

The honour of Dutch seamen: Benjamin Franklin's theory of oil on troubled waters and its epistemological aftermath

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The learned, too, are apt to slight too much the knowledge of the vulgar. (Benjamin Franklin, 1773)

In 1757 Benjamin Franklin was sent to London by the Pennsylvania Assembly to plead a more equitable taxation policy for covering the expenses of the war against the French. During the first part of his journey Franklin was on a ship that was part of a fleet of 96 sail bound against Louisbourg on Cape Breton Island which was still in the hands of the French. Looking out over the sea he observed the wakes of two of the ships to be remarkably smooth, while all the others were ruffled by the wind. He asked the captain, who told him that the cooks had probably been just emptying their greasy water. The captain thought it a fairly stupid question, as this was common knowledge among seamen. According to what he later confessed to William Brownrigg it was this experience that prompted Franklin to carry out his own experiments: "In my own mind I at first slighted his [the captain's] solution, tho' I was not able to think of another. But recollecting what I had formerly read in Pliny, I resolved to make some experiment of the effect of oil on water, when I should have opportunity."¹

During his long stay in England (1757-1762; 1764-1775) he found plenty of opportunity. The most significant occasion occurred in the summer of 1772, when Franklin and his close friend John Pringle on their way to Scotland paid a visit to William Brownrigg who lived in Ormathwaite in the English Lake District. The three of them went to nearby Derwent Water, where Franklin demonstrated the wave-stilling effect of a little oil which he had the habit of taking with him, whenever he went into the country, in the upper hollow joint of his bamboo cane, with which he might repeat the experiment as opportunity should offer.² The significance of this experiment is not that the waves of Derwent Water were effectively stilled by Franklin's oil but that the Reverend James Farish could not believe his ears when he heard an account of this event. It is Farish's incredulity that ultimately led to the account published in the *Philosophical Transactions*. Farish wrote a letter to Brownrigg assuring him that he would be glad to have an authentic account of the Derwent experiment. Brownrigg forwarded this letter to Franklin on January 27, 1773. Franklin responded on November 7, 1773 with an

1. Benjamin Franklin, "Of the stilling of waves by means of oil," *Philosophical Transactions* 64 (1774) 445-460: 448.

2. *Ibid.*, 450. More information on John Pringle (1707-1782), William Brownrigg (1711-1800), and the Derwent Lake experiment can be found in Charles Tanford, *Ben Franklin stilled the waves: An informal history of pouring oil on water with reflections on the ups and downs of scientific life in general* (Oxford & New York: Oxford University Press, 2004).

elaborate account of the effects of oil on water. “Perhaps,” he wrote to Brownrigg, “you may not dislike to have an account of all I have heard, and learnt, and done in this way.”³ Brownrigg read this account to a meeting of the Royal Society on June 2, 1774. Shortly afterwards it was published in the *Philosophical Transactions*.

In his detailed study of Benjamin Franklin’s theory of oil on water Charles Tanford remarks that Franklin’s philosophy of science is a simple and straightforward one: “There is no indication in any of Franklin’s writings that he ever followed any other philosophy. He always began with observation and experiment, and any *explanation* was solidly based on fact.”⁴ Tanford follows Franklin’s healthy positivism and divides Franklin’s 1774 paper into two parts: the observation (chapter 7 of Tanford’s study) and the interpretation (chapter 13). The content of Franklin’s letter to Brownrigg is however far more complicated. In the first place, the facts mentioned by Franklin are not all of them the result of experimental observation. Some of the facts are based on non-experimental observation, such as the smooth wakes observed in 1757. In the second place, quite a few of the facts collected by Franklin do not spring from his experiments at various English ponds and lakes but are part of stories told by sea captains. They have the character of hearsay accounts and, as we shall see, the value of these hearsay accounts was the central issue of the debate that raged in Leyden in 1775. In the third place, the large-scale experiment carried out by Franklin and Captain John Bentinck at Portsmouth in October 1773 is very different from Franklin’s earlier experiments. It was not only carried out at sea instead of on a lake, but it was inspired not so much by scientific curiosity as by the more practical intent of facilitating a landing through a violent surf breaking on the shore. For these reasons I shall divide Franklin’s paper into four parts: hearsay accounts, Franklin’s own experiments, his explanation, and the Portsmouth experiment.

The most ancient account of a practice involving the wave-stilling properties of oil can be found in Pliny’s *Natural History*: “Again everybody is aware that . . . all sea water is made smooth by oil, and so divers sprinkle oil on their face because it calms the rough element and carries light down with them . . .”⁵ When Franklin returned to Philadelphia at the end of 1762, he heard the story of an analogous practice from an old sea captain who made the same journey. This captain told him that the Bermudians put some oil on water to smooth it, “when they would strike fish, which they could not see, if the surface of the water was ruffled by the wind.”⁶ This same captain told him the story of another wave-stilling practice. Lisbon fishermen emptied “a bottle or two of oil into the sea, which would suppress the breakers, and allow them to pass safely” into the river.⁷ Pliny’s account was confirmed by someone who knew the Mediterranean well. He told Franklin that “the divers there, who, when under water in their business, need light, which the curling of the surface interrupts by the refraction of so many little waves, let a small quantity of oil now and then out of their mouths, which rising to the surface

3. Franklin, “Stilling of waves,” 447.

4. Tanford, *Ben Franklin*, 70.

5. Pliny, *Natural History*, Book II, chapter 106, transl. H. Rackham (London: William Heinemann & Cambridge, Mass.: Harvard University Press, 1938), Vol. 1, p. 361.

