

Oil on Troubled Waters: Benjamin Franklin and the Honor of Dutch Seamen

Men who worked at sea knew of the calming effects of oil on water long before Franklin began his investigations. Was their practical knowledge any different from the later scientific knowledge of the learned?

Joost Mertens

In 1757 the Pennsylvania Assembly sent Benjamin Franklin (1706–1790) to London to plead for a more equitable taxation policy to cover the Crown's expenses in 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 sailing vessels bound for the town of Louisbourg on Cape Breton Island, which was still in the hands of the French. Looking out over the sea, he observed that the wakes of two of the ships were remarkably smooth, while all the others were ruffled by the wind. Seeking an explanation, he asked the captain, who told him that the cooks on those two ships had probably just emptied their greasy water. The captain thought it a fairly stupid question, since the answer was common knowledge among seamen. According to Franklin's confession in a letter sent to William Brownrigg in 1773, that experience prompted him 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 stays in England (1757–62; 1764–75) Franklin found plenty of opportunities. The one whose result was most significant occurred in the summer of 1772 when he and his close friend John Pringle paid a visit to Brownrigg, who lived in Ormathwaite in the English Lake District. The three of them went to nearby Derwent Water (see figure 1), where Franklin demonstrated the wave-stilling effect of a little oil he kept in the hollow upper joint of his bamboo cane.² The significance of the experiment was not so much that the waves of Derwent Water were quieted by Franklin's oil but rather that the Reverend James Farish could not believe it when he heard an account of the event. Farish's incredulity drove him to write a letter assuring Brownrigg that Farish would be glad to have an authentic account of the Derwent experiment. Brownrigg forwarded that letter to Franklin, who responded with the aforementioned 1773 letter, which included an elaborate discussion of the effects of oil on water. Brownrigg read Franklin's account at a meeting of the Royal Society on 2 June 1774. Shortly afterward it was published in the *Philosophical Transactions*.

London 1773: Franklin and Allamand

Franklin's paper describes his experiments on various English ponds and lakes and includes a collection of stories told by sea captains Franklin had met on his journeys to and from England. Those stories have the character of hearsay accounts, and as we shall see, the value of such accounts was the central issue of the debate

that raged in the Dutch city of Leiden in 1775. Franklin's paper further presents a theoretical explanation of the effect of oil on water and the description of a large-scale experiment carried out by Franklin and Captain John Bentinck at Portsmouth in October 1773.

