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BIBLIOGRAFIE

1. Ongedrukte bronnen

Hoogheemraadschap van Rijnland, Leiden

Oud Archief Rijnland (OAR)
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Archief Herenwegse Polder (AHP)
Archief Vroonlandse Polder (AVRP)
Archief Grote Polder (Oudshoorn) (APO)
Archief Kleine Polder (AKP)
Archief Middelpolder (AMP)
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Archief Papenwegse Polder (APP)
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Archief Boshuizer- en Gasthuizerpolder (ABGP)
Archief Driemanspolder (ADP)
Archief Starrenburgerpolder (ASP)
Kaartenverzameling

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Archief van de gecombineerde Sloterbinnen- en Middelveldse polder (ASMP)
Archief van de familie Bicker en aanverwante families, Collectie Hudde (Coll. Hudde)
Archief Burgerweeshuis (AB)

Streekarchief Rijnlands Midden, Alphen aan den Rijn

Oud Gemeentearchief Woubrugge (OGW)
Oud Gemeentearchief Oudshoorn (OGO)
Rechterlijk Archief Esselijkerwoude (RAE)

Nationaal Archief, Den Haag

Archief van de Heerlijkheid Oudshoorn en Gnephoek (AHOG)

Familiearchief Heereman van Zuydtwijck (AHZ)
Kadaster en openbare registers, Oorspronkelijk aanwijzende tafels (KADOR-OAT)
Archief inspecteurs en commissies van de waterstaat in Nederland, 1551-1849 (AIC)

Universiteitsbibliotheek Leiden

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Archief Catarinagasthuis (AC)
Archief Nederlands Hervormde Kerkvoogdij (ANHK)

Museum Boerhaave, Leiden

Koninklijk Instituut voor de Ingenieurs (KIVI)

Noord-Hollands Archief, Haarlem

Archief Grondbelasting (AG)

Gemeentearchief Wassenaar

Oud archief Wassenaar (OAW)

2. Gedrukte en uitgegeven bronnen

Aeneae, H., *Verhandeling over de molenwieken* (Amsterdam 1785).

Aeneae, H., *Wiskundige beschouwing van een hellend water-scheprad, nieuwlings door den heere A.G. Eckhardt in 's Haage uitgevonden, waar in de voordelen van dit rad boven het gewoone scheprad wiskundig betoogd, en teffens de nadeelen, waar aan het onderheevig zoude kunnen zijn, in overweeging genomen worden, en de middelen aangetoond hoe dezelve weg te neemen of te verhelpen*

zijn (Amsterdam 1775).

De nieuwe verbeterde vysel of tonne molen door den heer Adrianus van Marle, Ferdinand Obdam en Klaas Klaverweyde zo gezegt word uitgevonden en door den beroemden hoogleeraar Johan Lulofs goed gekeurt (1762).

Dekkers, P.J.V., Gemeente Lisse: inventaris van de archieven van: *Secretarie 1942-1989, Dienst Openbare Werken 1926-1988, Dienst voor Sociale Zaken 1942-1989, Vleeskeuringskring Lisse 1972-1988, Gemeentelijke Sportstichting 1949-1967, Heerlijkheid Lisse 1581-1864 (Arnhem 1997).*

Douwes, B.J., *Verhandeling over de proportiën tusschen de vermogens der gewoone watermolens, werkende met een staand scheprad en der nieuwlings door de gebr. Eckhardt uitgevondene hellende schepradmolens ('s Gravenhage 1779).*

Engelman, J.; Bolstra, M.; Klinkenberg, D., *Rapport van observatie en proefbevindingen over de werkingen en vermogens van een ordinaire schepradmolen, met een verbeterde vyselmolen van F. Obdam, c.s., beide staande aan de Westvaart onder Hazerswoude (1763).*

Engelman, J.; Bolstra, M.; Klinkenberg, D., *Rapport van proeven gedaan op de werking van een vyselmolen, en een schepradmolen, staande aan de Westvaart onder Hazerswoude, in het jaar 1763.*

Fruin, R.J. (red.), *Enqueste ende Informacie upt Stuck van der Reductie ende Reformatie van den Schiltaelen, voertijts getaxeert ende gestelt geweest over de landen van Hollant ende Vrieslant: gedaen inden jaere 1494 (Leiden 1876).*

Fruin, R.J. (red.), *Informacie up den staet faculteyt ende gelegentheyt van de steden ende dorpen van Hollant ende Vrieslant om daerna te reguleren de nyeuwe schiltale: gedaen in den jaere MDXIV (Leiden 1866).*

Groenewegen, J., *Uytvoerige en nauwkeurige verhandeling van de geoctroyeerde tregtermolens ('s Gravenhage 1763).*

Hullu, J. de en Verhoeven, A.G (red.), *A. Vierlingh, 'Tractaet van dyckagie' ('s Gravenhage 1920).*

Kohier van het Klein Familiegeld van de dorpen van Rijnland, 1674. (transcriptie aanwezig in de bibliotheek van het hoogheemraadschap van Rijnland)

Linperch, P., *Architectura mechanica, of moolen-boek van eenige opstellen van moolens, nevens hunne gronden (Amsterdam 1727).*

Listingh, N., *Incitamentum & adjumentum. Dat is Opweckinge ende aanleydinge, tot het uytvinden van bequaame middelen en gronden om de zee-dycken in Hollandt en West-Vrieslandt, tegens het soo dickwils doorbreecken te beschermen en te beoreyden (Amsterdam 1702).*

Lulofs, J., *Berigt van den Professor J. Lulofs, wegens de Werkingen van de Nieuwe Verbeeterde Vyselmolen* (Leiden 1756).

Lulofs, J., *Korte beschrijving van het nieuwe waterrad, uitgevonden door Leopold de Genneté uit het Fransch vertaald; met een opdracht aan den uitvinder, met een voorrede aan de Nederlanderen, en met eenige aantekeningen ten dienste van ongeoeffenden verrykt door Z. v. J.* (1756).

Lulofs, J., *Wis- en water-beweegkundige aanmerkingen over de wiskundige beschouwing van een hellend water-scheprad : waarin tevens de ware werking van ons gewoone scheprad wordt aangewezen, en melding gemaakt van een middel om, volgens de werktuigkundige gronden van Maclaurin, Euler en anderen, deszelfs uitwerksels te vermeederen* (Leiden 1774).

Lulofs, J., *Wiskundige en werktuigkundige beschouwinge der windmolens* (Haarlem 1755).

Lulofs, J.; Bolstra, M., *Over het wiskundig aanleggen en maken der windmolens* (Amsterdam, 177?).

Martens, M., *Wiskundige beschouwing der wind-molens, vergeleken met die van Johan Lulofs* (Amsterdam 1758).

Nederlandsche jaerboeken, inhoudende een verhael van de merkwaerdigste geschiedenissen, die voorgevallen zijn binnen den omtrek der Vereenigde Provintien (Amsterdam 1747-1765).

Nieuwe Nederlandsche jaerboeken, of Vervolg der merkwaerdigste geschiedenissen, die voorgevallen zijn in de Vereenigde Provinciën, de Generaliteits landen en de volksplantingen van den staet (Leiden 1766-1798).

Natrus L., van, J. Polly, C. van Vuuren, P. Linperch, J. Punt, *Groot volkomen moolenboek; of, nauwkeurig ontwerp van allerhande tot nog toe bekende soorten van moolens, met haare gronden en opstellen, en al het geene verder daar toe behoort* (Amsterdam 1734).

Nijhof, P., *Molenbibliografie* (Zutphen 1982).

Posthumus, N.W., *Nederlandse Prijsgeschiedenis* (Leiden 1943-1964) 2 delen.

Rijnland, *Keuren ende ordonnantien van het hoog-heimraedschap van Rhijnland* (Leiden 1769).

Spille, H., *Beschryving van een nieuwe manier om molen-assen en molen-roeden, van meerdere sterkte en duurzaamheid, en tot minder kosten te maaken* (Amsterdam 1780).

Texeira de Mattos, L.F., *De waterkeeringen, waterschappen en polders van Zuid-Holland* (Den Haag 1906-1908) 2 delen.

Wilde, F. de, *Kadastrale Atlas Zuid-Holland 1832, deel 13: Oudshoorn* (Alphen aan den Rijn 2001).

Worp, J. A., *De briefwisseling van Constantijn Huygens (1608-1687)* ('s Gravenhage 1911-1917) 6 delen.

Zyl, J. van; Schenk, J., *Theatrum machinarum universale: of groot algemeen moolen-boek, behelzende de beschryving en afbeeldingen van allerhande soorten van moolens, der zelve opstellen en gronden* (Amsterdam 1761).

3. Secundaire literatuur

Abels, P.H.A.M (red.), *Duizend jaar Gouda. Een stadsgeschiedenis* (Hilversum 2002).

Allan, F., *Geschiedenis en beschrijving van Haarlem van de vroegste tijden tot op onze dagen* (Haarlem 1874-1888) 4 delen.

Amstel-Horák, M. van, 'De morgenboeken van Rijnland. Drie eeuwen ongeregeldheid', *Leids Jaarboekje* 77 (1985) 150-178.

Amstel-Horák, M. van, 'De Rijnlandse morgenboeken, een unieke bron uit het pre-kadastrale tijdperk', *Holland Historisch Tijdschrift* 26 (1994) 2, 87-111.

Amstel-Horák, M. van, 'Het akkoord van 1595 van het hoogheemraadschap van Rijnland', *Holland Historisch Tijdschrift* 28 (1996) 3, 117-138.

Amstel-Horák, M. van, 'Nieuwbouw van twee sluizen in een benauwde tijd, Halfweg: 1556-1558, L. Giebels (red.), *Zeven eeuwen Rijnlandse uitwatering in Spaardam en Halfweg. Van beveiliging naar beheersing* (Leiden 1994) 47-74.

Amstel-Horák, M.H.V. van, 'Pottenbakkersklei van het Elisabethgasthuis', J.W. Marsilje (red.), *Uit Leidse bron* (Leiden 1989) 214-219.

Amstel-Horák, M.H.V. van, 'De morgenboeken van Rijnland', *Broncommentaren* 4 (Den Haag 2001) 235-274.

Arends, G.J., *Stuwen en sluizen: de ontwikkeling van de sluis- en stuwbouw in Nederland tot 1940* (Delft 1990).

Aten, D., "*Als het geweld comt...*": politiek en economie in Holland benoorden het IJ, 1500-1800 (Hilversum 1995).

Aten, D., 'Petrus de Sonnaville (1765-1837). Heemraad en dijkgraaf van de Schermeer, stadsarts en politicus', *Tijdschrift voor Waterstaatsgeschiedenis* 13 (2004) 1, 1-12.

- Baar, P.J.M. de, 'Simon Jacobsz Hulsebos, uitvinder van de vijzel', *Jaarboekje Rijnlandse Molenstichting* (1980) 40-58.
- Baar, P.P. de, 'Sloten: een wandelend dorp', *Ons Amsterdam* 44 (1992) 1, 22-25.
- Baars, C., 'Andries Vierlingh', *Civiele techniek* 2 (1982) 15-19.
- Baars, C., 'Leeghwater: een herwaardering', *Spiegel Historiae* 21 (1986) 1, 2-9.
- Baars, C., 'Willem Symonsz en Cornelis Jansz Scraelinck', *Civiele techniek* 3 (1980) 17-20.
- Baars, C., *De geschiedenis van de landbouw in de Beijerlanden* (Wageningen 1973).
- Bakker, M.S.C., 'Engeland als leverancier van techniek en technische kennis. Enkele gevallen uit de achttiende en negentiende eeuw', *Jaarboek voor de Geschiedenis van Bedrijf en Techniek* 7 (1990) 35-53.
- Barends, W., 'De zeedijk van zijn ontstaan tot het jaar 1730', *Waterbouwkundig Tijdschrift Orgaan van de vereniging van waterstaatkundige ambtenaren van de Rijkswaterstaat (OTAR)* 45 (1961) 195-206.
- Bavel, B. van en J.L. van Zanden, 'The Jump-start of the Holland Economy during the late-medieval crisis, c. 1350-1500', *The Economic History Review* 57 (2004) 3, 503-532.
- Bavel, B. van, 'Land, lease and agriculture', *Past and Present* 172 (2001) 3-43.
- Bavel, B. van, 'People and land: rural population developments and property structures in the Low Countries, c. 1300-c. 1600', *Continuity and Change* 17 (2002) 1, 9-37.
- Beenakker, J., 'Het agrarisch veenlandschap', S. Barends (red.), *Het Nederlandse landschap* (Utrecht 1991) 37-46.
- Beenakker, J., *Lisse op de grens van droog en nat: de bewoningsgeschiedenis en landschapontwikkeling van een dorp in de bloembollenstreek tot omstreeks 1900* (Lisse 1993).
- Beenakker, J., *Van Rentersluze tot strijkmolen: de waterstaatsgeschiedenis en landschapontwikkeling van de Schager- en Niederperkoggen tot 1653* (Alphen aan den Rijn 1988).
- Belonje, J., *De Heer-Hugowaard (1629-1929). Een geschiedenis van den polder* (Alkmaar 1929).
- Berkel, K. van, *In het voetspoor van Stevin: geschiedenis van de natuurwetenschap in Nederland* (Meppel 1985).