6. Franklin, “Stilling of waves,” 448.

7. *Ibid.*, 449.

smooths it, and permits the light to come down to them.”⁸ Franklin also mentions some cases of the smoothing effects of oil he had observed for the first time in 1757 on his way to Louisbourg. John Pringle told him that Scottish fishermen located herring shoals by “the smoothness of the water over them, which might possibly be occasioned, he [Pringle] thought, by some oiliness proceeding from their bodies.”⁹ Body oiliness was also the cause of the harbour of Newport, Rhode Island being smooth “while any whaling vessels were in it; which probably arose from hence, that the blubber . . . or the leakage of their barrels might afford some oil . . .”¹⁰ Finally, Franklin mentions the miraculous preservation of a Dutch East India Company ship that was saved by its captain who “found himself obliged, for greater safety in wearing the ship, to pour oil into the sea, to prevent the waves breaking over her, which had an excellent effect, and succeeded in preserving us.”¹¹

These accounts can be said to report four types of facts. First, there is the smoothing effect of oil or whale oil leaking from or being pumped out of ships. Second, there is the practice of fishermen and divers who use oil to be able to see under water. Third, there is the practice of suppressing the breakers when entering a river or landing on a beach. And fourth, there is the practice of pouring oil on the sea during heavy storms in order to prevent the waves from breaking over the ship in distress. Neither these practices nor the implied natural phenomena had ever been the subject of scientific investigation. Franklin wondered “to find no mention of them in our books of experimental philosophy.”¹² This only proved that both ancient knowledge and the traditional knowledge of seamen, fishermen and divers were being disdained by contemporary philosophers: “I think with your friend [James Farish], that it has been of late too much the mode to slight the learning of the antients. The learned, too, are apt to slight too much the knowledge of the vulgar. The cooling by evaporation¹³ was long an instance of the latter. This art of smoothing the waves with oil, is an instance of both.”¹⁴

As to Franklin’s own oil on water experiments, we may safely assume that he regularly repeated them during his various trips around England. This assumption seems warranted by the remarks he made about his hollow bamboo cane. In his 1774 paper, however, he makes explicit mention of only three cases. The first is the experiment at the pond at Clapham Common, where on the windward side “not more than a tea spoonful produced an instant calm over a space of several yards square, . . . , making all that quarter of the pond, perhaps half an acre, as smooth as

8. *Ibid.*

9. *Ibid.*, 452.

10. *Ibid.*

11. Tegnagel to Count Bentinck (Batavia, January 5, 1770), quoted by Franklin, “Stilling of waves,” 456.

12. Franklin, “Stilling of waves,” 449.

13. In 1758, Franklin told John Lining of the experiments for cooling bodies by evaporation he and John Hadley had recently carried out at Cambridge. But he also pointed out that long before European philosophers became interested in this matter, this cooling method had been practised all along in Hindustan, where water was kept cool in flasks wrapt in wet woollen cloths or unglazed earthen pots. Benjamin Franklin to John Lining (London, June 17, 1758).

14. Franklin, “Stilling of waves,” 447.

a looking-glass.”¹⁵ The second experiment was carried out in the vicinity of Leeds, where Franklin paid a visit to John Smeaton before he went to Ormathwaite to see William Brownrigg. On a little pond near Smeaton’s house he dropped “little bits of oiled chips and paper cut in the form of a comma, of the size of a common fly.” The oil issuing from these “flies” made the commas turn around on the water.¹⁶ The third experiment took place at Green Park, London, where he showed the smoothing effect of oil to a party of three Dutchmen: Count Willem Bentinck, Lord of Rhoon and Pendrecht, his son Captain John (Johan Albert) Bentinck, and Professor Jean-Nicolas-Sébastien Allamand, of Leyden. This Green Park experiment is important, not because of any spectacular results — it was just a demonstration — but because of its consequences. After the experiment Franklin and his guests had a lively conversation on the subject of oil on water. It was on this occasion that Willem Bentinck came up with the letter he had received from Tegnagel relating his miraculous preservation in the middle of the Indian Ocean. This letter extended the discussion from ponds and lakes to the high sea, and the possibility of preventing waves from breaking over a ship. It was also on this occasion that John Bentinck offered the *Centaur* and its longboat and barge for the large-scale experiment at Portsmouth. But the most important consequence of the Green Park experiment and the subsequent discussion was the publication, in Leyden, of an essay on the subject of oil on water. And the connection between London and Leyden was the person of professor Allamand.

Jean-Nicolas-Sébastien Allamand (1713-1787) was born in Lausanne. There he studied theology and became a protestant minister. But in 1739 he moved to Leyden to accept a post of private teacher in some rich bourgeois family. In 1740 he enrolled as a law student at Leyden University, but this did not keep him from eagerly following various science courses (physics, chemistry, natural history, mathematics). He became friends with Willem Jacob van ‘s Gravesande, professor of physics at Leyden University. In 1746 he and Pieter van Musschenbroek investigated the working of the Leyden jar. These investigations were published by Nollet in 1751.¹⁷ In 1749 he was appointed professor of philosophy and mathematics at Leyden University. He specialized in natural history, zoology in particular. In 1751 he became the Head of the University’s Museum of Natural History. He frequented Dutch sea captains who provided him with plants, animals, and minerals they brought along from the exotic places their voyages took them. Allamand was a member of the Dutch Society of Sciences (Haarlem) and the Royal Society (London).¹⁸

Franklin and Allamand knew each other before they met in London in the summer of 1773. As an electrician Franklin read everything Nollet published. So he knew about Allamand’s electrical experiments carried out in 1746. They were both member of the Royal Society, Allamand from 1755, Franklin from 1758. In

15. *Ibid.*, 449.

16. *Ibid.*, 451.

17. Jean-Antoine Nollet, “Observations sur quelques nouveaux phénomènes d’Electricité,” *Histoire de l’Académie royale des sciences, année MDCCXLVI* (1751) 1-23.

