. By doing this Crommelin made his historical scientific instruments more suitable as *bona fide* museum objects. Now the instruments were not just an ensemble of educational tools used by scientists. They had accumulated a status as individual objects of the instrument maker's art and elements of the Netherlands' material culture. And instrument makers, in turn, were no longer anonymous craftsmen, but artisans with a name and a biography. Presenting the instruments as products of artisans with a name and a biography made the instruments themselves less abstract and anonymous, more analogous to works of art. This would help to make them appeal to a museum audience beyond the world of science from which they came.

Until well into the 1990s the instrument maker and the scientist remained the two key features in the information attached to the apparatus of the Leiden Cabinet of Physics in the museum, known since 1976 as the Museum Boerhaave. Much of the research done on the instruments and much of the information made accessible to the museum's visitors centred on the interaction of the instrument maker and the physics professor. The historical context of the instruments was present in the museum galleries, but only implicitly so. [fig. 8]

The cultural and historical surroundings of the instruments have only recently begun to play a bigger part in the way they are presented in the museum galleries. For example, the fact that these instruments were used to explain and popularise Newtonian physics in the Netherlands, and therefore played an important part in changing Dutch society by paving the way for amateur societies, salons and scientific *liefhebbers* during the later eighteenth century, was the central theme of a presentation of the Leiden Physics Cabinet in the Museum Boerhaave in 2009.[21] Exhibitions such as this explicitly integrated the instruments with the historical context of Dutch culture, which enhanced their meaning. Besides being presented as artfully crafted scientific instruments, they are now also projected as material

[21] *Newtonmania/Newton in Nederland*, exhibition Museum Boerhaave, 17 december 2009-12 september 2010.

symbols of a cultural movement which contributed to shaping Dutch society. Although this was a temporary exhibition, it was intended as a test case for a new lay out of the museum, in which more context and biographical stories will be included in the permanent presentation.

Accumulating Layers of Meaning

Thus the scientific instruments from the Leiden Cabinet of Physics evolved through time, gathering a new layer of meaning with each period. From a small collection of natural philosophical apparatus circa 1700, frowned at by Von Uffenbach, the Cabinet evolved into a respected ensemble of scientific apparatus associated with Willem Jacob 's Gravesande, who was recognised as an important natural philosopher and pedagogue by his contemporaries. In the nineteenth century the aura of 's Gravesande still clung to the Leiden Cabinet of Physics, mixed with respect for the trustworthiness of these sturdy old apparatus as demonstration tools in the lecture room. Towards the end of the century appreciation of the instruments became based on their value as historical relics, an appreciation that was mixed with nationalist overtones.

When the instruments went on permanent public display in a museum in the 1930s, they were given a new layer of significance as prize examples of the Dutch instrument makers' craft, in order to give them a status comparable to other *bona fide* craft objects in museums, like furniture or ceramics. Finally and only fairly recently their role in cultural history as objects representing a key cultural phenomenon in eighteenth-century Dutch society has come into play in the way they are presented in the museum.

The accumulation of layers of significance by these objects is an ongoing process, in which a new layer never fully eradicates its predecessors. But until now this process was guided by a limited number of authoritative actors providing and/or ratifying the different meanings in subsequent periods of the life of the objects. In the eighteenth century it was the scientists and students working with the instruments and the travelogue and journal writers reporting about them, who shaped the meaning of the Leiden physics apparatus. From the late nineteenth century onwards the meaning of the instruments of the Leiden Physics Cabinet was shaped by historians of science, joined from 1931 by museum curators. This last group of experts was (and is) also responsible for the way the instruments are currently presented to the public in the Museum Boerhaave.

New Media, New Challenge

According to Bruno Latour's *Science in Action* the production of facts is based on the authority of the scientific network which produces the scientific data.[22] This also applies to the subject of this essay. As I described, different sources through time have attached significance, meaning and stories to the scientific objects of the Leiden Cabinet of Physics. Especially from the 1870s onwards, as the scientific instruments lost their practical use and became a historical collection and eventually a museum collection, these sources belonged more and more to the sphere of experts. Historians and museum curators produced meaning and stories around the scientific apparatus, which were then communicated to the audience. The audience's reception of these messages did not exercise any influence on the experts' process of constructing the significance and narrative context of museum displays, a situation that was far removed from the dialogue between museum visitors and museum professionals described by Rina Knoeff in her account of the Leiden anatomy museum in the eighteenth century.[23]

The rather closed world of experts producing meaning around museum objects for an audience to consume, without any real possibility for them to engage in a dialogue with the experts is quite similar to the description of the traditional relationship between science and society given by Latour in an 1998 essay "From the World of Science to that of Research."[24] In this he likens "society to the flesh of a peach, and Science its hard stone. Science was surrounded by a society, that, in its essence, remained foreign to the inner workings of the scientific method; society could reject or accept the results of Science [... .] but there was no direct connection between the core of scientific results on the one hand, and the context [... .] The only way for Science to disseminate its results, its ethics, its methods, was to transform, through education, as many members as possible of the general public."[25] In the museum world this translated into the one-way traffic of information about the museum exhibits from the experts to the museum audience.