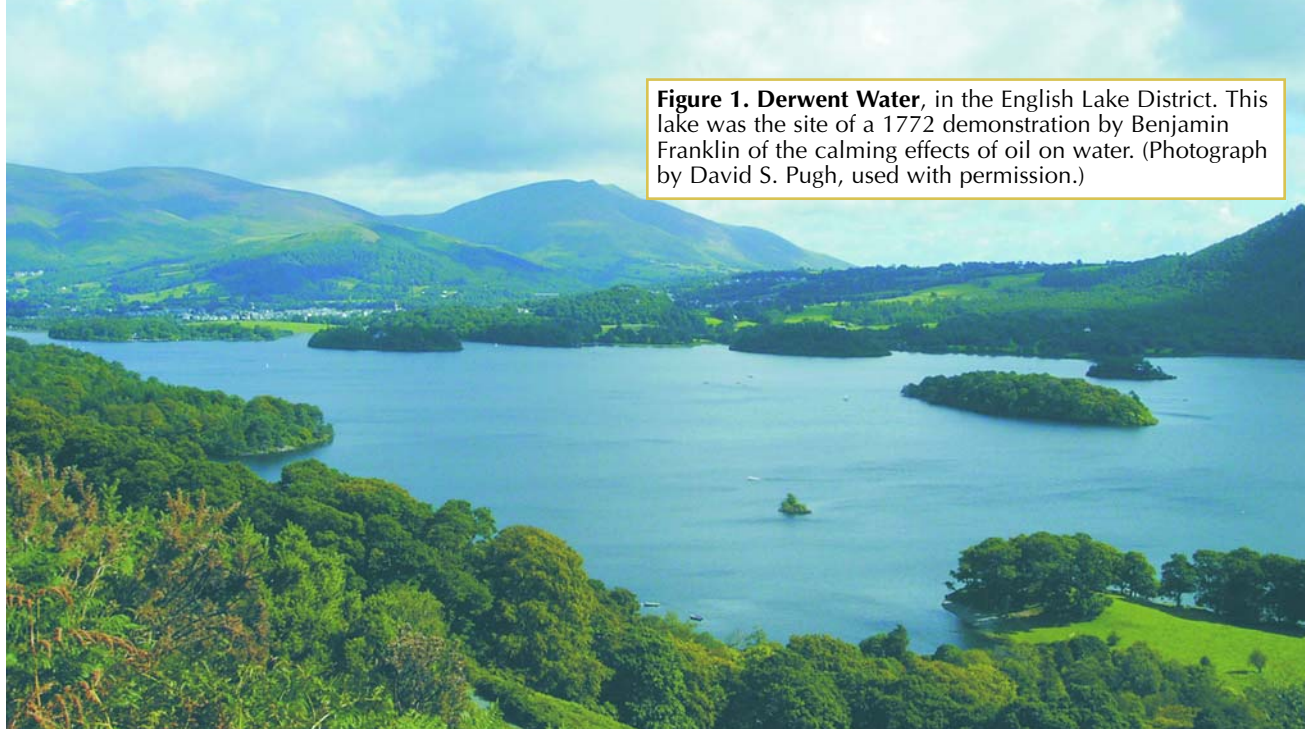
The earliest account of a practice involving the wave-stilling properties of oil can be found in Pliny's *Natural History*: "Again everybody is aware that all sea water is made smooth by oil, and so divers sprinkle oil on their face because it calms the rough element and carries light down with them."³ Franklin's conversations with various sea captains, as reported in the *Philosophical Transactions*, revealed that analogous practices could be found among the Bermudians when they were striking fish and among Mediterranean divers who needed light under water. Another wave-stilling practice could be observed among the Portuguese fishermen of Lisbon, who emptied a bottle or two of oil into the sea to suppress breakers; the fishermen could then pass safely into the Tagus River. Oil's smoothing effects Franklin had observed for the first time on his way to Louisbourg could also be observed in Scotland where, according to Pringle, herring shoals were identified by the smoothness of the water above them caused by oil from their bodies. Oil was also the reason behind smooth waters in the harbor of Newport, Rhode Island, when whaling vessels containing blubber were in it.

The calming properties of oil on water have been credited with rescuing sailing vessels. Franklin reports the miraculous survival of a Dutch East India Company ship that was saved by her captain, Thijs Fiereman, who poured olive oil into the sea to prevent waves from breaking over his ship. More than a millennium earlier, the Venerable Bede had related a similar incident⁴ (see the box on page 37).

Neither the practices referred to in the above hearsay accounts nor the implied natural phenomena had ever been the subject of scientific investigation. Franklin was surprised "to find no mention of them in our books of experimental philosophy."¹ 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 [Farish]," Franklin remarked to Brownrigg in his letter, "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."

Joost Mertens is a researcher in the History Department of the University of Maastricht, the Netherlands.

Figure 1. Derwent Water, in the English Lake District. This lake was the site of a 1772 demonstration by Benjamin Franklin of the calming effects of oil on water. (Photograph by David S. Pugh, used with permission.)