18. *Biographie universelle* (1843), Vol. 1, pp. 490-491; A.J. van der Aa, *Biografisch Woordenboek der Nederlanden* (Haarlem: Van Brederode, 1852), Vol. 1, p. 56; P.C. Molhuysen & P.J. Blok, *Nieuw Nederlandsch Biografisch Woordenboek* (Leiden: Sijthoff, 1911), Vol. 1, pp. 76-77.

1761 Franklin visited the Low Countries including Leyden where he met Musschenbroek and probably Allamand as well. In 1766 Franklin and Pringle undertook a European journey, and Franklin and Allamand may have seen each other once again in Leyden.

Before he went to London in 1773, Allamand was not unaware of the wave-stilling properties of oil. One of the sea captains he regularly met in Leyden was William May (c.1730-1798), who lived in Leyden in the period under consideration here. May had told him the following story. In 1755 the Dutch Republic declared war on Algiers who was disrupting maritime trade in the Mediterranean. May served as lieutenant on the *Phoenix*, which was part of a squadron of eight warships that was sent to the Mediterranean to protect Dutch merchantmen.¹⁹ When the *Phoenix* was escorting two merchantmen which had taken on a cargo of olive oil in Gallipoli, from Napels to Cartagena, May could observe that the liquid discharged into the sea contained some oil from leaking barrels and had the effect of preventing the waves from breaking. The small waves were smoothed out while the general swell remained. In January 1756 the *Phoenix* was part of a convoy heading from Malaga to the Netherlands. Somewhere off Lisbon the convoy ran into a violent storm, which compelled the captains to discharge twice a day. The result was that to a great distance around the ships carrying olive oil no breakers could be observed. The sea continued to heave but its surface was smooth and even.²⁰ These stories recurred to Allamand's mind when he witnessed the Green Park experiment and discussed it with Franklin and the Bentincks. After he returned to Leyden he went straight to William May. But before crossing the North Sea, or German Ocean as it was then called, we have to consider Franklin's theoretical explanation and the Portsmouth experiment.

Franklin's central theoretical statement is that oil diminishes the wrinkle raising capacity of the wind. Wrinkles are the elements of future waves, and wrinkles are turned into waves by the wind because "a small power continually operating will produce a great action."²¹ The wind's wrinkle raising capacity is dependent on the repulsion and attraction between water and air, water and oil, and oil and air. There is no repulsion between water and air, and "therefore air in motion, which is wind, in passing over the smooth surface of water, may rub, as it were, upon that surface, and raise it into wrinkles."²² There is a mutual repulsion between the particles of oil, Franklin goes on to say, and no attraction between oil and water, and these facts explain the spreading of oil on water: "Oil dropt on water will not be held together by adhesion to the spot whereon it falls; it will not be imbibed by the water; it will be at liberty to expand itself."²³ Finally, a film of oil diminishes the wind's wrinkle raising capacity: "Now I imagine that the wind blowing over water thus covered with a film of oil, cannot easily *catch* upon it, so as to raise the first

19. Johannes Cornelis de Jonge, *Geschiedenis van het Nederlandsche Zeewezen* (Haarlem: Kruseman, 1861), Vol. 4, p. 308; J.C. Mollema, *Geschiedenis van Nederland ter Zee* (Amsterdam: "Joost van den Vondel", 1941), Vol. 3.

20. Frans van Lelyveld, *Berichten en Prijis-vragen over het storten van olie, traan, teer, of andere dryvende stoffen, in zee-gevaren* (Leyden: Johannes le Mair, 1775), 10-13.

21. Franklin, "Stilling of waves," 453.

22. *Ibid.*

23. *Ibid.*

wrinkles, but slides over it, and leaves it smooth as it finds it."²⁴ This explanation fits Franklin's pond and lake experiments, as it were, but he also very tentatively tries to explain the suppression of breakers at sea practised by Lisbon fishermen and reported by Tegnagel and May: "When the wind blows fresh, there are continually rising on the back of every great wave, a number of small ones, which roughen its surface, and give the wind hold, as it were, to push it with greater force. This hold is diminished by preventing the generation of the small ones."²⁵

The Portsmouth experiment was undertaken for practical reasons. During the discussion following the Green Park experiment, Franklin tells us, "I mentioned to Captain Bentinck a thought which had occurred to me in reading the voyages of our late circumnavigators, particularly where accounts are given of pleasant and fertile islands which they much desired to land upon, when sickness made it more necessary, but could not effect a landing through a violent surf breaking on the shore, which rendered it impracticable. My idea was, that possibly by sailing to and fro at some distance from such lee shore, continually pouring oil into the sea, the waves might be so much depressed and lessened before they reached the shore as to abate the height and violence of the surf, and permit a landing; which, in such circumstances, was a point of sufficient importance to justify the expense of the oil that might be requisite for the purpose."²⁶

The experiment, a technological experiment I would like to call it, was carried out in October 1773. All in all, says Franklin, the experiment had not the success he wished, i.e. it did not permit an easy landing. Still, a tract of smoothed water could be observed, smoothed, Franklin adds, "not that it was laid level, but because, though the swell continued, its surface was not roughened by the wrinkles, or smaller waves, before-mentioned; and none, or very few white-caps (or waves whose tops turn over in foam) appeared in that whole space . . ."²⁷

Back in Leyden, Allamand went straight to William May and the philosopher Cornelis van Engelen to report the Green Park experiment and his conversation with Franklin and the Bentincks. Van Engelen (1722-1793) had studied philosophy at the University of Utrecht, and after serving as a Mennonite preacher for about two decades came to Leyden in 1771. He translated Buffon's *Natural History* into Dutch but, more to the point in our story of oil on water, he was one of the founders, in 1767, of the Maatschappij tot Redding van Drenkelingen (Society for the Rescue of Drowning Persons). As a philanthropist, Van Engelen was of course highly interested in the salutary effects of oil put on breakers threatening the life of drowning persons and their rescuers alike.