In his essay Latour also signals the replacement of the closed 'world of science' by the world of research, which he characterises as much more open to society: "warm, involving and risky", while science is "cold, straight and detached." In Latour's opinion the relationship between research and society is one of "collective experiment." As an example of this he describes the workings of research

[22] Cf. Latour, *Science in Action*, 30-62.
[23] Cf. Rina Knoeff elsewhere in this volume.
[24] Bruno Latour, "From the World of Science" in *Science* Vol. 280, issue 5361, 208.
[25] Ibid.

centres for the treatment of certain diseases, funded by money raised by patient organisations. Within these research institutions the patients and their advocates actively seek to steer the research programme in the direction of their perceived needs. Together with researchers the patients share the responsibilities and risks involved in the research for treating their particular disease.

Is such a process towards participation and involvement also taking place in the museum world? Is the audience actively influencing the content, the stories of museums and their exhibits, challenging the one-way traffic of information from expert to audience? In many countries public funding of museums declined from the 1980s onward. Museums were encouraged to think of themselves as an 'industry' with an economic role to play in social life. Marketing became important as museums began to focus on their audience: how could they attract more people and how could they give the people coming to the museum a satisfying experience.[26] The realisation that museums were in a market situation, that they had to compete with other – commercial – providers of entertainment such as theme parks or the cinema for the favours of the public, forced them to look critically at themselves and attend to their audience's questions, wishes and demands.[27]

The results of this increased attention to the audience vary. In some cases analysis of the results of marketing research led to the feeling that museum presentations were "too paternalist, too dominated by the concerns of curators and the fetishism of the artifact."[28] Many aspects of artifacts in museums, like their historical or geographical context or their specific biographies, were seen as confusing to a straightforward message. Especially in science related museums an objects based approach was sometimes felt to be in conflict with a mission of explaining science and scientific principles, which for the sake of comprehensibility were presented as abstract and decontextualised phenomena.[29] In practice this could lead to an increase of the amount of interactive displays in museum galleries, often at the expense of the number of historical objects.[30] A telling example of this is the refurbishment of the Natural History Museum in London in the late 1980s and

[26] Hooper-Greenhill, "Museums and Communication: an Introductory Essay," 1-2. Hooper-Greenhill describes the British situation, where the process of the decline of public funding is perhaps more extreme than in other European countries. Nevertheless the trend can be observed in the Netherlands as well: letter of the Dutch State Secretary of Culture, Halbe Zijlstra to Parliament with his proposals on "a new basic infrastructure for cultural funding" (6 December 2010), 1-3.

[27] Aedin Mac Devitt, "Fields of change," in *Icom News* No. 2 2010, 10.

[28] Andrew Barry, "On Interactivity," 101.

[29] Jim Bennett, "Practitioners' Postscript", 606.

[30] Andrew Barry, "On Interactivity," 100-1.

early 1990s, when a large part of the historical objects was moved into the depot, to make room for interactive displays. Changes to museum presentations like the one described above were intended to enhance audience participation and interactivity and thus integrate museums into the daily life of society, social relevance in turn being a condition for the survival of museums.[31] However, could this result only be reached at the cost of the number of objects in the museum presentation?

At the Museum Boerhaave this phenomenon, which some have described as "the rise of the science centre in a museum context" did not take place.[32] A new generation of curators, entering the museum from the 1990s onwards, however, feels the need to interact with a wider audience and to have that audience participate in the museum's displays. But they want to do so by making use of the many layers of meaning museum objects such as the apparatus of the Leiden Cabinet of Physics have historically acquired and not by relegating objects to the depot in favour of interactive displays. Their view is that it is precisely the "ambiguous and contingent" character of the objects, their "own agenda, derived in a large part from their pre-existing biographies", which make them rich mediators for participation and interaction.[33]

The rich texture of stories and meanings connected to the objects offers opportunities to involve people with the collection of the museum. There are of course barriers to be overcome. The ambiguity and the contingent character of the scientific instruments in the Museum Boerhaave, combined with the fact that the exact sciences – and to a lesser extent medical science – are not everybody's cup of tea to begin with, can make the museum's presentation seem rather inaccessible to a large portion of potential visitors. Text panels and audiovisuals can overcome these barriers only partly.