- Bicker Caarten, A., *Middeleeuwse watermolens in Hollands polderland. 1407/'08-rondom 1500* (Wormerveer 1990).
- Bicker Caarten, A., *Molenleven in Rijnland. Bijdrage tot de kennis van het volksleven in de streek rondom Leiden* (Arnhem 1979).
- Bicker Caarten, A., *Stenen poldermolens in Rijnland: een bijdrage tot de kennis van de windwatermolens in het hoogheemraadschap van Rijnland* (Zaltbommel 1981).
- Bicker Caarten, A., *Zuid-Hollands Molenboek* (Alphen aan den Rijn 1965).
- Bieleman, J., *Geschiedenis van de landbouw in Nederland: 1500-1950: veranderingen en verscheidenheid* (Meppel 1992).
- Bijker, W., 'De sociale constructie van netwerken en technische systemen; nieuwe perspectieven voor de techniekgeschiedenis', *Jaarboek voor de Geschiedenis van Bedrijf en Techniek* (1987) 7-24.
- Boer, D.E.H. de, *Graaf en grafiek: sociale en economische ontwikkelingen in het middeleeuwse 'Noordholland' tussen ± 1350 en ± 1450* (Leiden 1978).
- Boon, C.A. den en D. Geeraerts (red.), *Van Dale Groot woordenboek van de Nederlandse taal* (Utrecht 2005) 3 delen.
- Borger, G. J., *De veenhoop: een historisch geografisch onderzoek naar het verdwijnen van het veendek in een deel van West-Friesland* (Alphen aan den Rijn 1975).
- Bosch, A., *Om de macht over het water: de nationale waterstaatsdienst tussen staat en samenleving 1798-1849* (Zaltbommel 2000).
- Bosch, A., van der Ham, W, Berkers E. ea, *Twee eeuwen Rijkswaterstaat: 1798-1998* (Zaltbommel 1998).
- Bremer, J., *Heren, boeren en knechten: bedijking en bewoning van de Wieringerwaard, 1610-1810* (Schoorl 1989).
- Brink, P. van den, *Melchior Bolstra. Declaraties over het Leidse kwartier* (Haarlem/Leiden 1979-1985) 5 delen.
- Brink, P. van den, 'Rijnland en de rivieren. Inrichting en vormgeving van de Hollandse rivierzorg in de achttiende eeuw', *Tijdschrift voor Waterstaatsgeschiedenis* 12 (2003) 2, 69-78.
- Brink, P. van den, "In een opslag van het oog": *de Hollandse rivierkartografie en waterstaatszorg in opkomst, 1725-1754* (Alphen aan den Rijn 1988).

- Buis, J., *Historia Forestis. Nederlandse bosgeschiedenis* (Utrecht 1985) 2 delen.
- Burgh, W.F. van der, *Opzieners en landmeters van Rijnland* (Leiden 1954).
- Centraal Bureau voor Genealogie, *Nederlands Patriciaat* ('s Gravenhage, 1946).
- Clazing, A.M., *Wegenbeheer in Rijnland in de vijftiende en zestiende eeuw* (Onuitgegeven doctoraalscriptie Amsterdam 1980).
- Clercq, P. de, 'De ontwikkeling van het provinciale wegennet tot 1953', J.L. van der Gouw (red.), *Honderd jaar Provinciale Waterstaat in Zuid-Holland. Enige opstellen over de geschiedenis* ('s Gravenhage 1975) 95-145.
- Cock, J.K. de, *Bijdrage tot de historische geografie van Kennemerland in de Middeleeuwen op fysisch-geografische grondslag* (Groningen 1965).
- Cruyningen, P. van, 'Waterbeheer, landbouw en samenleving in West-Zeeuws-Vlaanderen in de 17^{de} en 18^{de} eeuw', *Jaarboek voor Ecologische Geschiedenis* 6 (2001) 57-66.
- Cruyningen, P. van, Profits and risks in drainage projects in Staats-Vlaanderen, c. 1590-1665, *Jaarboek voor Ecologische Geschiedenis* (2005/2006) 123-142.
- Dam, H., *De Oude Sluis te Vreeswijk: een waterstaatkundig monument* (Utrecht 1998).
- Dam, P.J.E.M. van, 'Gravers, ofzetters en berriedragers. Werkgelegenheid aan de Spaarndammerdijk omstreeks 1510', *Tijdschrift voor Sociale Geschiedenis* 18 (1992) 4, 447-478.
- Dam, P.J.E.M. van, 'Spuien en heien. Innovatie en de rol van de stedelijke elite bij de sluisbouw te Spaarndam in de 15^{de} eeuw', L. Giebels (red.), *Zeven eeuwen Rijnlandse uitwatering in Spaarndam en Halfweg. Van beveiliging naar beheersing* (Leiden 1994) 29-46.
- Dam, P.J.E.M. van, 'De tanden van de waterwolf. De rol van de turfwinning bij het ontstaan van het Haarlemmermeer in de vijftiende eeuw', *Tijdschrift voor Waterstaatsgeschiedenis* 5 (1996) 2, 81-91.
- Dam, P.J.E.M. van, *Vissen in Veenmeren. De sluisvisserij op aal tussen Haarlem en Amsterdam en de ecologische transformatie in Rijnland, 1440-1530* (Hilversum 1998).
- Dam, P.J.E.M. van, 'Digging for a dike. Hollands Labour Market, ca. 1510', J.L. van Zanden (red.), *Peasants into farmers? The transformation of a rural economy and society in the Low Countries (Middle Ages-19th century) in the light of the Brenner debate* (Turnhout 2001), 220-255.
- Dam, P.J.E.M. van, 'Ecological challenges, technological innovations: the modernization of sluice building in Holland 1300-1600', *Technology and Culture* 43 (2002) 500-520.

Dam, P.J.E.M. van, 'De nieuwe waterstaatsgeschiedenis. De interactie tussen mens en natuur in Holland', *Holland Historisch Tijdschrift* 36 (2004) 3, 128-141.

Danner H. en F. Kappers, *Geld onder water. Een onderzoek naar financiële bescheiden in de archieven van Noord-Hollandse droogmakerijen gedurende de vroegmoderne tijd* (Amsterdam 2002).

Davids, C.A., 'De technische ontwikkeling van Nederland in de vroeg-moderne tijd. Literatuur, problemen, hypothesen', *Jaarboek voor Geschiedenis van Bedrijf en Techniek*, 8 (1991) 9-37.

Davids, C.A., 'Successful and failed transitions. A comparison on innovations in windmill-technology in Britain and the Netherlands in the early modern period', *History and Technology* 14 (1998) 3, 225-248.

Davids, C.A., 'Universiteiten, Illustre scholen en de verspreiding van technische kennis in Nederland, eind 16^e -begin 19^e eeuw', *Batavia Academica* 8 (1990) 3-34.

Davids, C.A., *Zeewezen en wetenschap: de wetenschap en de ontwikkeling van de navigatietechniek in Nederland tussen 1580 en 1815* (Amsterdam 1986).

Davids, K., 'Patents and patentees in the Dutch Republic between c. 1580 and 1720', *History and Technology* 16 (2000) 263-283.

Davids, K., 'Public knowledge and common secrets and its limits in the early modern Netherlands', *Early Science and Medicine* 10 (2005) 3, 411-427.

Davids, K., 'River control and the evolution of knowledge: a comparison between regions in China and Europe, c. 1400-1850', *Journal of Global History* (2006) 1, 59-79.

Davids, K., 'Shifts of technological leadership in Early modern Europe', K. Davids en J. Lucassen (red.) *A Miracle Mirrored: The Dutch Republic in European Perspective* (1995) 338-366.

Davids, K., *Windmills and the openness of knowledge. Technological innovation in a Dutch industrial district, the Zaanstreek c. 1600-1800*, Paper for the Annual Meeting of the Society for the History of Technology (San Jose, CA, October 2001).

Devreese, J. en G. Vandenberghe, *'Wonder en is gheen wonder', de geniale wereld van Simon Stevin 1549-1620* (Leuven 2003).

Diederiks, H.A. en P.C. Spierenburg, 'Economische en sociale ontwikkelingen', *Deugd boven geweld. Een geschiedenis van Haarlem* (Hilversum 1995).

Dijk, B. van, 'Leeghwater en de Bijlmermeer', *Tijdschrift voor Waterstaatsgeschiedenis* 1 (1992) 2, 70-75.

- Dijksterhuis, E., *Simon Stevin* ('s-Gravenhage 1943).
- Disco, C. 'De verdeling van zoet water over heel Nederland 1940-1970', *Techniek in Nederland in de twintigste eeuw* (Zutphen 1998) deel 1, 111-121.
- Disco, C. en E van der Vleuten, 'The politics of wet system building: balancing interests in dutch water management from the Middle Ages to the present', *Knowledge, Technology and Policy* 4 (2002) 21-40.
- Dissel, E.F. van, 'Grond in eigendom en in huur in de ambachten van Rijnland omstreeks 1545', *Jaarboek van de Maatschappij der Nederlandse Letterkunde* (1897) 152-153.
- Dolfing, B., 'Commissarissen hoogheemraden van het Haarlemmerkwartier: professionalisering in bestuur en beheer', L. Giebels (red.), *Zeven eeuwen Rijnlandse uitwatering in Spaarndam en Halfweg, van beveiliging naar beheersing* (Hilversum 1994) 75-98.
- Dolfing, B., *Waterbeheer geregeld?: een bestuurskundige analyse van de institutionele ontwikkelingen van de hoogheemraadschappen van Delfland en Rijnland, 1600-1800* (Leiden 2000).
- Dolk, Th.F.J.A., *Geschiedenis van het hoogheemraadschap Delfland* ('s Gravenhage 1939).
- Doorman, G., *Octrooien voor uitvindingen in de Nederlanden uit de 16^e en 18^e eeuw* ('s Gravenhage 1940).
- Doorn, Z. van, 'De geschiedenis van het aftichelen van kleiland langs de Oude Rijn en de invloed daarvan op de landbouw en het landschap', *Jaarboekje van Oud-Utrecht* (1963) 75-88.
- Filarski, R., *Kanalen van de koning: goederenvervoer, binnenscheepvaart en kanalenbouw in Nederland en België in de eerste helft van de negentiende eeuw* (Amsterdam 1995).
- Fluit, Th.P.M. van der, 'De voorgeschiedenis van de Provinciale Waterstaat in Noord-Holland 1815-1881', *Holland Historisch Tijdschrift* 14 (1982), 185-192.
- Fockema Andreae, S.J., *Grondeigenaars en grondgebruikers in een hoekje van Holland* (Wageningen 1964).
- Fockema Andreae, S.J., *Het hoogheemraadschap van Rijnland, zijn recht en zijn bestuur van den vroegsten tijd tot 1857* (Leiden 1934). Facsimileherdruk Alphen aan den Rijn, 1982.
- Fockema Andreae, S.J., *Kastelen, ridderhofsteden en buitenplaatsen in Rijnland* (Leiden 1952).
- Forbes, R.J., *The principal works of Simon Stevin* (Amsterdam 1966) volume V.
- Frijhoff W. en M. Prak (red.), *Geschiedenis van Amsterdam* (Amsterdam 2004-2005) 3 delen.

- Fuchs, J.M., *Beurt- en wagenveren* (Den Haag 1946).
- Gerding, M.A.W., *Vier eeuwen turfwinning: de verveningen in Groningen, Friesland, Drenthe en Overijssel tussen 1550 en 1950* (Wageningen 1995).
- Gevers van Endegeest, D.T., *Het hoogheemraadschap van Rijnland* ('s Gravenhage 1871).
- Giebels, L. (red.), *Zeven eeuwen Rijnlands uitwatering in Spaarndam en Halfweg. Van beveiliging naar beheersing* (Leiden 1994).
- Giebels, L., 'Het waarborgfonds van het hoogheemraadschap van Rijnland', *Holland Historisch Tijdschrift*, 21 (1989) 160-180.
- Giebels, L., *Hollands water: het hoogheemraadschap van Rijnland na 1857* (Utrecht 2002).
- Giebels, L.A.M., 'Het stoomgemaal van 1857. Twee generaties boezemgemalen te Gouda', L. Giebels (red.) *Waterbeweging rond Gouda van ca 1100 tot heden* (Leiden 1988), 39-58.
- Gijsbers, W., *Kapitale ossen. De internationale handel in slachtvee in Noordwest-Europa (1300-1750)* (Hilversum 1999).
- Glaudemans, M., *Amsterdams Arcadia* (Nijmegen 2000).
- Gottschalk, M. K. E., *Stormvloeden en rivieroverstromingen in Nederland* (Assen 1971-1977) deel 2, 1400-1600.
- Gouw, J.L. van der, 'De voorgeschiedenis van de dienst van de Provinciale Waterstaat in Zuid-Holland', J.L. van der Gouw (red.), *Honderd jaar Provinciale Waterstaat in Zuid-Holland. Enige opstellen over de geschiedenis* ('s Gravenhage 1975) 9-43.
- Gouw, J.L. van der, *De landscheidingen tussen Delfland, Rijnland en Schieland* (Hilversum 1987).
- Habets, A.C.J., 'Het waterrad van Genneté', *Spiegel Historiae* 13 (1978) 620-625.
- Ham, W. van der (red.), *Hoge dijken, diepe gronden. Land en water tussen Rotterdam en Gouda: een geschiedenis van Schieland* (Utrecht 2004).
- Hart, G. 't, 'De polders rondom Voorschoten', J.L. van der Gouw (red.), *Voorschoten. Historische studiën* (Den Haag 1971) 89-127.
- Hart, M. 't, *Inventaris van het archief van de Lisserpoelpolder onder de gemeenten Lisse en Sassenheim 1622-1962*. (aanwezig in de bibliotheek van het hoogheemraadschap van Rijnland)

Haubourdin, R.M. (red.), *De Physique existentie dezes lands: Jan Blanken inspecteur-generaal van de waterstaat (1755-1838)* (Amsterdam 1987).

Havinga, A., *Windwaarnemingen in Holland in de 18^{de} eeuw* (Rotterdam 1948).

Hollestelle, J., *De steenbakkerij in de Nederlanden tot omstreeks 1560* (Arnhem 1976).

Hoogheemraadschap van Rijnland, *De uitwateringssluizen van Katwijk 1404-1984* (Leiden 1984).

Hoppenbrouwers P. en J.L. van Zanden, *Peasants into farmers? The transformation of rural economy and society in the Low Countries (middle ages-19th Century) in the light of the Brenner debate* (Turnhout 2001).

Horsten, F.H., *Historische wegeatlas van Nederland, 16e tot 19e eeuw* (Amsterdam 1992).

Horsten, F.H., *De doorgaande wegen in Nederland van de 16^{de} tot de 19^{de} eeuw* (Amsterdam 2005).

Houtzager, H.L., 'Joannes Hudde een veelzijdig Amsterdams regent', *Holland Historisch Tijdschrift* 19 (1987) 1, 44-54.