As to Franklin's oil-on-water experiments, only three of them are described in his 1774 paper. One took place at the pond at Clapham Common, where "a tea spoonful of oil produced an instant calm over a space of several yards square." Another was at a little pond near the house of John Smeaton near Leeds, where Franklin stayed before

How Bishop Aidan Foretold to Certain Seamen a Storm that Would Happen, and Gave Them Some Holy Oil to Lay It [AD 651]

How great the merits of Aidan were, was made manifest by the all-seeing Judge, with the testimony of miracles, whereof it will suffice to mention three as a memorial. A certain priest, whose name was Utta, a man of great gravity and sincerity, and on that account honored by all men, even the princes of the world, being ordered to Kent, to bring from thence, as wife for King Oswy, Eanfleda, the daughter of King Edwin, who had been carried thither when her father was killed; and intending to go thither by land, but to return with the virgin by sea, repaired to Bishop Aidan, entreating him to offer up his prayers to our Lord for him and his company, who were then to set out on their journey. He, blessing and recommending them to our Lord, at the same time gave them some holy oil, saying, "I know that when you go abroad, you will meet with a storm and contrary wind; but do you remember to cast this oil I give you into the sea, and the wind shall cease immediately; you will have pleasant calm weather, and return home safe."

All which fell out as the bishop had predicted. For in the first place, the winds raging, the sailors endeavored to ride it out at anchor, but all to no purpose; for the sea breaking in on all sides, and the ship beginning to be filled with water, they all concluded that certain death was at hand; the priest at last, remembering the bishop's words, laid hold of the phial and cast some of the oil into the sea, which, as had been foretold, became presently calm. Thus it came to pass that the man of God, by the spirit of prophecy, foretold the storm that was to happen, and by virtue of the same Spirit, though absent, appeased the same. Which miracle was not told me by a person of little credit, but by Cynemund, a most faithful priest of our church, who declared that it was related to him by Utta, the priest, on and by whom the same was wrought.

—Bede, *The Ecclesiastical History of the English Nation*

he went to Ormathwaite to see Brownrigg. The third experiment took place at Green Park, London, where he showed the smoothing effect of oil to three Dutchmen: Willem Bentinck, Lord of Rhoon and Pendrecht; son John (Johan Albert) Bentinck; and Jean-Nicolas-Sébastien Allamand, of Leiden.

The Green Park experiment is important, not because of any spectacular results 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 a letter he had received from a Mr. Tegnagel, a Dutch colonial official, who related his miraculous survival in the middle of the Indian Ocean thanks to the actions of Captain Fiereman. The letter, an extract of which is given in figure 2, extended the discussion from ponds and lakes to the high sea, and to the possibility of preventing waves from breaking over a ship. It was also on this occasion that John Bentinck offered the ship *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 Leiden of an essay on the subject of oil on water. And the connection between London and Leiden was Allamand.

Allamand (1713–87) was professor of philosophy and mathematics at Leiden University and head of the university's museum of natural history. He frequently visited Dutch sea captains, who provided him with plants, animals, and minerals from the exotic places to which their voyages took them. Allamand was a member of the Dutch Society of Sciences (Haarlem) and the Royal Society (London).

Even before he went to London in 1773, Allamand was aware of the wave-stilling properties of oil. One of the sea captains he regularly met in Leiden was William May (ca. 1730–98). May had told him that during the war of the Dutch Republic against Algiers in 1755, he had served as lieutenant on one of the warships sent to the Mediterranean to protect Dutch merchantmen and had observed that the liquid discharged from the merchantmen carrying olive oil prevented waves from breaking. The story recurred to Allamand when he witnessed the Green Park experiment and discussed it with Franklin and the Bentincks. After Allamand returned to Leiden, he went straight to May. But before we cross the North Sea, or German Ocean

“ Extract of a Letter from Mr. TENGNAGEL to
 “ Count BENTINCK, dated at Batavia the 5th
 “ of January 1770.

“ Near the islands Paul and Amsterdam, we met
 “ with a storm, which had nothing particular in it
 “ worthy of being communicated to you, except
 “ that the captain found himself obliged, for great-
 “ er 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 preserv-
 “ ing us. — As he poured out but a little at a time,
 “ the East India company owes perhaps its ship to
 “ only six demi-aumes of oil olive. I was present
 “ upon deck when this was done; and I should not
 “ have mentioned this circumstance to you, but that
 “ we have found people here so prejudiced against
 “ the experiment, as to make it necessary for the
 “ officers on board and myself to give a certificate of
 “ the truth on this head, of which we made no
 “ difficulty.”