Allamand repeated Franklin's experiments on the ditch around the city of Leyden. "By means of a few drops of oil," Allamand said, "which, taken together, would not have filled a common spoon, I smoothed all the small waves rippling the surface of the water to an area of at least fifty square Rhenish rods."²⁸ Allamand also told Frans van Lelyveld about his London experience and his own experiments

24. *Ibid.*

25. *Ibid.*, 454.

26. *Ibid.*, 457.

27. *Ibid.*, 458.

28. Lelyveld, *Berichten*, 10.

in Leyden. Lelyveld became very interested, and even more so after reading the French translation of Franklin's paper in the *Journal des sçavans* of November 1774. He planned to publish a collection of Dutch reports on this subject, and announced his intentions to Franklin in a letter dated December 9, 1774. In this letter²⁹ Lelyveld tells Franklin that he has read, "with a particular attention and affection," Franklin's letter to Brownrigg, that Allamand has told him of his own experiments and of William May's adventures ("the Anecdote of a Certain Experient Captain"), and finally that Allamand has informed him that, as a matter of standard practice, "our Fishers at Scheveningen [a fishing village near The Hague] . . . make constantly use of Oil of Line-sead, when the sea is very turbulent." Lelyveld then goes on to announce his project of publishing what was to become his *Berichten and Prijs-vragen* (Reports and Prize Questions), because "it must be universal known and more and more established with Experiences . . . in order to . . . bring it in a General Practick by all the Mariners." Finally, Lelyveld asks Franklin for additional information, because Franklin has mentioned the oil-stilling practices of Lisbon fishermen and Mediterranean divers, "but you speaks nothing of all that same Use by the Fishers and Navigators" of England. Lelyveld thinks it inconceivable that this practice should be unknown among English seamen, "for here [in Holland] I find that all our Fishers and all our Navigators and seamen know that use of oil and our Fishers practise them at every opportunity."

Frans van Lelyveld (1740-1785) was a merchant and cloth manufacturer with a glowing interest in Dutch language, literature, and poetry. He was one of the founders of the Maatschappij der Nederlandsche Letterkunde (Society of Dutch Literature), established in Leyden in 1766. He published studies of the Dutch language, the art of poetry, the art of translation, and Dutch literature.³⁰ Lelyveld must be considered a representative of the Dutch Enlightenment, which tried to oppose the moral, political, and economic decline of the Dutch Republic by a series of reform proposals and the spread of knowledge. Knowledge had to be practical as opposed to the contemplative knowledge sought after by the traditional learned societies. Knowledge was to serve the welfare of mankind.³¹

Lelyveld completed his project in March 1775 with the publication of his *Berichten en Prijs-vragen*, full title *Reports and Prize Questions as to the pouring of oil, whale oil, tar, or other floating substances, to reduce shipping dangers*.³² Lelyveld's piece is in five parts: a dedication, an introduction, twenty-two reports annotated by Lelyveld, seventeen prize questions, and the Dutch translation of Franklin's paper.

The *Berichten* is dedicated to John Nicolas Sebastian Allamand, William May and Cornelis van Engelen, who not only imported and discussed the subject of oil on water but also organized experiments in Leyden. Lelyveld mentions a successful experiment on the water of a broad canal in the city of Leyden. Here, on February

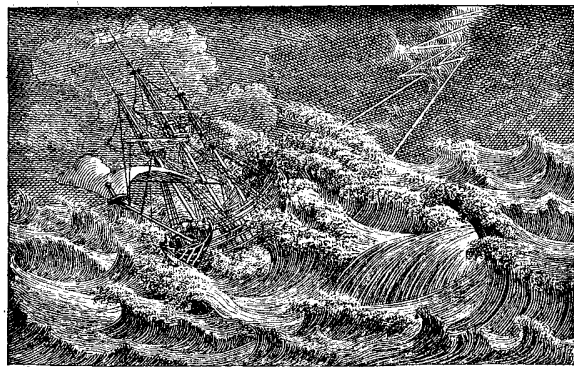
29. Frans van Lelyveld to Benjamin Franklin (Leyden, December 9, 1774).

30. A.J. van der Aa, *Biografisch Woordenboek der Nederlanden* (Haarlem: Van Brederode, 1852), Vol. 4, p. 94; H.A. Höweler, *De Lakenfabriek Frans van Lelyveld* (Leyden: Brill, 1966).

31. Wijnand Mijnhardt, *Tot Heil van 't Menschdom: Culturele genootschappen in Nederland, 1750-1815* (Amsterdam: Rodopi, 1988).

32. See note 20. In 1776 a French translation appeared: *Essai sur les moyens de diminuer les dangers de la mer, par l'effusion de l'huile, du goudron, ou de toute autre matière flottante, avec des questions proposées sur ce sujet, par M. de Lelyveld, traduit du hollandois* (Amsterdam: Rey, 1776).

BERICHTEN
E N
PRIJS-VRAGEN,
OVER HET STORTEN VAN
OLIE,
TRAAN, TEER,
OF ANDERE DRYVENDE STOFFEN,
IN ZEE-GEVAREN:
VOORGESTELD DOOR
FRANS VAN LELTVELD,



TE L E Y D E N,
BY JOHANNES LE MAIR,
M D C C L X X V.