Hughes, T.P., 'Technological momentum', M.R. Smith (red.), *Does Technology drive History?* (Cambridge 1994) 101-113.

Hughes, T.P., *Networks of Power. Electrification in Western Society, 1880-1930* (Baltimore 1983).

Huitema, T., *Dijken langs zee, rivieren en kanalen, kaden om polders, droogmakerijen enz.: samenstelling, aanleg, onderhoud* (Amsterdam 1947).

Ibelings, B., 'De Hollandse paardenmarkten', *Holland Historisch Tijdschrift* 29 (1989) 2, 91-106.

Ibelings, B., 'De route "binnen dunen". De scheepvaartroute langs de Goudse sluis en tol, de Wassenaerse Gouwesluis en de Spaarndammertol (13^e-16^e eeuw)', *Vander rekeninghe: bijdragen aan het symposium over onderzoek en editieproblematiek van middeleeuws rekeningmateriaal, gehouden in Utrecht op 27 en 28 februari 1997* (Den Haag 1998) 221-255.

Ibelings, B., 'Het begin van het slagturven in Holland', *Historisch Geografisch Tijdschrift* 14 (1996) 1- 10.

Ibelings, B., 'Turfwinning en waterstaat in het Groene Hart van Holland vóór 1530', *Tijdschrift voor Waterstaatsgeschiedenis* 5 (1996) 2, 74-80.

Jacob, M., *Scientific Culture and the Making of the Industrial West* (Oxford 1997).

Jansen, L., *De morgenboeken van het ambacht Ter Aer in Rijnland, 1543-1600* (1935). (aanwezig in de bibliotheek van het hoogheemraadschap van Rijnland)

Janson, E.M.Ch.M., *Uit de geschiedenis van Wassenaar* (Den Haag 1972).

Jeurgens, C., 'De bouw van de stoomgemalen te Spaarndam en Halfweg in het midden van de 19^e eeuw', L. Giebels (red.), *Zeven eeuwen Rijnlandse uitwatering in Spaarndam en Halfweg. Van beveiliging naar beheersing* (Leiden 1994) 99-118.

Jeurgens, C., 'Statistics as an Instrument in the Struggle against water 1700-1850', P. Klep en I. Stamhuis (red.), *The statistical mind in a pre-statistical era. The Netherlands 1750-1850* (Amsterdam 2002) 299-320.

Jeurgens, C., *De Haarlemmermeer. Een studie in planning en beleid 1836-1858* (Amsterdam 1991).

Jong, J.J. de, *Met goed fatsoen. De elite in een Hollandse stad, Gouda 1700-1780* (Amsterdam 1985).

Kaal H. en J. van Lottum, 'Duitsers in de polder', *Holland Historisch Tijdschrift* 35 (2003) 263-276.

Kaijser, A., 'Preparing the ground for the Golden Age. The development of Dutch water systems in the Middle Ages', B. Liljewall (red.), *Agrarian systems in early modern Europe. Technology, tools, trade* (Stockholm 1999).

Kaijser, A., 'System-building from below. Institutional change in Dutch water control systems', *Technology and Culture* 43 (2002) 3, 521-548.

Kaijser, A., 'Technological systems in the natural world. Water and windmills in the Netherlands', J. Odhnoff en U. Svedin (red.), *Technological systems. Changes and Economic theories* (Stockholm 1998).

Kaptein, H. *De Hollandse textielnijverheid 1350-1600. Conjunctuur en continuïteit* (Hilversum 1998).

Keunen, G.H., 'Waterbeheersing en de ontwikkeling van de bemalingstechniek in West-Nederland. De historische ontwikkeling van poldermolens en gemalen tot heden', *Bijdragen en mededelingen betreffende de geschiedenis der Nederlanden*, 103 (1988) 571-606.

Keuning, K.J.B., *Geschiedenis van de wegen tussen Rijn en IJ* (Haarlem 2000).

Kloosterman, W.L., 'Het waterstaatsbeheer in de Bataafs-Franse tijd: 1795-1813', J.C.N Raadschelders en Th.A.J. Toonen, *Waterschappen in Nederland. Een bestuurskundige verkenning van de institutionele ontwikkeling* (Hilversum 1993) 93-106.

- Kloot-Meyburg, B. van der, *De economische ontwikkeling van een zuid-hollandsch dorp (Oudshoorn) tot in den aanvang der twintigste eeuw* ('s Gravenhage 1920).
- Kooijmans, L., *Onder Regenten. De elite in een Hollandse stad, Hoorn 1700-1780* (Amsterdam 1985).
- Kuys, J. en J.T. Schoenmakers, *Landpachten in Holland, 1500-1650* (Amsterdam 1981).
- Labordus, J.Ph., *De Oudshoornse elite in de achttiende eeuw* (onuitgegeven doctoraalscriptie Leiden 1984)
- Leenders, K., *Verdwenen venen: een onderzoek naar de ligging en exploitatie van thans verdwenen venen in het gebied tussen Antwerpen, Turnhout, Geertruidenberg en Willemstad* (Brussel 1989).
- Leenheer, S.C.H. en W. Glasbergen, 'Het Armhuys van Rijnsburg', *Leids Jaarboekje* (1951) 94-101.
- Leeuwen-Canneman, M.C. van, 'Poldervorming in oostelijk Delfland aan het einde van de Middeleeuwen', *Hollandse studiën* 12 (1982) 73-111.
- Lesger, C., 'Lange-termijn processen en de betekenis van politieke factoren in de Nederlandse houthandel ten tijde van de Republiek', *Economisch en sociaal-historisch jaarboek* 55 (1992) 105-142.
- Lieburg, M.J. van, en H.A.M. Snelders, "*De bevordering en volmaking der proefondervindelijke wijsbegeerte*": de rol van het Bataafsch genootschap te Rotterdam in de geschiedenis van de natuurwetenschappen, geneeskunde en techniek (1769-1988) (Rotterdam 1989).
- Linden, H. van der, 'De Koningsroede', *Jaarboek voor Middeleeuwse Geschiedenis* (2000) 7-43.
- Linden, H. van der, 'De voorgeschiedenis van de Rijnlandse poldermolen', 25 jaar Rijnlandse Molenstichting (Leiden 1983).
- Linden, H. van der, 'Een nieuw publiekrechtelijk fenomeen in de veertiende eeuw: de Rijnlandse polder', *Samenwinninge: tien opstellen over de rechtsgeschiedenis geschreven ter gelegenheid van het tienjarig bestaan van het Interuniversitair Instituut Nederlands Centrum voor Rechtshistorische documentatie* (Zwolle 1977) 133-162.
- Linden, H. van der, 'Het ontstaan van de dorpen in de Rijnstreek', R. Leeftang (red.), *In de Rijnvaart der volkeren* (Alphen aan den Rijn 1988) 21-53.
- Linden, H. van der, 'Oorsprong en oudste ontwikkeling van het hoogheemraadschap van Rijnland', *Holland Historisch Tijdschrift* 22 (1990) 3, 129-149.

- Linden, H. van der, *De Cope: bijdrage tot de rechtsgeschiedenis van de openlegging der Hollands-Utrechtse laagvolakte* (Assen 1955).
- Lintsen, H., 'Stoom en bemaling', *Geschiedenis van de techniek in Nederland: de wording van een moderne samenleving* ('s Gravenhage 1993) deel IV, 105-148.
- Lintsen, H., 'Van windbemaling naar stoombemaling; innoveren in Nederland in de negentiende eeuw', *Jaarboek voor de Geschiedenis van Bedrijf en Techniek* 2 (1985) 48-63.
- Lintsen, H., *Ingenieurs in Nederland in de negentiende eeuw: een streven naar erkenning en macht* (Den Haag 1980).
- Lit, R. van, *Kastelen en buitenplaatsen in Rijnland* (Zutphen 1983).
- Lit, R. van, *Wassenaarse Oudheden* (Nieuwkoop 1979).
- Lucas, A., *Wind, water, work. Ancient and Medieval Milling Technology* (Leiden 2006).
- Lucassen, J., *Naar de kusten van de Noordzee* (Gouda 1984).
- Lunenburg, J. C., 'Van de vroegere molenrijkdom van Nieuwkoop en omgeving', *25 jaar Rijnlandse Molenstichting* (Leiden 1984).
- Lunenburg, J. C., 'Van Molenmakers en andere bedrijvigheden aan de Oude Wetering', *25 jaar Rijnlandse Molenstichting* (Leiden 1984).
- Maanen, R.C.J. van (red.), *Leiden. De geschiedenis van een Hollandse stad* (Leiden 2002-2004) 4 delen.
- Maanen, R.C.J. van, 'De ongemakkelijke verhouding tussen Leiden en Rijnland', *Holland Historisch Tijdschrift* 28 (1996) 3, 139-148.
- MacCants, A., *Civic charity in a golden age: orphan care in early modern Amsterdam* (Urbana 1997).
- MacLean, J., 'De nagelaten papieren van Johannes Hudde', *Scientiarum Historia* 13 (1971) 144-162.
- Misa, T., 'Retrieving Sociotechnical Change from Technological Determinism', M.R. Smith (red.), *Does Technology drive History?* (Cambridge 1994) 115-141.
- Moelker, H.P., *De molen van W.F. Dorn Seiffen* (Ruinen, 1993).
- Mokyr, J., *The Lever of the Riches. Technological Creativity and Economic Progress* (New York 1990).

- Mokyr, J., 'The industrial Revolution in the Netherlands: why did it not happen?', *De Economist* 148 (2000) 4, 503-520.
- Mokyr, J., *The Gifts of Athena: historical origins of the knowledge economy* (Princeton 2003).
- Mooij, W. de, *Uit Voorhouts verleden* (Arnhem 1964).
- Muller, E. en K. Zandvliet, *Admissies als landmeter in Nederland voor 1811* (Alphen aan den Rijn 1987).
- Neve, R. de, 'Bouwers van Nederland. De waterstaatsdynastie Caland', *Jaarboek Centraal bureau voor Genealogie* 57 (2003) 113-138.
- Nierop, H. van, *Van ridders tot regenten. De Hollandse adel in de zestiende en de eerste helft van de zeventiende eeuw* (Amsterdam 1990).
- Noordegraaf, L., 'Droogmakerijen en bedijkingen in Noord-Holland (16^e-19^e eeuw). Financiën en economie', *Alkmaar, stad en regio. Alkmaar en omgeving in de Late Middeleeuwen en Vroegmoderne Tijd* (Hilversum 2004) 51-62.
- Noordegraaf, L., 'Het platteland van Holland in de zestiende eeuw. Anachronismen, modelgebruik en traditionele bronnenkritiek', *Economisch en Sociaal-historisch Jaarboek* 48 (1985) 8-18.
- Noordegraaf, L., *Hollands Welvaren? Levensstandaard in Holland 1450-1650* (Bergen 1985).
- Noort, A.C.L. van, 'De buitenplaats Hemmeer te Warmond', *Leids Jaarboekje* 90 (1998) 205-210.
- Oerle, H.I. van, *Leiden binnen en buiten de stadsvesten: geschiedenis van de stedenbouwkundige ontwikkelingen binnen het Leidse rechtsgebied tot aan het einde van de Gouden Eeuw* (Leiden 1975).
- Pauw, S. van der, *Verhaal van middelen tot verversching van het water in de grachten der stad Leyden, gedurende eene reeks van bijna tweehonderd en vijftig jaren* (Leiden 1829).
- Pols, K. van der, 'De introductie van de stoommachine in Nederland', H. van Riel (red.), *Ondernemende geschiedenis* ('s Gravenhage 1977) 183-198.
- Pouls, H.C., *De landmeter: van de Romeinse tijd tot de Franse tijd: inleiding in de geschiedenis van de Nederlandse landmeetkunde* (Alphen aan den Rijn 1997).
- Pouw, G.J., *Wiekssystemen voor polder en industriemolens* (Deventer 1982).
- Prak, M., *Gezeten burgers. De elite in een Hollandse stad: Leiden 1700-1780* (Amsterdam 1985).

- Prooije, L. A. van, 'De invoer van Rijns hout per vlot 1650-1795', *Economisch- en Sociaal-historisch Jaarboek* 53 (1990) 30-79.
- Radkau, J., *Natur und Macht. Eine Weltgeschichte der Umwelt* (München 2000).
- Ramaer, J.C., *De omvang van het Haarlemmermeer en de meren waaruit het ontstaan is op verschillende tijden voor de droogmaking* (Amsterdam 1892).
- Regtdoorzee Greup-Roldanus, S.C., *Geschiedenis der Haarlemmer bleekerijen* ('s Gravenhage 1936).
- Renes, J., 'Water management and cultural landscapes in the Netherlands', Danner, S., Renes, J., Toussaint, B. ea (reds.), *Polder Pioneers. The influence of Dutch engineers on water management in Europe 1600-2000* (Utrecht 2005) 13-32.
- Riet, A.J.J. van 't, 'Een droevig noodlot. Turfwinning in Rijnland en de ondergang van het ambacht Schoot', *Holland Historisch Tijdschrift* 36 (2004) 3, 256-278.
- Riet, A.J.J. van 't, 'Meetten, boren en besien'. *Turfwinning in de buitenrijnse ambachten van het Hoogheemraadschap van Rijnland 1680-1800* (Hilversum 2005).
- Roberts, L., 'An Arcadian Apparatus', *Technology and Culture* 45 (2004) 2, 251-276.
- Roest, M., 'De molenaars van de Vierambachtspolder', *De Jacobs ladder* 17 (1997) 1-2, 5-16 en 2-7.
- Roever, J.G. de, *Jan Adriaensz Leeghwater. Het leven en werk van een zeventiende-eeuws waterbouwkundige* (Amsterdam 1944).
- Roosenboom, M., *Die Holländischen Optiker Jan und Harmanus van Deijl und ihre Mikroskope* (Leiden 1940).
- Schaik, P. van, *Van polderpeil en molenzeil, 1764-1964: de geschiedenis van de uitgeveende Bovenkerkerpolder onder Amstelveen* (Drachten 1963).
- Schillemans, C. A., *De houtveilingen van Zaandam in de jaren 1655-1811* ('s Gravenhage 1947).
- Schilstra, J.J., *Schermerland: mensen en molens* (Schermerhorn 1971).
- Schmal H. en T. Stol, 'Vorming en omvorming van de polder Rietwijkeroord', A.O. Kouwenhoven, G.A. de Bruijne en G.A. Hoekveld (red.), *Geplaatst in de tijd* (Amsterdam 1984) 320-344.
- Schoorl, H., 'Het Hollandse kustgebied tussen Helinium en Vlie vanaf de Romeinse tijd tot 1421', J. Beenakker (red.), *Holland en het water: strijd tegen het water en beheersing en gebruik van*

het water (Hilversum 1997) 9-19.