Figure 2. A 1770 letter from a Dutch colonial official to Willem Bentinck. After Bentinck showed this letter to a small gathering that included Franklin, the group's discussion turned from ponds and lakes to the possibility that oil could calm the high seas. (From ref. 1.)

as it was then called, and return with Allamand to Leiden, let us consider Franklin's theoretical explanation and the Portsmouth experiment.¹

Franklin's central theoretical statement is that oil diminishes the wrinkle-raising capacity of the wind. Wrinkles—nowadays called capillary waves—are the elements of future waves, and they are turned into waves by the wind because, Franklin wrote, “a small power continually operating will produce a great action.” The wind's wrinkle-raising capacity is dependent on how repulsive or attractive the interactions are between water and air, water and oil, and oil and air. Water and air don't repel one another, 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.” There is a mutual repulsion between particles of oil, Franklin goes on to say, and no attraction between oil and water. Those 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.” And that oil, once spread, 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 wrinkles, but slides over it, and leaves it smooth as it finds it.”¹

Franklin's explanation fits his pond and lake experiments; he also very tentatively tries to explain the suppression of breakers at sea as practiced 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.”

The Portsmouth experiment was undertaken for practical reasons. During the discussion following the Green Park experiment, Franklin told John Bentinck about his idea that pouring oil into the sea at some distance from the shore might lessen the waves before they reach the shore. That would permit an easy landing. The experiment was carried out in October 1773. All in all, says Franklin, the experiment did not have the success he wished. Still, those in the longboat could observe a tract of smooth water, whose surface was not roughened by wrinkles.

Leiden 1775: Frans van Lelyveld

After returning to Leiden, Allamand reported to May the Green Park experiment and his conversation with Franklin and the Bentincks. He repeated Franklin's experiments in the ditch around the city of Leiden, smoothing the waves over an area of fifty square Rhenish rods (roughly 700 m²) by means of an amount of oil that would not have filled a common spoon. Allamand also told Frans van Lelyveld about his London experience and his own experiments in Leiden. Lelyveld became very interested, 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 the subject, and announced his intentions to Franklin in a letter⁵ dated 9 December 1774. Two months later, he and May witnessed a demonstration of the effects of rapeseed oil on the waters of Leiden's Oude Vest canal (see figure 3).

In his letter to Franklin, Lelyveld said that he had read Franklin's letter to Brownrigg and that Allamand had told him of his own experiments and of May's adventures (“the Anecdote of a Certain Experient Captain”). Lelyveld then announced his plan to publish what was to become his *Berichten en 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 asked Franklin for additional information, because Franklin had mentioned the wave-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 thought it inconceivable that such practices 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 practice them at every opportunity.”

Lelyveld (1740–85) was a merchant and cloth manufacturer with a keen interest in Dutch language, literature, and poetry. He was a representative of the Dutch Enlightenment, which, by a series of reform proposals and the spread of knowledge, opposed the moral, political, and economic decline of the Dutch Republic. And that knowledge had to be practical, as opposed to the contemplative knowledge sought by the traditional learned societies. Knowledge was to serve the welfare of mankind.