Title page of Lelyveld's *Reports and Prize Questions* (1775)

20, 1775, Allamand demonstrated the smoothing effect of a few drops of rapeseed oil to a party consisting of Engelen, May, and Lelyveld himself.³³

Lelyveld opens his *Berichten* with the remark that May, Allamand and Franklin have been the first philosophers after Pliny and Plutarch³⁴ to pay special attention to the astonishing effects of oil on water. Like Franklin who had found no mention of these phenomena in contemporary works of experimental philosophy, Lelyveld stresses the fact that so far the practice of putting oil on troubled waters was unknown to the learned. Therefore “this is worth being subjected to closer experimental observation, freed from prejudice, and brought to a satisfactory degree of certainty, both by Philosophers and Seamen.”³⁵ Unlike Franklin, Lelyveld is not interested in a theoretical explanation of the effects of oil on water. He first wishes to set the facts straight, as these facts are largely unknown and uncertain at that. According to Lelyveld, the practice of pouring oil on water is one of those important discoveries that has been hidden for centuries until it came to the attention of men called *Esprits Observateurs* by the French.³⁶ In other words, the practice of pouring oil on water, unknown to the learned, well-known among seamen and fishermen, is a case of tacit knowledge transmitted by practice and verbal tradition, not by writing. The first thing an observing spirit such as Frans van Lelyveld should do is to unearth this tacit knowledge and put it into words, and this is exactly what Lelyveld is after in his *Berichten*. On this point, Lelyveld criticizes Franklin. Franklin seems to think he made a new discovery, which he tries to explain theoretically. But the facts he brings forward do not go beyond some stories about fishermen from Lisbon and the Bermudas, and the salvation of a Dutch East Indiaman that was on its way to Batavia. “It seems to me,” Lelyveld concludes, “that this idea, of having made a new discovery, has filled Mr Franklin to such an extent that the thought has not occurred to him to make some inquiries with a few Seamen and Fishermen of his Country [which Lelyveld thinks is England].”³⁷ It was to make this suggestion that Lelyveld wrote Franklin the letter already mentioned. In that letter Lelyveld had already pointed out his philanthropic intention of transforming the more or less hidden practical knowledge of the salutary effects of oil on water into “a General Practick by all the Mariners.” In the *Berichten* he repeats this intention. The experimental investigation of the practice of oil on water should serve not only the commercial interest of preserving ships and their cargo but also and especially the human interest of saving lives. Think of the many Dutchmen out there at sea every season of the year, Lelyveld adds.³⁸

He also uses the introductory pages for telling the “true Story” of Tengenel’s adventure on his way to Batavia. Lelyveld asked Mr. Frederik Willem Boers, *Advocaat* of the East India Company, to search the Company’s archives in

33. Lelyveld, *Berichten*, 51-53.

34. “They say that when divers take oil into their mouths and blow it out in the depths, they get illumination and can see through the water.” Plutarch, *Moralia* (transl. Lionel Pearson & F.H. Sandbach), Vol. XI, *Causes of Natural Phenomena (Quaestiones naturales)* (London: Heinemann & Cambridge, Mass.: Harvard University Press, 1965), 177.

35. Lelyveld, *Berichten*, 2.

36. *Ibid.*, 4.

37. *Ibid.*, 14.

38. *Ibid.*, 2.

Amsterdam. Boers found the logbook written by Thijs Fiereman, captain of the *Vrouwe Petronella Maria*. On Saturday, September 23, 1769, Fiereman saved his ship and its passenger Tengnagel by pouring his stock of olive oil into the sea to escape from the heavy breakers.³⁹

In order to obtain reliable information on the various practices common among Dutch seamen and fishermen Lelyveld followed a three-pronged strategy. First, he looked for recent publications mentioning the practice of oil on water. Second, he personally interviewed some fishermen of Katwijk and Noordwijk, two coastal villages not very far from Leyden. His third strategy, however, turned out to be the most fruitful. He wrote letters to a whole series of friends and acquaintances begging them to inquire with seamen about the practice of stilling the waves by means of oil. He thus wrote to merchants, philosophers, professors, captains, poets, bankers, and also to city administrators such as mayors, aldermen, and pensionaries. Their replies constitute the main part of the *Berichten*. It is an overview of the practical knowledge available in the fishing villages and sea ports along the entire coast of Holland and Zeeland, from Texel in the North to Middelburg in the South, including Amsterdam, Rotterdam, and Zierikzee.

Lelyveld's first strategy yielded two publications, one a book relating the adventures of the crew of *De Juffrouwen Anna Cornelia en Anna*, a whaler that was lost on the Dutch coast in August 1773,⁴⁰ the other a set of instructions as to how to behave in the Dutch coastal waters.⁴¹ In the history of the shipwrecked whaler Lelyveld found the interesting detail that Commander Hoogerduin had ordered the pouring of whale oil from the three boats that tried to reach the shore.⁴² It seemed to be standard procedure in this type of landing. Hoogerduin's story was also important for another reason. Lelyveld considered it a kind of model to be imitated in the interest of science. "These stories, well-written," he thought, "would also be read by learned men, who at present are complete strangers to many things that are common knowledge among Seamen and are thus incapable to civilize and perfect this practical knowledge by experiments and closer investigation, and in that way to explain and deduce other useful arts."⁴³ In other words, stories like Hoogerduin's should disclose the hidden practical knowledge of seamen and fishermen, and this knowledge would play the role of imperfect empirical material, which should be taken up by experimental philosophers, who could set the facts straight and then find theoretical explanations and further technological applications. The author of the second publication, Agge Roskam Kool, was another representative of the Dutch Enlightenment. He owned a vinegar manufactory in Beverwijk, but he also produced sea charts and Dutch dictionaries. Like Cornelis van Engelen he was interested in rescuing people from the sea, and

39. *Ibid.*, 7-9.

40. Dirk Cornelisse Hoogerduin, *Singulieren of Byzonderen Historien, wegens het verongelukke van het Groenlands Schip, De Juffrouwen Anna Cornelia en Anna* (Amsterdam: W.A. Leeuwendaal, 1774).