Schoorl, H., *Het waddeneiland Callensoog onder het bewind van de heren van Brederode en hun erfgenamen, de graven van Holstein-Schaumburg, tot de verkoop aan vier Hollandse heren in ca. 1250-1614* (Hillegom 1979).

Schultz, E., *Van zee tot land. Waterbeheersing van de Nederlandse droogmakerijen* (Lelystad 1992).

Sipman, A., *Het hellend scheprad* (Zutphen 1977).

Sipman, A., *Molenbouw. Het staande werk van bovenkruiers* (Zutphen 1975).

Sliggers, B., '100 jaar natuurkundige amateurs te Haarlem', A. Wiechman (red.), *Een elektriserend geleerde: Martinus van Marum 1750-1837* (Haarlem 1987) 67-102.

Sloof, J., 'Voorschotens ambachten en neringen', J.L. van der Gouw (red.) *Voorschoten. Historische studiën* (Den Haag 1971) 169-196.

Sloof, J.H.M., 'De duikers en volmolens te Gouda en de gevolgen daarvan voor Rijnlands waterstaat', Hoogheemraadschap van Rijnland (red.), *Waterbeweging rond Gouda van ca 1100 tot heden* (Leiden 1988), 25-38.

Sloof, J.H.M., *De oudste bestuursregisters van het hoogheemraadschap van Rijnland (1444-1520): regesten van de handelingen van dijkgraaf en hoogheemraden* (Leiden 1999).

Sloof, J.H.M., *Inventaris van de polderarchieven van de voormalige polderafdelingen Middengeest en Zuidgeest* (Hilversum 1995).

Smit, J.G., *Vorst en Onderdaan. Studies over Holland en Zeeland in de late Middeleeuwen* (Leuven 1995).

Soens, T., 'Het waterschap en de mythe van democratie in het Ancien Régime. Het voorbeeld van de Vlaamse kustvlakte in de Late Middeleeuwen', *Jaarboek voor Ecologische Geschiedenis* 6 (2001) 39-56.

Soens, T., *Waterbeheer in een veranderende samenleving. Een ecologische, sociaal-economische en politiek-institutionele studie van de watering in het Vlaamse kustgebied in de overgang van de Middeleeuwen naar de Moderne Tijden. Testregio: het Brugse Vrije* (Ongepubliceerd proefschrift Gent 2006).

Sprenger, J. en V. Vrooland, *'Dit zijn mijn beren!': een onderzoek naar de arbeidsverhoudingen bij de aanleg van het Noord-Hollands kanaal* (Amsterdam 1976).

Staudenmaier, J.M., *Technology's Storytellers. Reweaving the Human Fabric* (MIT 1985).

- Steenmeijer, G., *Tot cieraet ende aensien deser stede. Arent van 's-Gravensande (ca. 1610-1662), architect en ingenieur* (Leiden 2005).
- Steur, A.G. van der, 'De geschiedenis van de Zwanburgerpolder te Warmond', *Leids Jaarboekje* (1961) 115-135.
- Steur, A.G. van der, 'De 18^e eeuwse administratie van een koopman in hout te Alphen aan den Rijn', *Rijnland*, 17/18 (1968) 633-635.
- Steur, A.G. van der, 'Grondbezit in Alkemade', *Tussen Kaag en Braassem* (Alphen aan den Rijn 1985) 173-176.
- Steuver, J. (red.), *Kastelen en buitenplaatsen in Zuid-Holland* (Zutphen 2000).
- Stokhuyzen, F., *Molens* (Bussum 1982).
- Stol, T. 'Schaalvergroting in de polders van Amstelland in de 17^e en 18^e eeuw', *Tijdschrift voor Waterstaatsgeschiedenis*, 3 (1994) 1, 13-21.
- TeBrake, W., 'Hydraulic engineering in the Netherlands during the Middle Ages', P. Squatriti (red.), *Working with water in Medieval Europe* (Leiden 2000) 101-127.
- TeBrake, W., *Medieval Frontier. Culture and Ecology in Rijnland* (College Station 1984).
- Teeling, P.S., *Repertorium van Oud-Nederlandse Landmeters, 14^e tot 18^e eeuw* (Apeldoorn 1981) 2 delen.
- Toen, E., 'Waterschappen en de maatschappelijke en ecologische transformatie van de Kustvlakte in de Middeleeuwen en het Ancien Régime. Bedenkingen en onderzoeksmogelijkheden', E. Huys en M. Vandermaesen (red.), *Polders en wateringen. Studiedag georganiseerd te Damme op 19 mei 2000* (Brussel 2001) 111-134.
- Thurkow, A.J., 'De droogmakerij van Bleiswijk en Hillegersberg, een opmerkelijke onderneming', *Holland Historisch Tijdschrift* 22 (1990) 1, 33-54.
- Thurkow, A.J., 'De overheid en het landschap in de droogmakerijen van de 16^{de} tot en met de 19^{de} eeuw', *Historisch Geografisch Tijdschrift* 2 (1991) 49-56.
- Tielhof, M. en P.J.E.M. van Dam, *Waterstaat in stedenland. Het hoogheemraadschap van Rijnland tot 1857* (Utrecht 2006).
- Tielhof, M. van, 'Turfwinning en proletarisering in Rijnland 1530-1670', *Tijdschrift voor sociale en economische Geschiedenis* 2 (2005) 4, 95-121.

Tuyl, W. van, *Het ambacht Zwammerdam: een bijdrage tot de geschiedenis van zijn vorming en zijn bestuur* (Hilversum 1998).

Unger, R.W., *Dutch Shipbuilding before 1800. Ships and Guilds* (Amsterdam 1978).

Veenendaal, A.J., 'De kennisoverdracht op het gebied van de spoorwegtechniek in Nederland 1830-1870', *Jaarboek voor de Geschiedenis van Bedrijf en Techniek* 7 (1990) 54-82.

Veenendaal, A.J., *De ijzeren weg in een land vol water: beknopte geschiedenis van de spoorwegen in Nederland 1834-1958* (Amsterdam 1998).

Ven, G. van de, 'Blanken en de waterstaat', R.M. Haubourdin (red.), *De Physique existentie dezes lands* (Amsterdam 1987) 59-94.

Ven, G.P. van de (red.), *Leefbaar laagland. Geschiedenis van de waterbeheersing en landaanwinning in Nederland* (Utrecht 1993).

Ven, G.P. van de (red.), *Leefbaar laagland. Geschiedenis van de waterbeheersing en landaanwinning in Nederland* (Utrecht 2003) (Tweede, gewijzigde druk).

Ven, G.P. van de, 'De uitwatering van de landstreek tussen Oude Rijn en Hollandse IJssel tot 1850', Hoogheemraadschap van Rijnland (red.), *Waterbeweging rond Gouda van ca 1100 tot heden* (Leiden 1988) 9-24.

Ven, G.P. van de, *Aan de wieg van Rijkswaterstaat: wordingsgeschiedenis van het Pannerdens kanaal* (Zutphen 1976).

Verbeek, T. (red.), *The Correspondence of Descartes 1643* (Utrecht 2003).

Visser, H.A., *Zwaaiende wieden. Over de geschiedenis en het bedrijf van windmolens in Nederland* (Amsterdam/Wormerveer 1946).

Vleuten, E. van der, 'Infrastructures and Societal Change. A View from the Large Technical Systems Field', *Technology Analysis and Strategic Management* 16 (2004) 3, 395-414.

Vleuten, E. van der, 'Twee decennia van onderzoek naar grote technische systemen: thema's, afbakening en kritiek', *NEHA-jaarboek voor economische, bedrijfs- en techniekgeschiedenis* 63 (2000) 349-353.

Vleuten, E. van der, en C. Disco, 'Water wizards: Reshaping Wet nature and Society', *History and Technology* 20 (2004) 3, 291-309.

Vliet, R. van, 'De poliep en de luis. Geleerden en boekverkopers in het midden van de achttiende eeuw', *Jaarboek voor Nederlandse boekgeschiedenis* 11 (2004) 145-161.

Vries, J. de en A. van der Woude, *Nederland 1500-1815. De eerste ronde van moderne economische groei* (Amsterdam 1995).

Vries, J. de, *Barges and Capitalism. Passenger Transportation in the Dutch Economy, 1632-1839* (Utrecht 1981).

Vries, J. de, *European Urbanization, 1500-1800* (London 1984).

Vries, J. de, *The Dutch rural economy in the Golden Age* (New Haven 1974).

Wereld, H. van der, *Polder Vierambacht. De geschiedenis van een droogmakerij* (Alphen aan den Rijn 1988).

Wiechmann, A., 'Van Accademia naar Academie. Het decor van de achttiende-eeuwse natuurwetenschappen in een notedop', A. Wiechman (red.), *Een elektriserend geleerde: Martinus van Marum 1750-1837* (Haarlem 1987) 33-66.

Wilt, C. de, 'Maaslandse kampen in Delfland. De sociaal-economische factor in de conflicten over gecentraliseerd waterbeheer in de zestiende eeuw', *Holland Historisch Tijdschrift* 37 (2005) 2, 78-101.

Winter, P.J. van, *Hoger beroepsonderwijs avant-la-lettre: bemoeiingen met de vorming van landmeters en ingenieurs bij de Nederlandse universiteiten in de 17^e en 18^e eeuw* (Amsterdam 1988).

Woud, A. van der, 'De ruimtelijke orde', *Geschiedenis van de techniek in Nederland: de wording van een moderne samenleving* (Zutphen 1992-1995) deel II, 95-101.

Woud, A. van der, *Het lege land. De ruimtelijke orde van Nederland, 1798-1848* (Amsterdam 1987).

Wouda, B. (red.), *Ingelanden als uitbaters. Sociaal-economische studies Oud- en Nieuw-Reijerwaard, een polder op een Zuid-Hollands eiland* (Hilversum 2004).

Woude, A. van der, *Het Noorderkwartier. Een regionaal historisch onderzoek in de demografische en economische geschiedenis van westelijk Nederland van de late Middeleeuwen tot het begin van de negentiende eeuw* (Utrecht 1983).

Woude, A. van der, *Leven met geschiedenis. Theorie, praktijk en toepassing van historische kennis* (Amsterdam 2000).

Zanden, J.L. van en A. Van Riel, *Nederland 1780-1914. Staat, instituties en economische ontwikkeling* (Amsterdam 2000).

Zanden, J.L. van, 'De timmerman, de boekdrukker en het ontstaan van de Europese kenniseconomie: over de prijs en het aanbod van kennis voor de Industriële Revolutie',

Tijdschrift voor sociale en economische geschiedenis 2 (2005) 1, 105-120.

Zanden, J.L. van, 'Op zoek naar de 'missing link'', *Tijdschrift voor sociale geschiedenis* 14 (1988) 359-386.

Zanden, J.L. van, *De economische geschiedenis van de Nederlandse landbouw in de negentiende eeuw, 1800-1914* (Wageningen 1985).

Zeischka, S., 'Besluitvorming rond de droogmaking van de Vierambachtspolder', *Tijdschrift voor Waterstaatsgeschiedenis*, 15 (2006) 1, 1-11.

Zeischka, S., 'De rekening gepresenteerd. Een onderzoek naar de rendabiliteit van een Zuid-Hollandse droogmakerij: de Lisserpoelpolder', *Holland Historisch Tijdschrift* 36 (2004) 3, 237-255.

Zeischka, S., 'Dealing with diversity: small-scale dikes in early modern Rijnland, 17th-early 19th century', *Jaarboek voor Ecologische Geschiedenis* (2005/2006) 175-194.

Zuidervaart, H., *Van 'Konstgenoten' en hemelse fenomenen. Nederlandse sterrenkunde in de achttiende eeuw* (Rotterdam 1999).

Zwet, H. van, 'De achtkante binnenkruier van de Schermer. Kosten en technieken', *Alkmaar, stad en regio. Alkmaar en omgeving in de Late Middeleeuwen en Vroegmoderne Tijd* (Hilversum 2004) 141-182.

Zwet, H. van, 'De 52 molens van de Schermer. Ontwikkeling van het molenbestand', *Alkmaar, stad en regio. Alkmaar en omgeving in de Late Middeleeuwen en Vroegmoderne Tijd* (Hilversum 2004) 65-140.

Zwet, H. van, 'De financiering van een droogmakerij. Een financiële analyse van de bedijking van de Schermer', *Holland Historisch Tijdschrift* 36 (2004) 3, 205-236.

REGISTER

Niet opgenomen in dit register zijn 'Rijnland', 'Haarlemmermeer' en de namen van polders uit de onderzochte casussen. Onvermeld zijn ook verwijzingen naar plaatsnamen en personen uit de bijlagen.