Lelyveld published his *Berichten en Prijs-vragen*—the full translated title is *Reports and Prize Questions as to the pouring of oil, whale oil, tar, or other floating substances, to reduce shipping dangers*—in March 1775; figure 4 shows the book's cover. The work is in four parts: an introduction, 22 reports annotated by Lelyveld, 17 prize questions, and a Dutch translation of Franklin's paper.⁶

The *Berichten* opens with the remark that May, Allamand, and Franklin were the first philosophers after Pliny and Plutarch⁷ to pay special attention to the astonishing effects of oil on water. Like Franklin, who had found no mention of those phenomena in contemporary works of experimental philosophy, Lelyveld stresses the fact that the

Figure 3. Oude Vest canal in Leiden, the Netherlands. Near this site in 1775, Jean-Nicolas-Sébastien Allamand demonstrated the wave-stilling effects of oil to William May and Frans van Lelyveld. One month later, Lelyveld completed his four-part *Reports and Prize Questions*, an investigation into the practice of pouring oil on water. (Photograph by Tim Sikkema, used with permission.)



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.” 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 those facts are largely unknown and uncertain. According to Lelyveld, the practice of pouring oil on water is one of those important discoveries that had been hidden for centuries until it came to the attention of men the French called *esprits observateurs*. The first thing an observing spirit such as Frans van Lelyveld should do is unearth that tacit knowledge and put it into words—and that is exactly what Lelyveld is after in his *Berichten*.

On this point, Lelyveld criticizes Franklin. Inasmuch as Franklin was the first natural philosopher to subject the question of oil and water to a scientific analysis, he may be said to have made a new discovery, which he tries to explain theoretically. But the previously existing working knowledge that Franklin brings forward does 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].”

To make that suggestion, Lelyveld wrote Franklin the letter of December 1774, which pointed out Lelyveld’s 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 that intention. The experimental investigation of the practice of pouring oil on water should serve not only the commercial interest of safeguarding ships and their cargo but also and especially the human interest of saving lives. Think of the many Dutchmen at sea every season of the year, he adds.

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 pouring oil on water. Second, he interviewed some fishermen of Katwijk and Noordwijk, two coastal villages not far from Leiden. His third strategy, however, turned out to be the most fruitful. He wrote letters begging a series of friends and acquaintances to ask seamen about the practice of stilling waves by means of oil. He thus contacted merchants, philosophers, professors, captains, poets, bankers, and such city administrators as mayors, aldermen, and pensionaries. Their replies constitute the main part of the *Berichten* and provide an overview of the practical knowledge available in the fishing villages and seaports 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 unearthed two publications, one a book⁸ relating the adventures of the crew of the whaler *De Juffrouwen Anna Cornelia en Anna*, which was lost on the Dutch coast in August 1773, the other a set of instructions on how to behave in the Dutch coastal waters.⁹ Dirk Cornelisse Hoogerduin, the commander of the shipwrecked whaler, had ordered that whale oil be poured from the three boats that tried to reach the shore. Lelyveld highly recommended Hoogerduin’s story to experimental philosophers because it disclosed the hidden practical knowledge of seamen and fishermen. The author of the second publication, Agge Roskam Kool, owned a vinegar factory in Beverwijk, but he also produced sea charts and Dutch dictionaries. According to Kool, heavy breakers could be prevented by throwing oil, whale oil, tar, or even beer overboard.

The reports Lelyveld received from his various correspondents mention three kinds of phenomena. First, barrels leaking oil could produce a wake as smooth as glass. That phenomenon is similar to what Franklin observed in Louisbourg and Newport. Second, oil can prevent white-capped waves from breaking over ships during heavy storms at sea. (Those breakers are called *stortingens*—crashers—in 18th-century Dutch.) Third, pouring oil on waves can facilitate a landing through violent surf. Lelyveld found the practice of pouring oil on water to be widespread among Dutch fishermen operating in the