41. Agge Roskam Kool & Jan Rokusz Douw, *Beschryving en Onderrichtingen behorende tot de Nieuwe Platte Paskaart der Hollandsche Stranden* (Amsterdam: Gerard Hulst van Keulen, 1773).

42. Hoogerduin, *Historien*, 36.

43. Lelyveld, *Berichten*, 18-19.

to that end invented a prototype of the breeches buoy.⁴⁴ Lelyveld found the following instruction involving the use of oil on water: “When a Commander who has run aground learns that a Barge is approaching his Ship, he should throw overboard (or pump out of his Ship) Oil, Whale Oil, Tar, or even Beer or any other greasy Liquid, even dirty Water will do, if nothing better is within reach, so that the heavy Breakers are prevented and the Barge is allowed to approach the Ship safer and sooner.”⁴⁵

As to Lelyveld’s personal interviews, he spoke to fishermen and seamen in Noordwijk and Katwijk on January 13, 1775, and they assured him, “as if with one voice, that Oil, Whale Oil, Tar, Cod-Liver Oil, or any other greasy matter, whatever, is a well-tried Means to smooth the Sea and suppress the breakers.”⁴⁶

The reports he received from his various correspondents mention three kinds of phenomena: (1) barrels leaking oil or whale oil producing a wake as smooth as glass (similar to the observations made by Franklin in Louisbourg and Newport), (2) preventing whitecapped waves from breaking over ships during heavy storms at sea (these breakers are called *Stortings* in eighteenth-century Dutch, “crashers” that sweep over the deck), and (3) pouring oil on the waves to effect a landing through a violent surf. He found the practice of oil on water to be widespread among Dutch fishermen operating in the North Sea and whalers operating near Greenland and in Davis Strait. The practice was less common in the world of merchantmen, Indiamen, and men-of-war. The use of (whale) oil for effecting a landing appeared to be standard procedure.

True to his intention of first setting the facts straight he invited experimental philosophers and other observing spirits to answer one or more of seventeen prize questions Lelyveld formulated after a careful and critical analysis of the reports he had received. He did not ask for theoretical explanations but facts and experiments relating to questions such as: When you first heard of the practice of oil on water, was it hearsay, tradition, or personal experience; Do you know of any experiments; Does the practice of pouring oil on water extend beyond suppressing surf breakers and *stortings* at sea; What kind of oil is to be preferred; In what amounts should it be used; How is one to pour the oil into the sea; For how long will it be effective; Did you run into any prejudices? “And,” Lelyveld adds, “to make every possible effort on my part to encourage my Countrymen to draw up elaborate Treatises and comprehensive Reports . . . I have decided to offer a Prize of thirty Ducats or a Medal of the same value to . . . anyone who will submit the best Treatise, corroborated by satisfactory Experiments, on . . . the proposed questions relating to the reduction of shipping dangers.”⁴⁷ To further encourage the cultivators of experimental philosophy Lelyveld included a Dutch translation, prepared by himself, Allamand and May, of the three letters by Farish, Brownrigg, and Franklin that had been published in the *Philosophical Transactions*. He also sent six copies of his *Berichten* to Franklin, expressing the hope that his piece would be “of utility for

44. W.A. Spruit, *Het dorpse Sint-Aagtenkerke en het stedelijke Beverwijk* (Beverwijk 1998), 49-51.

45. Kool & Douw, *Onderrichtingen*, 10.

46. Lelyveld, *Berichten*, 46, 51.

47. *Ibid.*, 92.

the publicq, and give inducements to exact inquiries,” and suggesting that his piece be translated into English.⁴⁸

Lelyveld’s *Berichten* elicited several reactions, both positive and negative. Newspapers began to be interested in stories of preservation involving the use of wave-stilling oil. The Dutch East India Company decided to precribe experiments to be carried out at sea and the results to be put down in the logbook. Lelyveld received many additional letters from fishermen and seamen, which were included in a Supplement published in 1776. And a vicious criticism was published by Johannes le Francq van Berkhey, who extended the discussion opened by Franklin to the epistemological aspects of the matter.

On Friday, January 12, 1776, the ‘s *Gravenhaagsche Courant*, explicitly referring to the recent discussion in Holland, published an extract from a letter sent by a passenger of a Dutch merchantman which, on the fourth of November 1775, had run into a violent storm that drove the ship to the shore of Jutland. Captain Jurrien Jurriensen decided to empty six barrels of oil onto the waves, which allowed him to pass safely into a Danish harbour.⁴⁹

Shortly after the publication of the *Berichten*, the Zeeland Chamber of the East India Company, referring explicitly to Lelyveld’s tract and the action of Thijs Fiereman, proposed to generalize the use of oil on the Company’s ships. This led to a resolution adopted by the *Heeren XVII*, the Directors of the Company, in Amsterdam on April 10, 1775, to prescribe that experiments be carried out on the ships both outward bound and on their voyages back. The captains were to include accurate accounts of these experiments in their logbooks, and when outward bound should hand in an extract to the local authorities of the Company at the first port they called in at. These authorities should then forward these extracts to Amsterdam as promptly as possible.⁵⁰ Lelyveld, of course, welcomed this resolution, as experiments at sea were crucial in setting the facts straight.⁵¹