Practical experience has taught museum staff that a good way of getting the public involved with the collection, taking full advantage of the richness of meaning connected to the museum objects, is to guide a group of visitors through the museum personally.[34] Of course the first task of the museum guide is to inform his or her group about the objects (s)he shows them. But, in the setting of a guided tour it is inevitable that guides establish a dialogue with their audience. They ask questions, relate their own stories inspired by what they see, and prod the guide to adapt his or her story to their frame of reference and interests. Together, guide and

31 Hooper-Greenhill, "Museums and Communication", 2.

32 Jim Bennett, 606.

33 Jim Bennett, ibid.

34 Cf. Ad Maas, "The Storyteller and the Altar", in Lehmann-Brauns, Sichau, Trischler, *The Exhibition as Product and Generator of Scholarship*, 59.

group bring to life the objects in the museum collection; in very much the same way as the customs of the eighteenth century anatomical museum brought to life the collection of anatomical preparations in dialogue with his guests.

Effective as guided tours may be as a means to involve the public with the museum's collection, their outreach is of course rather limited. Individual visitors often do not join the guided tours at the museum, and the staff's, as well as the building's capacity to facilitate tours is limited. Furthermore the dialogue and interaction engendered by guided tours only take place in the museum galleries and are as fleeting as the contact between visitor and guide. In and of themselves, such conversations have the status of signs made on the shore, which can be washed away by the oncoming tide. They neither possess permanence nor the ability to reach beyond the museum to involve a broader, potential audience.[35]

New developments in contemporary media however could make the outreach of these positive aspects of guided tours much bigger. These new developments, known popularly as web 2.0, can be characterised as web based applications with an architecture of participation, one in which users generate, share and curate the content; applications like eBay, Amazon and You Tube are examples of these content management systems.[36] What these systems have in common is that people attach their own 'tags' to the content of a database (either actively or generated by the search engine), thus constantly rearranging the content according to their interests and forming and joining communities of people with the same interests as they go along. A further stage of interactivity these new media make possible is for their users to share ratings or comments on the content they have just seen. And a final stage on which users can interact via these media is the creation of new content, for instance by writing a review of a book or a CD, a feature offered by Amazon, among others. In this the web 2.0 is different from the original web (web 1.0), in which sites are "authoritative content distributors."[37] The user experience with web 1.0 is passive: the user is a viewer, a consumer; while the web 2.0 moves the authority from the content provider and places it in the hands of the user.

On her blog Museum 2.0 and her book *The Participatory Museum* Nina Simon explores and discusses ways in which the philosophies of the web 2.0 can be applied to museums. Simon points out the analogies between the evolution of the web and museum practice. She describes museums as "traditionally also author-

[35] Compare this with Latour's description of Lapérourse's encounter on the shore of Sahkalin. Bruno Latour, *Science in Action*, p. 216.

[36] Cf. Tim 'o Reilly, What is Web 2.0.

[37] Description by Nina Simon on http//museumtwo.blogspot.com.

itative content providers" to a passive, consuming audience and advocates their transformation into "dynamic platforms for content generation and sharing."[38]

In her book Simon elaborates – among other things – how this can be realised. In general objects play an important part in engendering social interaction – an encouraging thing for an object-based museum like the Boerhaave! With the objects, and the information about them provided by the museum as mediators, interaction with and among the museum's public will develop. Individual members of the public will comment on the exhibits, might wish to discuss their opinions with museum staff, or might like to share their comments with each other. They even might want to add their own stories about an object or objects to the stories presented by the museum. The role the museum plays in this is comparable to that of the guide in a tour. The museum acts as a host, a moderator, who by bringing people together, by offering them information and by asking the right questions gets his guests talking and interacting. This can be facilitated 'live' by museum staff, by the exhibition design, and by the design of the museum's virtual platform: the website. The results of this interaction engendered by objects can be manifold, ranging from enhanced participation and engagement of the audience with the museum and its collection to new content, new stories and layers of meaning for the individual objects.

Contemporary media such as blogs on the internet and twitter enable a far larger number of people to present their opinions about the objects and attach their significances to them. As museum professionals presenting the material culture of the history of science in a public space and with public funding, the curators of the Museum Boerhaave cannot afford to ignore the emancipation of the public to attach its stories and interpretations to the museum exhibits.[39] The curators of the Museum Boerhaave also feel that – especially for the younger objects in the collection – this new way of accumulating information connected to the objects could be an important source of new data.[40]

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[38] Simon, http//museumtwo.blogspot.com.