- Aalsmeer, 45, 49, 90, 128, 246, 286, 288
Aar, Ter, 25, 73, 76, 77, 78, 80, 81, 84, 96,
99, 100, 110, 118, 119, 120, 121, 139, 149,
150, 151, 153, 155, 186, 213, 214, 229,
230, 285, 286
Aarlanden, de, 73, 74
Abshoven, 139, 242
Abshoven, R. van, 139, 242
Abswoude, 174, 177, 180, 237
Adriaans, P., 189
Aeneae, H., 71, 93, 269, 278
Aerssen van Voshol, C. van, 186, 286
Alblasserwaard, 54
Aldenhoven, J., 139
Alkemade, F. van, 53, 264
Alkmaar, 39, 53, 253
Almere, het, 32
Alphen aan den Rijn, 46, 48, 204
Ambachtsheer, 235
Amersfoort, 253, 254
Amstelland, 39, 42, 304
Amstelveen, 40, 233, 286
Amsterdam, 9, 23, 26, 34, 36, 38, 39, 40, 42,
43, 50, 68, 84, 85, 86, 87, 88, 93, 101, 103,
110, 123, 124, 125, 128, 139, 161, 166,
192, 204, 249, 271, 276, 284, 286, 297,
307
Archimedes, 10
Aremberg, 41
Assendelft, van, 283
Backer, J., 258
Baerle, J. van, 266
Balthasars, F., 76, 77
Barreveld, 254
Bedijkte honderd morgen, 232
Beeckman, I., 276
Beijerlanden, 64, 65, 66, 216
Bennebroek, 41, 48
Berckenrode, H. van, 283
Berkenwoude, 59
Bilderdam, 39, 41, 250
Blanken, J., 21, 60, 100, 101, 158, 270, 282
Bleau, W., 139
Bleiswijk, 59, 232, 253
Blijdorp, polder, 59
Bloemendaal, 48
Blok, J.C., 139
Blom, 286
Bloys van Treslong, 179
Boel, G., 141
Boepolder, 139
Boerhaave, H., 267
Bolstra, M., 82, 268, 272, 273, 274, 275, 277,
278, 281, 282, 283, 284, 287, 301, 306,
307
Bonenburg, 233
Bosch, J., 284
Boskoop, 45
Bovenkerkerpolder, 93, 187, 233, 244, 286,
288
Braassemermeer, 26, 34, 76, 78, 79, 81, 84,
98, 100, 253, 287
Brederode, Reinoud III van, 40
Brons, 242, 243, 249, 250, 285
Brons, A., 243, 249
Brons, B., 242, 249
Brons, J., 249
Brugmans, H., 189
Bruijning, 284
Brunings, C., 164, 250, 269
Castelij, 245
Clock, J.A., 265, 266, 267
Colom, 76
Cronestein, 53
Cruquius, N.S., 21, 267, 268, 274, 281, 283,
286, 287
Da Vinci, 14
Dancker, 284

De Ligne, 41
 Deijl, J. van, 93, 268
 Delfland (Hoogheemraadschap van), 22, 33, 35, 42, 53, 54, 55, 90, 286, 287
 Delft, 35, 40, 48, 207, 247, 266
 Den Bosch, 74, 253
 Den Bosch, Meierij van, 253
 Den Haag, 9, 25, 40, 68, 123, 176, 192
 Desaguliers, 267
 Descartes, 266
 Diemerzeedijk, 267
 Dijkslot, 107
 Dobbe, J.P., 174
 Does, 33, 76, 134, 219
 Dordrecht, 39, 206
 Dorn Seiffen, W.F., 60, 250
 Douw, F., 267
 Douw, J., 249, 267
 Douwes, 249, 269, 282
 Douwes, J., 269
 Driemanspolder, 90, 287, 288, 294
 Drost, 239
 Duikerwetering, 76, 107, 119, 152, 153
 Duinen (Oude/Jonge), 31, 32
 Duitsland, 12
 Duivenvoorde, kasteel, 180
 Dusse, 76, 77, 96
 Duvenvoorde, heer van, 128
 Duyvis, 158
 Eckhardt, gebroeders, 59, 269, 278
 Eindhoven, 46
 Elias, F., 139
 Elst, A. van der, 230
 Engeland, 15, 60, 206, 208
 Engelman, J., 268, 274, 283, 284
 Esselijkerwoude, 25, 73, 74, 76, 77, 78, 81, 96, 100, 110, 111, 118, 119, 120, 121, 122, 123, 124, 134, 138, 149, 150, 151, 155, 216, 217, 218, 281, 285
 Fahrenheit, D.G., 58, 82, 267
 Fijnje, H., 270
 Florijn, J., 269
 Friesland, 48, 64, 252, 253
 Genneté, L. de, 49, 58, 59, 278, 289
 Gerstecoorn, J., 104, 105, 257, 281, 283, 286
 Golius, 276
 Goog, 33
 Googerpolder, 287
 Gouda, 9, 30, 35, 36, 37, 38, 39, 41, 49, 51, 117, 287
 Goude, C.F. van der, 62
 Goudriaan, K., 158, 270
 Gouwe, 32, 35, 38, 225
 Graft, 104, 253
 Greveling, 89, 104
 Grietensoen, J., 53, 264
 Grinwis, van, 282
 Groenweg, 102
 Groot-Brittannië, 12
 Haarlem, 9, 34, 36, 37, 38, 39, 40, 41, 43, 45, 46, 49, 54, 68, 84, 85, 86, 89, 101, 112, 117, 125, 126, 128, 167, 257, 268, 291
 Halfweg, 34, 35, 40, 49, 50, 51, 62, 84, 265, 267, 274, 283, 284
 Hamers, J., 239
 Hart, G. van der, 249
 Harteveld, A., 174, 175, 248, 249
 Hazerswoude, 147, 273, 275, 298, 307
 Heemstede, 41, 48, 59
 Heer Jacobswoude, 76
 Heereman van Zuydwijck, D., 139, 189
 Heerhugowaard, 272, 273, 274, 278
 Heerweg, 98, 110, 111, 112, 156, 170, 192
 Hees, van, 249
 Hees, W. van, 249
 Heijnoort, J., 139
 Heimanswetering, 33, 76, 78, 79, 97, 110, 151, 152, 217
 Hellegat, 88, 89, 104, 105, 167
 Hellevoetsluis, 59
 Helmond, 46
 Hemert, 242, 249
 Hemmeer, 43, 58
 Heussen, A., 189
 Heyningen, M. van, 204
 Hillegom, 41, 48, 73, 74, 116
 Hofman, 236
 Hoge Rijndijk, 50, 225
 Holland, 9, 20, 25, 33, 36, 39, 43, 44, 45, 46, 47, 49, 50, 52, 53, 54, 64, 70, 116, 117, 124, 130, 135, 147, 158, 161, 168, 169, 171, 173, 191, 192, 226, 249, 252, 253, 294
 Hollandse IJssel, 34, 35, 38, 48
 Honderd Morgen, 90
 Hondskoperdijk, 76, 110, 152

Hoochduijn, 176
 Hoochduin, 231
 Hoogeland, 253
 Hoogendijk, S., 268, 282
 Hoogeveen, C., 156
 Hoogeveen, G., 133, 140, 156
 Hoorn, 39, 117, 139
 Hoorn, P.J. van der, 139
 Hope, J., 59
 Houtrijk, 40
 Hudde, J., 139, 161, 267, 271, 274, 275, 276, 277, 284, 298
 Hulsebos, S., 58, 59, 89, 90, 266, 286, 288, 289
 Huygens, C., 266, 276
 Huygens, Chr., 267, 276
 IJ, het, 25, 26, 32, 33, 34, 37, 39, 63, 66, 67, 68, 71, 84, 85, 86, 101, 117, 252, 267, 275
 Jacobswoude, 73, 76
 Jans, G., 126
 Jansz, A., 266
 Jansz, R., 189
 Jordaan, 38
 Kalkoven, D.Dzn., 121, 138
 Kalkoven, familie, 231
 Kalkpolder, 48
 Kalslagen, 41
 Katwijk, 32, 35, 48, 49, 50, 59, 116
 Kerklaanvaart, 76
 Kerkvliet, 140
 Klinkenberg, B. van, 237, 238, 246, 247, 248, 285
 Klinkenberg, D., 237, 238, 246, 247, 248, 268, 273, 274, 285
 Klinkenberg, J.B. van, 237
 Kooij, R. van der, 247
 Korteraar, 76
 Korthoef, 249
 Kostverlorenvaart, 39, 84, 85, 87, 101, 102, 103, 109, 127, 131, 160, 163, 166, 209
 Koudekerk, 48, 76
 Kroon, 124
 Kudelstaart, 40, 41
 Kuijper, P.P., 139
 Langeraar, 77, 232
 Langerarse Dijk, 110, 111
 Lee, 32, 104, 253
 Leeghwater, J.A., 21, 49, 74, 257, 266, 278
 Leeuwen, F. van, 55, 238, 246, 247, 249, 250, 280, 283, 285, 296
 Lefebvre, Z., 139
 Leiden, 25, 27, 36, 37, 38, 40, 41, 42, 43, 44, 45, 49, 50, 53, 57, 89, 91, 92, 112, 118, 128, 129, 130, 131, 159, 161, 167, 169, 170, 172, 176, 205, 210, 237, 245, 246, 257, 267, 281, 295
 Leiderdorp, 41, 44, 48, 249
 Leidse Vaart, 76, 78, 79, 96, 97, 98, 100, 108, 120, 152, 253
 Leidsemeer, 34
 Leijden, D. van, 123
 Leimuiden, 40, 250
 Lek, 242
 Lelivelt, H.D., 139
 Lette, J., 164
 Lijkerpolder, 250, 287
 Lindenburg, M.Jzn., 121
 Lisse, 20, 40, 44, 45, 68, 73, 74, 88, 89, 104, 105, 112, 116, 128, 129, 130, 140, 166, 167, 169, 170, 181, 237, 238, 246, 253, 302
 Listingh, N., 267, 277
 Loo, G. van, 189
 Loten, I., 189
 Luiten, J.J., 139
 Lutkemeer, 85
 Maljapenkade, 102, 103, 162, 209, 284
 Mare, 32
 Maurik, H. T. van, 139
 Maurits, prins, 265
 Meer van Hoogeveen, familie van der, 140
 Mérode, I. van, 41
 Minerva, 310
 Mijderwijk, 236
 Mijdrechtse Poel, 59
 Molenaar, P., 139
 Moreel, 246, 285
 Mourisz, J.D., 258
 Muiderdijk, 254
 Musketier, familie, 190
 Muys, C., 266
 Nassau, M. van, 271
 Nieuwe Meer, 87, 102
 Nieuwediep, 59
 Nieuwer-Amstel, 233
 Nieuwerkerk, 41, 49

Nieuwkerk, 253
 Nieuwkoopse Droogmakerij, 187, 233
 Nieuwkoopse Poel, 187
 Nieuwveen en Noorden, 41
 Nooms, W., 41, 43
 Noord-Holland, 20, 39, 43, 45, 49, 54, 57,
 64, 65, 117, 130, 147, 186, 190, 249, 252,
 253, 255, 292
 Noordplassen, 273, 292
 Noordwijk, 48, 116
 Noordwijkerhout, 48, 116
 Noordzee, 21, 32, 44, 50, 252, 253, 255
 Noort, van, 43, 245
 Noppen, J., 268, 273, 274
 Obdam, F., 58, 272, 274, 331
 Obreen, H., 179
 Oegstgeest, 41, 48
 Ookmeer, 85
 Opdam, Jacoba, 250
 Opdam, Jan, 250
 Opdam, P., 250
 Osdorp, 40, 85, 162, 333
 Osdorperslimweg, 165
 Osdorperweg, 165
 Osdorperzijweg, 165
 Oudshoorn, 25, 40, 41, 48, 73, 76, 77, 78,
 80, 81, 96, 97, 98, 100, 110, 111, 118, 119,
 120, 121, 122, 123, 124, 138, 141, 149,
 150, 151, 152, 155, 156, 184, 185, 189,
 191, 194, 197, 210, 211, 253, 259
 Oudshoorn, F., 141
 Oudshoorn, J.J., 139, 330
 Overbrakerbinnenpolder, 101
 Overbrakerbuurt, 85
 Overpad, 102
 Overtoom, 39, 88, 102, 103, 109, 162, 163,
 165
 Overtoomse Vaart, 39
 Overveen, 48
 Paddenburg, 285
 Paddenburg, S., 179, 250
 Paddenburg, T., 250
 Pallandt, baron G.J.A.A. van, 130
 Panders, A., 274
 Papenweg, 176
 Passavant, G., 277
 Pauw, familie, 41, 281
 Pieters, W., 249
 Poellaan, 112
 Polanen, 40
 Pot, firma, 59
 Redelykheid, C., 278
 Reeuwijk, J., 141
 Reuvens, ir., 282, 287
 Ridder, P.C., 121
 Ridderbuurt, 111, 123
 Rietveld, A. van, 230
 Rietwijk, 49, 233
 Rijn, (Oude), 25, 26, 32, 35, 36, 40, 42, 43,
 46, 48, 50, 53, 54, 55, 63, 66, 67, 68, 76,
 77, 79, 105, 111, 116, 130, 204, 210, 225,
 287, 291
 Rijndijk, 50, 67, 76, 173, 225
 Rijnsaterwoude, 25, 73, 77, 81, 110, 124,
 149, 155
 Rijnsburg, 116, 132, 232
 Rijnsburger, D.K., 123
 Rijnsburger, familie, 121, 123, 139
 Rijnsburger, W.Kzn., 121
 Rijpwetering, 76, 250
 Rob, P., 139, 370
 Roos, F., 267, 283
 Rotgans, J., 139
 Rotterdam, 40, 59, 266, 282
 Ruijchaver, W., 283
 Sassenheim, 73, 75, 88, 89, 116, 128, 166,
 167, 238
 Schalkwijk, 41
 Schellingerhout, C. van, 123, 138
 Schermer, 164, 185, 186, 187, 188, 190
 Scheurleer, J., 140
 Schieland, 35, 42, 53, 232
 Schinkel, 39, 102, 232
 Schinkelweg, 102
 Schouten, 124, 139, 147
 Schrama, 140
 Schuyt, G., 139
 Segens, A.J., 266
 Six, familie, 41
 Sleswijk-Holstein, 65
 Slimweg, 102
 Sloot, 85
 Sloten, 26, 40, 42, 85, 86, 87, 102, 104, 111,
 124, 125, 126, 127, 130, 139, 159, 160,
 161, 162, 165, 181, 192, 219, 252, 284,
 286, 291, 293, 294, 296, 302, 307