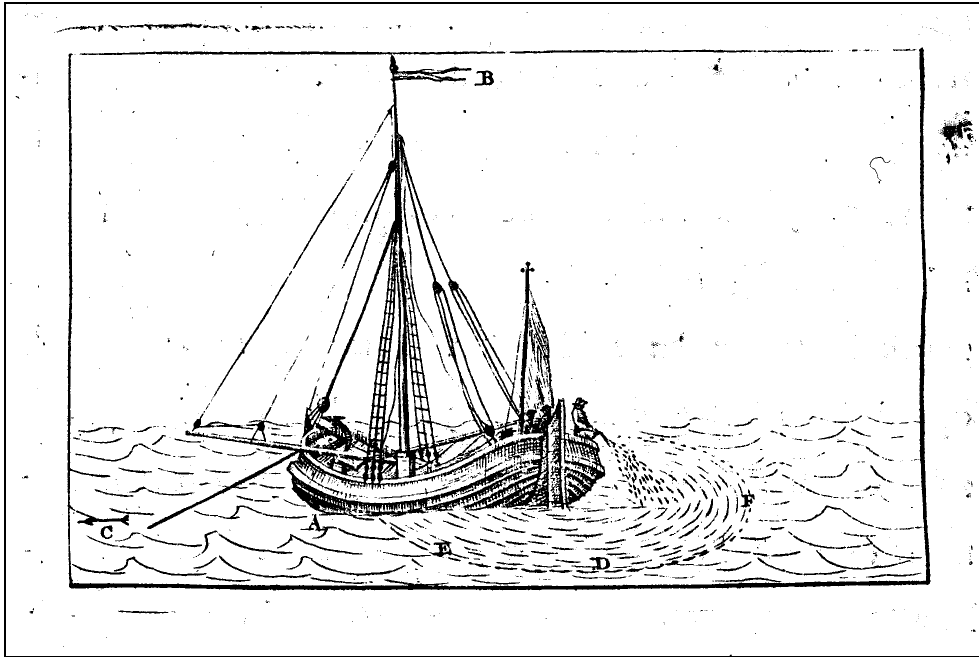
The Supplement (*Byvoegsel*) published in 1776 contains ten additional letters written by commanders, captains, or former captains, dated from Amsterdam, Rotterdam, and Vlaardingen, but also from France and Portugal. The themes discussed are similar to those of the original reports: *stortings*, landings, and seeing through the water, the Mediterranean practice already mentioned by Pliny and Plutarch. These letters made it clear that the practice of pouring oil on water extended far beyond Holland. The practice could be found in Sweden, Denmark, England, Spain, the Mediterranean, Guyana, Newfoundland, and South-east Asia, where the Ambonese, Malay, Chinese, Papuan, and Javanese all made use of coconut oil to effect a smooth landing through the surf. One of these letters deserves special attention because its author, Isak Kalisvaar, was one of the few non-scientists who performed “intentional experiments” at sea. Shortly after leaving Vlaardingen on the fourth of January 1776 in search of cod, Kalisvaar ran into a violent storm that drove him against the Dogger Bank. Here, Kalisvaar decided to carry out an “intentional experiment.” He poured three or four pints of

48. Frans van Lelyveld to Benjamin Franklin (Leyden, March 11, 1775).

49. ‘s *Gravenhaagsche Courant* (January 12, 1776).

50. *Extract uit de Resolutien. door de Vergadering der Heeren Seventienen binnen Amsterdam, genomen op Maandag 10. April 1775.*

51. Lelyveld, *Berichten*, 132.



Isak Kalisvaar experimenting on the North Sea, January 1776
(Lelyveld, *Berichten*, 197)

whale oil into the sea, “in order to observe its effect on those ferocious waves. I came into action when a wave, just behind our Ship, rose into the air, turned over and crashed on the water like a thunderbolt. We all watched carefully what the result might be. I repeated this three or four times, just when the wave began to turn over. And behold, it seemed as if this brute wave showed more respect to the Whale Oil than many a child to his Father . . . I carried out this experiment in the presence of the ship’s crew, who all witnessed the effect without fear . . . I will always commit myself to support Your purpose, even with experiments at Sea.”⁵²

Someone who did not support Lelyveld’s purposes was Johannes le Francq van Berkhey who, in 1775, published a venomous pamphlet entitled *Serious reproofs and criticisms of the Reports and Prize Questions as to the pouring of oil, whale oil, tar, or other floating substances, to reduce shipping dangers, proposed by Mr Frans van Lelyveld; stated, with frankness and patriotism, by Joannes le Francq van Berkhey, to uphold the honour of the fishermen and seamen of the Low Countries, especially those of Holland and Zeeland, who deserve this honour for their ancestral knowledge.*⁵³

52. Isak Kalisvaar to Frans van Lelyveld (Vlaardingen, April 10, 1776), quoted by Lelyveld, *Berichten*, 194-200.

53. Johannes le Francq van Berkhey, *Ernstige berispingen en aanmerkingen, op de Berichten en Prijsvragen, over het storten van olie, traan, teer, of andere dryvende stoffen, in zee-gevaren, voorgesteld door den Heere Frans van Lelyveld; rondborstig en vaderlandlievend opgegeven, ter handhaving van de eere der Nederlandsche, en byzonder der Hollandsche en Zeeuwsche visschers en zeelieden, in die voorvaderlijke kundigheid; door Joannes le Francq van Berkhey* (Leyden: Heyligert & Hoogenstraaten, 1775).



Johannes le Francq van Berkhey,
 Medicinæ Doctor,
 Author of the *Natural History of Holland*.
 Born in Leyden, January 23, 1729.
 (1771. Portrait by Hendrik Pothoven,
 Engraving by Jacob Houbraken)

Johannes le Francq van Berkhey (1729-1812) began his career in the art shop of his mother, the widow Maria Berkhey, where he sold antiques and collectibles, and in between made anatomical preparations and read books on anatomy. Around 1754 he began to study at Leyden University, where he took his degree in medicine in 1761 on a thesis treating the structure of flowers. Then he took the job of toll-collector at the canal between Leyden and Haarlem, which left him plenty of time to read and write on a wide spectrum of subjects. He wrote poetry, hymns, satires, plays, tragedies, literary criticism, but also a six-volume *Natural History of Holland*. In 1773 he was appointed lecturer of natural history under Jean Allamand. In 1775 he published his *Serious reproofs* which, according to his nineteenth-century biographer, “was pervaded with a vehemence unworthy of a scientist.”⁵⁴