[39] For museums incorporating social media cf. The Powerhouse, Sydney http://www.powerhousemuseum.com/ The Brooklyn Museum, New York http://www.brooklynmuseum.org/, The Van Gogh Museum, Amsterdam http://www.vangoghmuseum.nl/ besides Museum Boerhaave Leiden, http://www.museumboerhaave.nl For recent discussions on museums and social media cf. J. Trant, D. Bearman, *Museums and the Web 2010; Selected Papers from an International Conference,* especially N. Proctor, "The Museum Is Mobile" 59-72, F. Romeo, N. Waterson, "Flickr as Platform: Astronomy Photographer of the Year" 205-218, D. Allen-Greil, M. MacArthur, "Small Towns and Big Cities" 219-230.

[40] In fact, the museum is experimenting with inviting groups of retired employees of laboratories and research departments of companies like AKZO, of which we have recently acquired a con-

The curators of the Museum Boerhaave are developing ideas to reach out and interact with their public in order to get more of the public's stories and interpretations of the objects into the presentation of the museum. As this world of social media and web 2.0 is in constant flux it seems that any initiative in this field will be a question of trial and error. But what the curators hope to gain from it is the involvement and commitment of a broader audience with the museum and its collection.[41] These new developments should make it possible for more of the dialogue between the curator and the public, which is such a satisfying characteristic of guided museum tours, to enter the relationship of the museum and its audience in general. The curators also think that the larger input of the museum's audience will lead to a useful further accumulation of stories, information and knowledge of scientific instruments. Crossing over from the old network of authority to the new public network of interactive media will make interpreting and enjoying the museum's collection a shared enterprise, a result of interaction between the museum and its audience. Thus the Museum Boerhaave could become even more of a living organism than Crommelin had envisaged in 1931.

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siderable part of their scientific inventory, into the depot to tell us about their day to day work with these instruments.

41 Paul Stork, "Musea en het Web" in: EM-Cultuur: "Ik denk dat experimenteren meer brengt dan formaliseren" (experimenting will bring us more results than formalising).

Biographical sketches

Karel Davids studied history at the University of Leiden, was assistant professor at the Erasmus University Rotterdam and research fellow of the Royal Netherlands Academy of Sciences and is now Full Professor of Economic and Social History at the VU University Amsterdam. His publications include *The Rise and Decline of Dutch Technological Leadership. Technology, Economy and Culture in the Netherlands, 1350-1800* (2008), *A Miracle Mirrored. The Dutch Republic in European perspective* (co-edited with Jan Lucassen,1995) and *Zeewezen en wetenschap. De wetenschap en de ontwikkeling van de ontwikkeling van de navigatietechniek in Nederland 1585-1815* (1986).

Arjen Dijkstra is currently completing his PhD-dissertation at the University of Twente. His research focuses on the practice of mathematics in the Dutch province of Friesland in seventeenth century, with special attention to issues related to the history of the book. He previously studied history in Groningen, where he took his masters degree. Before he started his current research he worked as a secondary school history teacher.

Alette Fleischer received her PhD in the History of Science and Technology at University of Twente (Dec. 2010). Her research seeks to connect the histories of natural inquiry and technology in the Low Countries in the seventeenth century by focusing on a number of specific sites that can all be classified as gardens. Recent publications include "Into the Light: Constructors and Examiners of Nature in a Dutch 17th Century Garden Grotto," *History of Technology*, 29 (2009), 113-139 and "The Beemster Polder: Conservative Invention and Holland's Great Pleasure Garden," in *The Mindful Hand: Inquiry and Invention from the Late Renaissance to Early Industrialisation*, ed. L.L. Roberts, S. Schaffer, and P. Dear, (2007), 145-166.

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Tim Huisman trained as an art historian at Leiden University, specialising in museology, graphic art and early modern art. Since 1991 he works at the Museum Boerhaave, the Dutch National Museum for the History of Science and Medicine. His activities include the catalogueing of the museum's collection of portraits of scientists and the stageing of exhibitions on subjects varying from Dutch 17th century medicine, antique globes, optical toys and the science of sound. Since 2000 he has served as one of the museum's curators, specialising in the museum's collection of prints, drawings and paintings, in anatomy and in early modern medicine and life sciences. In 2009 he published his PhD thesis on the Leiden anatomy theatre and anatomical teaching at Leiden University in the 17th century called *The Finger of God; Anatomical Activity in 17th Century Leiden.* Currently Huisman is working on a project concerning the storyline for the future refurbishment of the presentation of the Museum Boerhaave.

Johan de Jong studied electrical engineering at Eindhoven University of Technology, enjoyed working for over thirty years as a physics teacher in secondary education and loves serious hillwalking in Scotland. Taking advantage of early retirement, he studied 'Philosophy of Science, Technology and Society' at the University of Twente. He graduated with a masters thesis on innovation and standardization in VOC's shipbuilding and is currently extending his research as a PhD project, directed by Prof. Dr. Lissa Roberts.

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