Sloterdam, 85
 Sloterdijk, 40, 85
 Sloterdijkmeer, 126, 164
 Slotermeer, 85, 86
 Sloterslimweg, 165
 Slotervaart, 102, 109, 124
 Sloterweg, 102, 103
 Snoek, A., 284
 Spaarndam, 34, 35, 37, 39, 49, 50, 51, 61, 84, 250, 252, 267
 Spaarndammerdijk, 26, 33, 34, 40, 50, 63, 67, 84, 85, 86, 101, 102, 125, 159, 252
 Spaarne, 32, 33, 35, 37, 49, 117
 Spieringhornerbinnenpolder, 101
 Spieringmeer, 34
 Spruytenburg, D., 243, 245, 247, 250, 269
 Stampioen, 281
 Starnmeer, 58
 Steengracht d'Oosterland, N., 134
 Steenstra, P., 269
 Stevin, H., 276
 Stevin, S., 21, 27, 57, 58, 62, 63, 69, 70, 265, 266, 271, 272, 275, 276, 278, 298
 Stigten, W., 285
 Stommeer, 58, 128
 Stommeerpolder, 287
 Stompwijk, 41, 73, 74, 90
 Storm-Buysing, 282
 Strichthuizen, van, 246
 Suurmond, W., 141
 Swaenenburgh, C. van, 189
 Tetrode, 233
 Teunisse, L., 246
 Tienhoven, 254
 Timmers, J., 243, 250, 285
 Trekvaart, Haarlemmer, 281, 284
 Trekweg, 86
 Treurniet, L., 247
 Twent van Rozenburg, A.J., 134
 Uiterbuurt, 41
 Uithoorn, 232
 Uitweg, 86, 87, 102, 104
 Utrecht, 40, 45
 Valkenburg, 73, 75, 90
 Van Berkum, D., 254
 Van Dam, 124
 Van Egmond, 41
 Van Gael, 286
 Vecht, 48, 242
 Velsen, A., 247, 267
 Vennip, de, 41
 Verdegaal, 140
 Verenigde Staten, 12
 Verhaar, J., 231
 Verkade, C., 139
 Versloot, W.J., 138
 Verwer, J.H., 189
 Veur, 45, 90, 178, 233, 249
 Vierlingh, A., 21, 65, 264, 276
 Vijfheerenlanden, 54
 Vijfhuizen, 41
 Vilsteren van Laren van der Straten, G. van, 121
 Viruly, 287
 Vis, K., 101, 157, 158, 159, 232, 247, 282, 283, 284
 Vlamingh, C. de, 41, 43
 Vliet, 15, 26, 32, 40, 105
 Voorhout, 44, 73
 Voorschoten, 26, 73, 74, 75, 90, 91, 116, 130, 131, 132, 133, 135, 136, 141, 172, 173, 174, 175, 176, 177, 178, 181, 197, 211, 227, 249, 285, 288, 297, 301, 302
 Voort, van der, 140
 Voshol, landen van, 147
 Vreeburg, 140
 Vries, J. de, 249
 Vriesekoop, 40
 Vrije Geer, 162
 Vroonland, 98, 107, 217
 Vroonlanden, 77, 281
 Vroonlandse Wetering, 76, 150
 Vuuren, C. van, 82
 Vuyk, 236
 Waddinxveen, 232, 247, 249, 285
 Waltman, M., 59, 232, 242, 243, 244, 273, 282, 286
 Warmond, 43, 82, 116, 232, 249
 Wassenaar, 26, 43, 44, 73, 90, 91, 116, 130, 131, 132, 133, 134, 136, 141, 172, 173, 174, 175, 176, 178, 181, 197, 217, 218, 219, 227, 285, 287, 288, 297, 301, 302
 Wassenaarse Polder, 58, 294, 309
 Wassenaer van Twickelo, graaf van, 123
 Wassenaer, familie van, 133, 139, 140, 287

Wassenaer, graaf van, 123, 141, 218, 219, 221
Wassenaer, gravin van, 134, 141
Wassenaer, Vrouwe van, 123
Wassenaer-van Ruyven, van, 177
Watergraafsmeer, 127
Wendeldijk, 33
West-Zaandam, 249
Wierikke, Enkele en Dubbele, 35
Wieringen, G. van, 123, 124, 139, 232
Wijde Aa, 76
Wijngaerden, J. van, 117
Willem I, 255
Willem VI, 53
Wittert, A., 121
Woerden (Grootwaterschap van), 22, 33, 233
Wolfse, Z., 267
Woubrugge, 108, 110, 124, 156, 315
Woudweg, 119
Woudwetering, 33, 76, 81, 123, 152
Zaal, C. van der, 238
Zaandam, 204, 205, 249
Zaanstreek, 279
Zeeland, 252, 253
Zevenhoven, 41
Zevenhovense en Nieuwkoopse Droogmakerij, 187
Zijl, 33, 235, 236, 249
Zijl, Dammis van, 235
Zijl, Dirk van, 236
Zijl, J. van, 249
Zoetermeer, 34, 47, 233
Zoetermeer, het, 34
Zoeterwoude, 41, 48, 117, 273
Zuiderzee, 32
Zuid-Holland, 9, 20, 25, 42, 43, 45, 46, 52, 53, 54, 55, 56, 71, 124, 171, 253, 264, 266
Zuidwijk, 90
Zwammerdam, 32, 33, 45
Zwetwetering, 76, 81, 83
Zwyndrecht, P. van, 268

SUMMARY

Minerva in the polder. Water management and technology in the hoogheemraadschap of Rijnland (1500-1856)

1. Introduction

This dissertation deals with early modern water management technologies (polder mills, sluices, dikes and roads which sometimes serve as embankments) in the so-called *hoogheemraadschap van Rijnland*, covering more or less the area between Amsterdam, Haarlem, The Hague and Gouda. It presents a contextual history of the mentioned water technologies between 1500 and 1856 and has three main goals. First of all, the book investigates the role of technology in water management on the Dutch countryside: did technology stimulate or hinder certain trends in the way man dealt with water? Or did a very complex process that found its origins in societal, economic and environmental evolutions have technological developments as outcome? Secondly, this study can be considered as a contribution to the debate on technological history of the Dutch Republic. What differences and similarities can be discerned between developments in water technologies and other fields of technology, for example ship building or navigation? Apart from the historical developments, one can also confront traditional explanatory models used in these fields with the findings of our research. Have the causality and arguments formulated by other historians any validity if applied to water technology, or did the latter follow its own path? Finally, this book contains a more theoretical approach to the subject. The analysis of early modern water management deals with the question whether or not a combination of the concept of Large Technological Systems (LTS) and the concept of circulation of knowledge enriches our understanding of the actual technological developments.

2. Research questions and setup

The first chapter of this study discusses the main features of the Rijnland region and the major developments within this area. It contains necessary information for the understanding of the rest of this summary. For that reason, it is welcome to look closer to chapter's content. Water management was organized in a two-levelled structure: the *hoogheemraadschap van Rijnland* or regional water authorities (RWA) were in charge of water management and infrastructures of regional importance, for example the dunes, sea dikes and drainage sluices along the IJ (the only outlets for the whole area, see the map on page 30). The RWA also managed the regional drainage system. A very significant feature of the system's structure was the Haarlemmermeer: a big inland lake that functioned as a reservoir where locally drained water could be stored before it ran through Rijnland's sluices into the IJ. The lower level, in fact most of the local scale water management, was under control of so-called polders

or local water boards (the role of *ambachten* can be considered less important). The majority came into being between 1580 and 1660; some were reclaimed lakes, but they were not so numerous in Rijnland.

The Rijnland region witnessed a complex and multifaceted social and economic transformation during the early modern times. Speaking in general terms, one can distinguish two phases. The first, commonly referred to as the Golden Age, a period of almost continuous growth, started at the end of the sixteenth century and ran up to about 1660. It was followed by an 'age of crisis'.

The Rijnland area differed of course very little from the rest of the province of Holland as far as the more general societal developments are concerned. Both rural and urban population grew steadily from the sixteenth century onwards, which made agricultural commodities as well as fuel more expensive. Except for grain imports from the Baltic, the countryside could provide both: land was used for pasturage and for the extraction of peat. In such an economic environment, the traditional, sixteenth-century peasant, with his small mixed farm (both agriculture and small-scale peat digging) could survive quite easy. After 1660 however, the decades of economic prosperity were over: population figures started to stagnate and urban industries declined. This downswing affected the countryside very deeply because prices and land leases dragged dramatically. In fact, the crisis triggered a long process of social polarization and proletarianization, starting after 1660 but continuing throughout the entire eighteenth century. On the one hand, the small peasant holding concentrating on cattle and small-scale peat digging experienced difficult times and was doomed to disappear. Lower prices threatened the livability of such family businesses; the situation got even worse because other dramas hit rural communities too, for example devastating outbreaks of cattle virus. Other, more structural, trends undermined the small farm as well. The lands could not provide any longer enough income since most private owned peat lands were completely exhausted and as a result the remaining lands were too small to live from. On the other side, the economic crisis offered chances for others. Some farmers were able to turn the situation into their advantage by innovating and by purchasing lands of the waning small farmer. Bigger commercial enterprises took the lead, landownership concentrated, remaining peat digging became 'big business', and in response to the agricultural crisis more extended farms emerged. In short, the farmer replaced the peasant and those with too little means to adapt were obliged to look for other incomes. Moreover, the urban elites eager to invest in landownership in the previous century now withdrew from landownership. The eighteenth century witnessed thus the emergence of a rural elite of more commercial farmers and a large group of proletarians.

Throughout the early modern period, the Rijnland region also experienced an extended environmental transformation. The Haarlemmermeer was more difficult to control and its size increased incessantly, despite the modernization of the sluices along the IJ in the sixteenth century. Besides peat digging near the borders, natural elements played a very destructive role. Winds drove the water to one border where the raised water level caused strong swells. The lake washed away the peaty lands and caused an immense devastation: even some villages disappeared in the lake. Nevertheless, the expansion of the lake had its advantages as well, because – from the local water management point of view – it increased the storage capacity. The construction of stone protection works at the most vulnerable spots (1766) stopped the lake's expansion; a first step towards its reclamation in the first half of the

nineteenth century. The construction of a new outlet for Rijnland's water near Katwijk was undoubtedly a precondition for this huge project (1807).

Chapter II provides the reader a literature-based introduction to general developments in early modern water technology. After discussing four specific technologies (drainage technologies, sluice building, dike and road construction), it compares general patterns in water technology with developments in ship building and navigation technology. It also draws some provisional conclusions on the characteristics of water technology.

The actual (archival) research uses a bottom-up perspective and presents a comparison of four micro studies, taking four polders and their local water boards as principal research units: the Vierambachtspolder and its predecessors, the Sloterbinnenpolder, the Lisserpoelpolder and finally a cluster of polders on the *Zuidgeest*, south of Leiden (see the map on page 30). The technological developments in these polders in relation to their historical context are the main focus in the rest of the book.

Chapter III starts with a detailed reconstruction of technological developments in each single case, while chapters IV to VIII constitute a thematic analysis of the context. Each of them explores a specific cluster of research questions. Chapter IV discusses land ownership, land use and land profitability. There are not only obvious and direct relations between land use and water technology, but these topics provide necessary elements for the following chapters. For example, when we consider the ownership of water board members, we can define the social background of the decision makers. The analysis of financial aspects is not accurate if data on land profitability based on rents and land leases are not taken into account. The next chapter focuses on decision making. Rules and regulations from the water boards themselves or from the RWA are one thing, but what was real practice like? How did people with different interests solve their problems? What was the role of the RWA considering its supervising position and its juridical powers? Chapter VI scrutinizes financial aspects of local water management, exploring short term and long term financing, the latter obviously in relation to agrarian conjuncture. Other questions are: what was the share of technology in the total amount of expenses? What dynamics appeared on the long term and how were they related to technological developments? The last but one chapter deals with labour organization. Windmill operators, carpenters, millwrights, dike workers but also land owners who were sometimes responsible for maintenance, were all important for operating, constructing and maintaining water technology. How did they influence technology? Could they stimulate or block innovation or not? In order to answer such questions, it is necessary to analyse their relation to local water boards, their labour conditions and for some of them their position on the labour market or their social status. Finally, technological knowledge is the connecting thread that runs through the concluding chapter. It investigates the social and institutional background of 'knowledge producing' people and the place of science in the process of innovation. Other questions concern knowledge itself: how 'open' was it, what kind of technological knowledge are we talking about and what role played knowledge in developing technology, considering its intrinsic characteristics? The ultimate goal is to track down patterns in which knowledge circulated and to define to what extent local water boards participated. Once these matters are clear, it becomes possible to relate technological developments and application of certain knowledge in the polder to circulation patterns.

3. Results and interpretations

Reconstruction of technological developments

In the beginning of the sixteenth century, only a few drainage mills and some polders existed in Rijnland: they were situated along the borders of the Old Rhine and close to Haarlem. The overwhelming part of the area still drained in a natural way. The real breakthrough of mill drainage dates from the second half of the sixteenth century (especially between 1560 and 1570) and consisted mainly of individually owned horse mills. The switch to wind mills took place in the last quarter of the century. It is worth mentioning that although the diffusion of mill drainage was a phenomenon with regional dimensions, local developments displayed very sharp differences mostly in numbers and types of mills. The emergence of polders resulting from collaboration between local peasants, started from the 1580's.

During the so-called Golden Age (1580-1660), local communities embanked and drained nearly every square inch of Rijnland's countryside. In some areas, for example in peat areas, establishing one polder led to the erection of another because non-embanked lands experienced water problems caused by polder drainage and thus had to be drained as well. In other areas, for example in the *Zuidgeest* (south of Leiden on the sandy soil near the dunes), polders grew more steadily beginning with smaller polders that successively expanded. Except for these 'normal' polders which were intended to improve the quality of existing lands, the same period also saw the reclamation of a few lakes. In this respect, however, Rijnland holds a rather modest place and the few examples of drained lakes are not comparable to the simultaneous spectacular achievements in other parts of Holland. Technological developments went hand in hand with this total reorganization of the landscape. Mills became bigger and aerodynamically better designed (for example the shape of the sails), although one has to interpret such innovations as modifications of existing technologies. Radical innovations were unsuccessful despite some new inventions. Two types of mills (the octagonal mill and the so-called *wipmolen*) equipped with scoop wheels remained dominant. Although the Lisserpoelpolder used the Archimedean screw successfully as an alternative for scoop wheels, its application would prove to be exceptional. It is difficult for this early period to draw clear conclusions about developments in other fields of water technologies (dikes, embankments, sluices or roads) because the archival sources remain too scarce and too vague. Nevertheless, one can fairly state that such technologies played a major role in the emergence of polders. Roads, for example, started to function as a polder's embankment.