If, however, we subtract the vehemence, venom, and viciousness from Berkhey’s *Reproofs*, he certainly has a point. Lelyveld had proposed that the practical knowledge of the wave-stilling effects of oil and whale

oil be freed from prejudice and brought to a satisfactory degree of certainty by carrying out philosophical experiments. But who is to decide, Berkhey exclaims, whether the series of reports Lelyveld has collected in his *Berichten* is based on dubious prejudice or real experience. Berkhey himself fully accepts the reliability of Dutch seamen as a matter of course. For the knowledge of how to avoid shipping dangers by pouring oil into the sea has been possessed by the Dutch for ages. Berkhey therefore acclaims Lelyveld’s suggestion that more stories in the style of Hoogerduin’s be published. But he does not agree to the view that these stories would be but imperfect empirical material to be “civilized and perfected” by learned men. There is no difference between the scientific knowledge of natural philosophers and the practical knowledge of Dutch fishermen. These fishermen are themselves learned men, for their science of the wave-stilling properties of oil is confirmed by experience and has been for ages. Well, Berkhey continues, “isn’t it hard for our Seamen that their true and faithful testimony is condemned, against their experience and without any mathematical proof, as falsehood and silly prejudice; for that is what is implied.”⁵⁵ Lelyveld’s idea of imperfect notions goes against the honour of both the fishermen and the correspondents who forwarded their reports, as if they have just been drivelling.

54. A.J. van der Aa, *Biographisch Woordenboek der Nederlanden*, Vol. 5 (1859) 194-201: 196.

55. Berkhey, *Berispingen*, 86.

In fact, Berkhey goes on to say, the knowledge involved is very ancient. In the case of the Dutch, its origins must be traced to the Nordic and Gothic peoples who knew the use of the oil and fat originating from whales, seals, and other marine animals. When these nations made their voyages [in the ninth century] to the German, the Dutch and even the Italian shores, they passed on this knowledge to the local inhabitants. “I think there are sufficient arguments for the conjecture that the pouring of oil, especially whale oil, in dangerous situations at sea, has been passed on to our people as a natural result of a skill practised in these Nordic countries.”⁵⁶ In evidence of the antiquity of this practical skill Berkhey quotes Valerianus who, in his *Hieroglyphica* (1602), quotes a monk called Johannes Synæ who speaks of the practice of taking along a leather bag filled with oil (*velut uter oleo repletus*) for quieting the turbulent waves of a wild sea.⁵⁷ Berkhey concludes this evolutionary approach of the matter by pointing out that the practice of pouring oil on the waves can be found among the Greeks, Romans, Vikings, Turks, Germans, and the Dutch, that is among those nations that sailed or sail the North Sea, the Mediterranean, and the Oceans.

This traditional knowledge, someone might object, is not the result of intentional experimental research. It is just tradition. It is not part of natural philosophy. But tradition, Berkhey exclaims, does not exclude experience. Synæ’s leather bag and the actual practice of our fishermen must be taken as evidence of a well-tryed experience. “Alas, poor Philosophers who manage to think up intentional investigations of general and already well-tryed truths.”⁵⁸ Berkhey does not deny that tradition sometimes does constitute an obstacle to progress and improvement. Ancestral customs and vested interests very often do impede the application of useful knowledge. But in the case in hand, that of stilling the waves by means of oil, the ancestral customs are guaranteed by experience and for that reason are perfectly reliable. Nothing could be gained by scientific tests. Recording our national skills [as Lelyveld has done in his *Berichten*] is undeniably useful for posterity, but criticism is uncalled for.

This episode, from Franklin’s theoretical explanation to Berkhey’s defense of traditional knowledge, shows that in the eighteenth century science was still fighting for recognition vis-à-vis traditional practices. The case of electricity is different. Electrical science was wholly in the hands of natural philosophers. Electrical phenomena, experiments, apparatus, demonstrations, recreations, and theory all belonged to the jurisdiction of the learned and of experimental philosophers. There were no electrical artisans. There was no tradition of electrical engineering. Electrical engineering came into existence only in the 1850s after the instruments of electrochemistry and electromagnetism moved from the research laboratory to the technological sphere of electrometallurgy and the electric telegraph. In the case of oil on water, however, natural philosophy met with age-old traditions based, not on myth, superstition, or prejudice, but on solid

56. *Ibid.*, 110.

57. Ioannis Pierii Valeriani Bellunensis *Hieroglyphica sev De Sacris Aegyptiorum aliarumque gentium Literis Commentarii* (Lyons: Frelon, 1602; reprint New York & London: Garland, 1976), 562, quoted by Berkhey, *Berispingen*, 114.

58. Berkhey, *Berispingen*, 116.

experience. This experience, moreover, touched the question of life and death. That is why Lelyveld's suggestion that the Dutch practice of pouring oil on water might be tainted with prejudice went against the honour of Dutch seamen, that is the respectability and reliability of Dutch ancestral knowledge. Lelyveld's natural philosophy was far too weak to criticize this piece of practical knowledge. It would have been presumptuous to do so. What would Lelyveld have said, and what would Agge Roskam Kool have said, when some pre-Lavoisier chemist had suggested that the methods they followed in their manufactories for dyeing cloth (Lelyveld in Leyden) or producing vinegar (Kool in Beverwijk) were based on prejudice?

Benjamin Franklin was more modest. His theory of stilling the waves by means of oil was not critical of existing practices. He just tried to explain the effectiveness of practical knowledge whose effectiveness he did not doubt. He told himself not to slight the knowledge of the vulgar, and his theory was an endorsement of the sea captain's account of the smooth wakes Franklin had observed on his way to Louisbourg in 1757.

The Hague, February 20, 2005