The year 1660 was a decisive turning-point. The process of establishing polders came to a halt, neither were there new lake reclamations. Yet, technological developments did not stop and the last decades of the seventeenth century could be characterized as a period of technological divergence between polders. In general it is right to say that some evolutions took place in every polder, but the extent and the tempo of these developments were very uneven. The nature of the evolutions also differed in comparison with the Golden Age: small innovations and improvements replaced the construction of new polders, mills and dikes (a process that can be considered as one of radical and comprehensive innovation). Specifications for the construction of sluices and embankments, for example, reveal changes in size, shape and materials. Nevertheless, the most important development was related to

the specifications which tended to become longer and more precise. Specifications for sluices comprised very detailed and elaborated descriptions about the exact measurements of certain parts and of the way they should be assembled. These developments could be tracked down for every technology except for roads which were by that time in bad condition. In some cases, the *ambachten* were in charge for roads that served as embankments and local water boards were thus unable to do something about the situation. As mentioned, technological developments consisted mostly of smaller modifications, but that does not alter the fact that sometimes big innovations took place. Especially disasters (inundations or mills that burned down) acted as triggers for more radical novelties. On the other hand, water boards could handle smaller problems (like unequal drainage) by altering the use and operation of existing technological infrastructures.

New dynamism began to dawn from the 1730's onwards. Peat extraction had reached its zenith and had turned many polders into peat lakes. Their reclamation was not only large, capital intensive project but also meant a splendid opportunity to introduce new technologies, in particular new drainage devices. A lot of experiments with new inventions took place but in the end, they proved unsuccessful and the traditional scoop wheel remained most popular. Another eighteenth century innovation implied the use of new materials (bricks for wind mill construction, instead of wood). This possibility was discussed in nearly every water board but its eventual application bears a geological stamp: brick mills were only built on sandy soils and not on the soft and weak peat soils where this innovation would have required much many modifications (pile-works) and costs. The use of iron was also discussed but in the end, the material was not applied because too expensive. Innovation in dike construction showed divergent developments. In some polders new technologies made their entry, for example in the Vierambachtspolder and the Lisserpoelpolder. Elsewhere (polders on the *Zuidgeest*), eighteenth century developments should be interpreted as a continuation of seventeenth century evolutions. Finally, there was no change for the better in Sloten, where roads protected the polders from the threatening Haarlemmermeer. The situation remained very precarious, despite serious discussions after 1750.

The nineteenth century showed much more stability in local water technologies. In fact the infrastructure in Rijnland's polders did not change very much, especially during the French period. Discussions on technological innovation revived only in the last decades of the research period (after 1830), but one has to admit that such discussions are documented only for bigger polders like the Vierambachtspolder and the Sloterbinnenpolder. In the former the subject of the debates was steam drainage and the introduction of Archimedean screws (a project realized in the second half of the century), in the latter only the screws appeared in the arguments. Realization of fundamental changes did not occur rapidly as the introduction of screws in the Sloterbinnenpolder clearly demonstrates: 35 years separate the first experiments with a horse powered mill and the replacing of the last scoop wheel with a screw. Other innovations touched the domain of water protection works and more specifically smaller embankments and roads. Traditional decentralized maintenance was quite detrimental for such infrastructures and lead to a great extent to their dysfunction. Reforms of maintenance practices and the introduction of new materials intended to improve the quality of these small scale technologies.

The paragraph above discussed technological developments. The next step is to interpret and explain these evolutions. The first way of looking to the historical story is the most empirical one: it specifically aims at defining the relation between technology and water management, or more precisely formulated: the relation between historical evolutions in water technologies and the transformation of the countryside. Today's historiography offers new interpretations of water management history that broaden existing explanations. Water management becomes the result of the interplay between environmental challenges, economic interests, policy and social developments. In fact, it covered the interests of many different groups in society. How does our research on technology fit into such new insights and what was the role of technology in such a complex process?

First of all, it seems appropriate to consider land-related trends as driving forces behind water management and water technology because water management in our case was by definition intended to affect the condition of land and soil. Many choices in relation to land use had direct effects on water technology. Thus, economic choices evoked certain technological developments. A few illustrations make this point very clear. The breakthrough of polders and mill drainage is to be interpreted as land improving measurements and investments in the agrarian sector, supported by a growing economy. Everywhere in Rijnland, peasants started to embank and drain their lands, the longer the more in a collective manner. The same counts for the first two thirds of the seventeenth century. Some peasants experienced detrimental effects of other polders, an incentive for them to follow the others and establish a polder. Accounts have shown that the costs for such an investment are not to be underestimated, although one has to be careful with such generalizations. The reclamation of lakes fits in the scheme of economic prosperity and investment opportunities for urban elites. Land use also played a remarkable role in the eighteenth century. By then, the central part of Rijnland had experienced severe environmental damage because of several decades of land destructive peat extraction. Thousands of acres turned into water. A total reorganization of drainage and water management infrastructures was inevitable in order to realize a recovery of agrarian activities. Again, massive sums of money were invested which resulted in big geometrical peat-reclamations. The social polarization and the emergence of a new rural elite of large farmers supported of course this scale enlargement. In the course of our research period, technology has always been able to realize or to maintain an economic rational land use. It did not always require the introduction of new technology or heavy investments. Modifications in the use of technology sometimes sufficed, for example the introduction of drainage during the winter in the late seventeenth century.

Although such land-related issues explain the cause of many technological interventions, it does not explain the ultimate choice for this or for that technology. At this point, one has to look for completely different mechanisms. Local water boards, fully in charge of their polders, had in theory a free choice in matters of technological decision-making. In reality however mainly four factors influenced or even limited their freedom of movement. These were land ownership, the landscape and its consequent impact on land ownership, some economic parameters and finally the role of other interest groups.

Land ownership was important in various ways. First of all, it influenced the background of decision-makers. One can say that, speaking in general terms, the economic elite of the

polder had always the power in hand. Smaller farmers still had the opportunity to participate in the seventeenth century, but gradually lost this possibility in later centuries. To have a position in decision-making was the business of big land owners who occupied all important functions in the local water board. This trend reflected the social polarization in the eighteenth century. Another aspect of land ownership relates to the networks on which a water board could rely and thus also to the availability of certain technological knowledge. Water boards with urban land owners had in this respect many more options than those without them. Our research pointed out that the latter gradually withdrew from (innovative) knowledge circuits. Social networks in relation to landownership thus influenced decision-making much more than the pure institutional features of water boards.

Such factors influenced decision-making, others limited it. For instance, one can not deny the impact of the environment and of the landscape. In some cases, purely natural phenomena challenged the water boards with very specific technological challenges. The continuous growth of Haarlemmermeer until well into the eighteenth century threatened the dikes and embankments of adjacent polders (especially the Sloterbinnenpolder and the Lisserpoelpolder). The bigger depth of peat reclamations like the Vierambachtspolder is a direct consequence of a geological situation. But if the environment set such constraints or challenges with which men had to deal, its impact was not deterministic. Given a certain situation, men still had the choice to react one way or another. This becomes very evident if one looks to the diffusion of the use of bricks for mill construction. From a technical point of view, it was perfectly possible to build them in peat areas as well, but because the board of the Vierambachtspolder considered the necessary pile-works too expensive, they ultimately abandoned the plan. The landscape played also a more indirect role via landownership. Shifts in land ownership depended mostly on the general economic and agrarian conjuncture. But its impact differed from place to place because of the environment and the investment priorities of various social groups. Urban elites, for example, bought lands during the Golden Age but geographically in a rather concentrated way. They were definitely not omnipresent; they rather participated in the reclamations of lakes or bought some lands and near the cities where they gradually replaced other groups. Vice versa, urban elites were almost absent in peat areas. It is interesting to note that urban land owners withdrew in the eighteenth century. As a consequence, polders previously dominated by urban landownership came in hands from rural landowners, as the case of the Lisserpoelpolder clearly showed. This in its turn affected the available networks and diminished the need for administration.

The impact of economic trends was mostly felt in the eighteenth century, when land leases collapsed and costs for water management seriously increased due to a price-rise for timber. It is not always clear how water boards reacted to the narrowing financial margins. There are indications of the under-financing of the Lisserpoelpolder and the Sloterbinnenpolder, in the sense that the polder's income (based on a sort of land tax, called *molengeld*) was lower than the expenses for at least a few successive years. More important, however, is how water boards dealt with the situation technologically. The shrunken financial liveability was an incentive to replace timber with less wearing bricks, so that maintenance cost would not continue to rise. More commonly, most water boards introduced organizational changes, by redefining labour relations, stricter wage policies (long term contracts instead of the yearly putting out) and better administration. The nineteenth century saw a relaxation in financial terms, which meant that the incentive for further innovation (for example steam technology)

disappeared. It is clear that water boards were well aware of financial aspects, even in good times. Big projects like reclamations went always hand in hand with at least the will to introduce cost cutting innovations. In case of the Vierambachtspolder's reclamation, the water board had at least thought of three alternative drainage devices for the traditional scoop wheel.

Finally, the last factor is other interest groups, for local water management did not take place in a vacuum. The RWA was of course a major player for all Rijnland polders. The RWA remained rather passive towards the local water boards in the sixteenth and seventeenth century, despite its juridical powers and its right to grant licenses for all interventions in local water affairs. It started to become more active in the eighteenth century when it could rely on a well-educated technical staff of surveyors and supervisors. Nevertheless, its role would be very selective, both geographically and technologically. It intervened only in dike construction near the Haarlemmermeer. It is obvious that the RWA could play a role as a supplier of technical knowledge, thanks to social networks and to its institutional connection with local water boards. For the rest, the number and background of interest groups depended on specific local conditions. In the Zuidgeestpolders, water management became part of a conflict between two *ambachten* (Wassenaar and Voorschoten). This mainly political conflict did hinder not only a smooth introduction of winter drainage, but it also caused many other facets of water management to become problematic. In other areas, for example the Vierambachtspolder, all parties (local water boards, several *ambachten* and boatmen) always managed to find a harmonious way out. Local water boards were sometimes the victim of discussions between other groups as this was the case in eighteenth century Sloten, where the RWA and the city of Amsterdam (having the municipal rights of Sloten and in this way in charge of the roads and embankments) were in conflict about how to protect Sloten from the Haarlemmermeer. In the end, no solution was found, leaving the water boards in a very dangerous situation.

The impact of science or scientific culture remains rather limited within this variety of explanations. The results and the sort of knowledge (basically empirical) that scientists, 'engineers' and other experts produced, did not allow to design successful inventions. Even more, there was no real accumulation of knowledge until the second half of the eighteenth century. Experiments were isolated events and did not lead to a broader discussion about how to improve water technology. The institutionalization of (Newtonian) scientific research did not alter the nature of technological knowledge, which remained altogether very empirical and concentrated on measuring performances of devices rather than intending technological progression. Other cultural aspects, however, were visible in local water boards, for example a better administration towards the end of the eighteenth century. This was not everywhere to the same extent because challenges (for example the narrower financial margins) were different from place to place. In this respect, the social background of water board members also remains important. In fact, urban land ownership equals in most cases more administration. Such cultural aspects went hand in hand with the other factors mentioned above. They are to be interpreted as following or accompanying developments rather than as driving forces.

Finally, summarizing the relation between water technology and the transformation of the countryside, one has to conclude that technology itself stood in function of the economic

interests of different groups. Thus, although technology was not the cause of such broad historical evolutions, it made an essential part of the comprehensive rural transformation.

Water management and technological history

Now that an interpretation on the empirical level has been formulated, one can question the peculiarity of water technology in comparison with developments in other fields of technology. What exactly is the place of water technology in the technological history of the Dutch Republic? As mentioned earlier, ship building and navigation technology serve as counterexamples.

Even a superficial approach reveals some remarkable differences with the other technologies, in the first place because the chronology, pace and characterization of developments display some striking features. Historians have interpreted the standardization of design in ship building and navigation from the beginning of the seventeenth century onwards as a stagnation, which continued well into the eighteenth century. This was definitely not the case for local water technologies, where the period 1650-1730 was as one of incremental innovation. One just has to think of the specifications for embankments and sluices. However, it has been mentioned that the evolutions in the whole Rijnland area were not uniform. On the contrary, they were divergent. In short, technological developments in water history were more fluent and more differentiated than this was the case with ship building and navigation. How can this be explained?

The answer to that question consists of three elements. First, there was the role of centralization which was in matters of water management almost non-existent, especially when compared to ship building and navigation. Secondly, water management was much more interwoven with broad societal processes than other technologies. Finally, water technologies had some intrinsic features that help to explain the specific characteristics of their developments.

Let us first consider the role of centralization in decision-making. In the case of ship building, the specific organization of production proved to be crucial. In fact, there was a relatively decentralised structure: each town had its own guild. Their efforts for the education of apprentices and the exchange of knowledge came to the benefit of innovation. Slowly, a small group of entrepreneurs started to dominate the guilds and by consequence to control the whole system with more rules and regulations. This ultimately led to a stagnation of innovation in the seventeenth and eighteenth century. In navigation, however, centralization through the introduction of exams and regulations for the Indian Companies and the Admiralties turned out in totally different ways. Such a centralization limited the choice of technologies used on ships. But due to the fact that a group of key figures within the organization was in favour of innovation, the centralization eventually fostered innovation in the eighteenth century. The centralized organization and limited choice of the individual navigators proved ideal to introduce innovations.

Such mechanisms were by no means present in the world of water management, in the first place because of the institutional decentralization. The institutional structure of the RWA and the local water boards was not comparable to that in ship building or navigation. For example, there was no or only a very limited steering from above until well into the

nineteenth century. Water boards represented an almost completely autonomous structure, in which the RWA had no role in decision making. Nor did they limit the freedom of choice of the water boards in such a way that it significantly changed the course of local water technology history.

In fact the opposite took place. If in the case of navigation and ship building centralization affected technology, in water management technology provoked institutional centralization. Such processes could be traced in the polders where the narrow financial margins and the price-rise for timber initiated several organizational reforms, including more administration and in some cases the introduction of supervisors which can be regarded as a form of centralization. The same happened in the RWA, where the almost uncontrollable Haarlemmermeer led to a bigger role of the RWA's technical staff. Not only differed the causality of such centralization processes, moreover, centralization in eighteenth century water management occurred rather from a bottom-up perspective, in contrast to the top-down mechanisms in ship building and navigation. One should bear in mind however that centralization in water management did not start from the lowest level (that is local water boards), the dynamic sparked off from closely linked networks of hydraulic experts in scientific societies and the RWA. They contributed to the creation of a platform from which *Rijkswaterstaat* (the national service for water management) could emerge several decades later, although the origins of *Rijkswaterstaat* were much more situated in controlling the upper rivers such as the Meuse and the Rhine.

The consequences of centralization and its peculiarities in water management had little effect on technological evolutions, in the first place because they did not imply any institutional changes. There was no shift towards more hierarchy or more regulation. Local water boards remained autonomous and the interventions of the RWA in local affairs should be interpreted as a very partial feedback. Our research has shown that the RWA only intervened when their own interests were at stake, which was mainly in polders near the Haarlemmermeer. The same is true for *Rijkswaterstaat*, which focused on big projects of national prestige, something that was of course not to be found in Rijnland's polders.

The role of specialized millwrights as innovators and important carriers for circulation of knowledge among water boards is another intriguing feature of water management, for which there is no counterpart in ship building or navigation. The position of such technical experts is by no means comparable to those of experts in the other technological fields. The absence of guilds on the countryside was one of the main reasons: millwrights could act freely and were able to make their own technological choice, in contrast to the regulations imposed by guilds or the exams in the Indian Companies. On the other hand, millwrights were not able to play a role in decision making within water boards because they had no fixed place within the organizational structures. They were mere employees, despite their technological know-how. In short, (local) water management lacked a 'technical community' that could influence organizational structures.

Next to the multifaceted decentralization, the stronger impact of societal factors gives a clue of why water technologies followed their own paths through early modern times. In fact, both go hand in hand. Decentralization also entailed small scale decision making bodies which were very sensitive for specific local (social, economic and political) relations. Local water boards were thus relatively 'open' in contrast to guilds, not only internal but also external because water management had to deal with many other interest groups than just the

polder's land owners. Therefore, the outcome of a technical problem depended very much on the conflict solving abilities of a local community. In such a situation, there are three possible scenarios: one of the parties admits; both parties reach a consensus, or – the worst case scenario – there was no solution at all until the societal relations or interests at stake changed and the problem 'evaporated'. A first sight at the historical evidence for conflict solving in local water management, reveals no clear pattern. In one case, the conflict was solved rapidly and peacefully while it took decades to settle the argument in other cases. However, one gets a clearer picture on conflict solving if one takes social aspects into account. Conflicts seemed to have social implications and dimensions (for example urban versus rural land owners or nobility versus peasants) that almost determined the outcome. Speaking in general terms, the conclusion is that the bigger the social differences between conflicting parties, the more difficult it seems to solve problems. An extreme example makes the point clear. From the very reclamation of the Lisserpoelpolder (1622), the local water board of the polder was in conflict with the *ambacht* Lisse about navigation on the polder's circular canal. The polder experienced damage, while the navigation was of vital economic importance for the *ambacht*. There was however a sharp social difference between both parties. The polder was in hands of distant rich, urban investors, while the *ambacht* represented the interests of local peasants. The conflict led to a century of juridical processes and mutual nagging but its intensity gradually calmed down when the urban elite started to withdraw from land ownership in the eighteenth century. The immediate effect was a social equalization of the polder and the *ambacht* with the result that both came in hands of a single group of large farmers with non-conflicting interests. The ongoing conflict disappeared very quickly.

Finally, the third element in the comparison with other technologies (next to the decentralized structure of local water management and the greater impact of societal factors) consists of specific features of water technology. First of all, it is impossible to deny the connection between water technology and the environment or the landscape. Environmental changes in relation to economic trends determined to a large extent the pace and intensity of the necessity of technological intervention. The Haarlemmermeer and the RWA's intervention in matters of polder dikes and the land destruction through peat digging with the consequent reclamation illustrate this quite well. But environmental changes did not necessarily provoke a technological response. Again, the institutional decentralization or a conflict between several involved interest groups could block any solution as was the case in Sloten where technological progress did not come along, despite the overall awareness of the roads' bad condition.

Secondly, there is another striking difference with ship building and navigation which goes back to the intrinsic qualities of water technologies. It deals with the impact of short and long term developments. In ship building, for example, the continuous construction activities on wharves, created a platform for gradual innovation. Polders, however, were made of durable infrastructures: once the mill was built, he could easily serve for more than a century and thus limiting the opportunity for bigger innovations. This had two consequences. Technological developments in a single polder are characterized by a sharp distinction between short and long term developments. In case of the former, disasters usually triggered big, more radical innovations. A typical example is the burning down of a wooden octagonal mill; an event that suddenly created the opportunity for innovation. So, considering high timber prices in the eighteenth century, one should not be surprised that the next mill was made of bricks. The

second consequence was that technological developments and the adoption of innovations differed between polders, depending on the possibilities and constraints in specific places. This also explains the more gradual and differentiated picture of developments in local water management.

This paragraph concentrated on three elements that explained the different patterns in various domains of early modern technology, but one should not overlook that there were similarities as well. The most important were 'cultural' resemblances, for example the increasing role of 'technical communities' (in particular specialized millwrights, surveyors and supervisors) in the eighteenth century. There were many other parallels, especially when Newtonianism dropped in on water sciences: experimenting, popularization of science and technology and the institutionalization of research through scientific societies are just a few aspects, illustrating the common 'cultural background' of different technologies.

System and circulation

The last section of this summary focuses on another way of interpreting early modern water technology. It is according to the third historiographical aim of the dissertation a more theoretical approach which uses theoretical concepts such as the Large Technological Systems (LTS) and the circulation of knowledge. The original LTS-model contains various concepts of which the so-called 'reverse salients' is the most important for the theoretical analysis of our story. 'Reverse salients' can be understood as certain developments in the system's functioning that interest groups consider 'problematic'. Precisely these situations make not only interest groups visible but also facilitate the link to the circulation of knowledge: in solving 'problematic developments' and thus ensuring the system's functioning one needs per definition a certain amount of knowledge and in this way, these 'reverse salients' also give a hint about circulation patterns. The implementation of this approach into our research has been fruitful. The final conclusion goes in two directions: on the one hand, the structure of the system explains patterns in circulation, but the inverse is also true. The significance of this conclusion for technological developments is that technology was in many ways the outcome of the interaction between both spheres (system and circulation). The more standardized polder dike design near the Haarlemmermeer, for example, can only be explained by system dynamics (the lake's growth) and the coercive knowledge transfers from the RWA (through the expertise of its staff and its interventions in granting licenses for reclamation projects). However, technological developments are by no means the *necessary* outcome of circulation of knowledge. The Archimedean screws from the Lisserpoelpolder were known in other polders, but their water boards did not follow the Lisserpoelpolder's example.

At this point, new questions rise. How should we define the exact relation between system and circulation? And how do we explain the dynamics of this interaction? The answer to these questions begins with the significance of knowledge circuits. Such circuits are connections between two or more system components that transfer knowledge. They can be very diverse. In our study, circuits were for example social networks, technology related literature, oral traditions, education and training of surveyors or technicians, while components are local water boards, the RWA, scientists or other technical experts,

millwrights, carpenters, mill operators and so on. If such circuits and their significance are more than incidental and they can no longer be separated from the system itself, they are inherent to the system. The institutional connection between the RWA and local water boards is one of this kind. Other circuits are much more dynamic but nevertheless, they also reshape and restructure the system. Some eighteenth century scientific societies got in touch with water management and thus extended and reshaped the system, but when they withdrew from participating in developing water technologies, one can no longer consider them part of the system. In this way, it is impossible to separate the development of a system and the circulation of knowledge.

The interaction between both spheres is thus evident, but what causes the dynamics in this interaction? Why and when does such an interaction take place and how does this affect technological evolutions? Again, 'reverse salients' are a helpful starting point for the analysis but one must be aware of the methodological consequences. Because 'reverse salients' are problematic developments they per definition throw a light on dynamic moments or transitional phases. These are not only exceptional situations from a theoretical point of view, but also from a historical, because such 'problems' are documented best. Normal non-problematic situations reveal much less and as a consequence we lose very rapidly knowledge circuits out of sight. There are nevertheless some conclusions to be drawn.

The satisfactory availability of existing knowledge is a major parameter with impact on the interaction between system and circulation: if existing knowledge and circuits are enough to deal with problematic developments, it is very probable that no changes will take place. This also includes the possibility that existing circuits start to provide other knowledge than they were originally intended for. The presence of RWA-surveyors in the Vierambachtspolder in relation to the polder's drainage problems in the second half of the eighteenth century illustrates this possibility because the original reason for their activities in this polder was in fact dike construction in relation to the RWA's 'Haarlemmermeer policy'. On the other hand, changes in the interaction between system and circulation become very likely if existing knowledge and circuits are dissatisfactory.

Such changes do not always happen by 'free acceptance' or 'free choice'. In some cases, new circuits originated from coercion or conflict situations. The RWA could enforce a standardized dike design in polders around the Haarlemmermeer because of its institutional supremacy, allowing the RWA to modify technological aspects of reclamation projects. In conflict situations, arguing parties sometimes mutually deny the accuracy of the others' knowledge and each of them searches for specific knowledge or particular circuits with the purpose to strengthen their own position in the conflict. The mechanisms that settle the conflict are of course similar to the ones mentioned the paragraph above, but the interesting thing is, that the intrinsic qualities of knowledge were not decisive in the final settlement. The conflict about roads in Sloten, where the RWA and the city of Amsterdam got involved, showed this very good. The RWA had its own technical staff of course, but Amsterdam did not hesitate to employ the city's own surveyors for a counter expertise.

Another important question focuses on the absence of interaction between system and circulation. It is true that changes in circulation usually come from system related problems, but the inverse is not. 'Reverse salients' do not necessarily lead to changes. Why not? What hinders the expected interaction?

First of all, the structure and dynamics of the system itself have a great impact. If certain components of the system are relatively distant to core developments, it is very likely that they adopt novelties much slower than others. In fact, the necessary and/or decisive incentives for innovation fail even if the possibility for innovation is present. A lack of priority for such cases (very often the result of the choices of system builders or other interest groups) explains thus why some parts of the system do not interact with changes in circulation patterns in the rest of the system. Although innovation in dike design was without any doubt a hot item in the eighteenth century, very little of it dropped in on the polders on the Zuidegeest, precisely because of this mechanism. These polders were of no priority to the RWA's staff, while local water boards did not feel the need to tap from these knowledge circuits, even if it was perfectly possible.

A second factor explains why changes in interaction did not take place, even with major incentives: the availability of own knowledge. If for example a local water board considered its 'own' knowledge satisfactory, the chances that the board might tap from newer or better circuits decreased seriously. *Rijkswaterstaat*, as the new (national) knowledge centre in the early nineteenth century, had no significance for local water boards, even not for water management on the provincial level, because they considered national engineers too expensive and their own expertise enough for the problems and challenges they had to deal with.

This example also leads to the role of a third parameter: the costs of knowledge. To what extent did this play a role? The final conclusion on this point is that technical knowledge was very cheap and very accessible and that costs did not hamper its circulation. The structure and the openness of the system, and the large impact of its societal context made circulation of knowledge in nearly every possible way very easy. The costs for knowledge are a theoretical possibility but offer very little explanation for early modern water management.

The different factors discussed in this paragraph determined to what extent system developments and related changes in knowledge circulation took place. Is there on this point any pattern in history to be discovered? What were the actual features of this interaction for the particular system of water management?

One of the most important aspects was the loose structure of the system. Speaking in institutional terms, the interconnectedness between the RWA and the local water boards remained rather limited. The water management system also showed a remarkable technological elasticity: developments on the regional level did not affect the local level everywhere to the same extent. The opposite is also true: isolated local trends were of little influence on the entire system. In addition, there was no real interdependence or whatsoever between the specific technologies within the polder: mills and dikes could develop relatively independent. Apart from such institutional and technical diversity, the social background of system builders and operators displayed a large fragmentation and differentiation. The conclusion therefore is that the technological system had impact on the possibility of applying knowledge (through the 'reverse salients'), but the actual form in which interaction between system and circulation took place was more the result of societal trends. This conclusion is not surprising if we consider the importance of decentralized decision making (see previous paragraph).

In particular social networks around certain individuals (mostly urban capital entrepreneurs belonging to innovative knowledge circuits) have left their fingerprints on

historical water technologies. This meant that land ownership was very crucial in local water management in the sixteenth and especially the seventeenth century when urban people invested more than ever – although geographically rather selective – in land ownership. Therefore it is no wonder that the economic malaise after 1660 had important consequences for water technology (less innovative initiatives). From that moment on, innovation kept going on only if the system's dynamic was strong enough, that is mostly around the Haarlemmermeer and mainly in dike construction. Anyway, the general picture of system remains very diffuse and nuanced.

Structural changes are situated in the eighteenth century in the form of an institutionalization of knowledge (for example scientific societies) and of more dense and homogenous social networks which made the traditional differentiation and fragmentation slowly fade away. Yet, the typical 'LTS-momentum' remained limited because such changes were not exclusive in water management, but were in fact more general societal trends. Moreover, the LTS-momentum concentrated on the national level (with the birth of *Rijkswaterstaat* in 1798) while the impact of such 'national' trends were of minor importance for local water management. This development went on in the first half of the nineteenth century. The prestige and priorities for *Rijkswaterstaat's* engineers were not in local water management. Autonomous water boards could thus continue to go their own way. By that time, it was not so much 'tradition' that hindered innovation in local water management, but rather the absence of necessary incentives to escape from it.