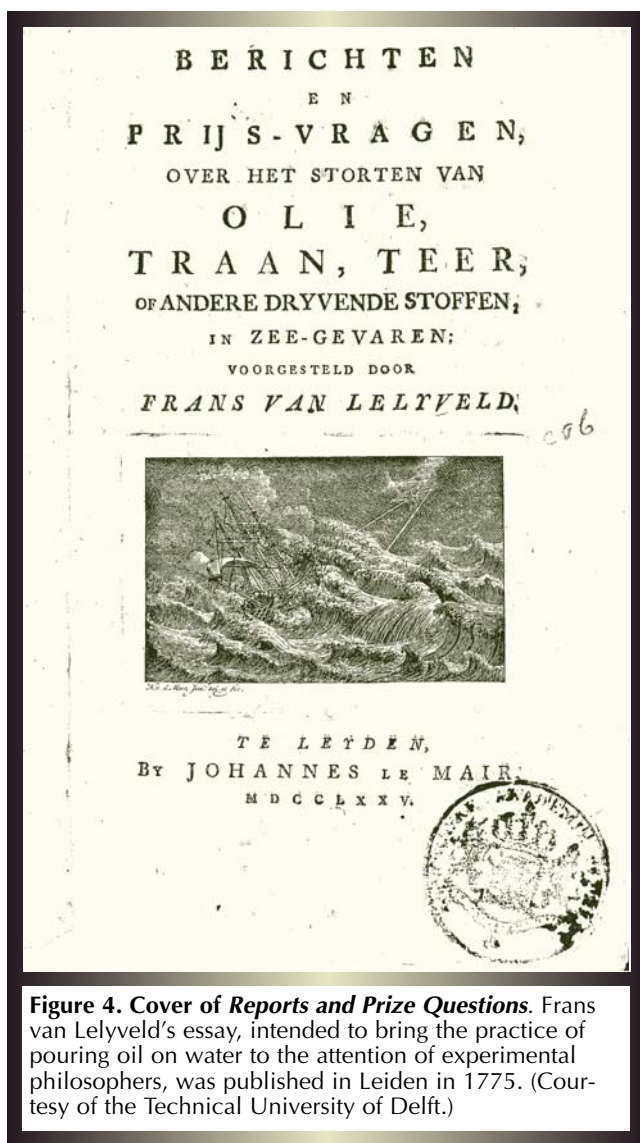


Figure 4. Cover of *Reports and Prize Questions*. Frans van Lelyveld's essay, intended to bring the practice of pouring oil on water to the attention of experimental philosophers, was published in Leiden in 1775. (Courtesy of the Technical University of Delft.)

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 to facilitate a landing appeared to be standard procedure.

True to his intention of setting the facts straight, Lelyveld invited experimental philosophers and other observing spirits to answer one or more of 17 prize questions he formulated after a careful and critical analysis of the reports he had received. He did not ask for theoretical explanations but for facts and experiments relating to such questions as

- ▶ When you first heard of the practice of pouring 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 *storting* 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?

Lelyveld offered a prize of 30 ducats for the best treatise, and to further encourage the cultivators of experimental philosophy, he included a Dutch translation of Franklin's paper. He also sent six copies of his *Berichten*

to Franklin, expressing the hope that his piece would be "of utility for the publicq, and give inducements to exact inquiries" and suggesting that his piece be translated into English.¹⁰

Johannes le Francq van Berkhey

Lelyveld's *Berichten* elicited several reactions, both positive and negative. Newspapers began to be interested in stories of rescues involving the use of wave-stilling oil. The Dutch East India Company decided to prescribe experiments to be carried out at sea, the results of which were to be written down by the captains in their logbooks. Lelyveld received many additional letters from fishermen and seamen, and included those 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 questions of epistemology.

The *Supplement (Byvoegsel)* contains 10 additional letters written by commanders, captains, or former captains from Amsterdam, Rotterdam, and Vlaardingen, but also from France and Portugal. Figure 5 illustrates an experiment described in one such letter. The themes discussed are similar to those of the original reports—*storting*, landings, and seeing through water. The letters make it clear that the practice of pouring oil on water extended far beyond Holland: It could be found in Sweden, Denmark, England, Spain, the Mediterranean, Guyana, Newfoundland, and Southeast Asia, where the Ambonese, Malay, Chinese, Papuan, and Javanese all made use of coconut oil to effect a smooth landing through the surf.

Someone who did not support Lelyveld's purposes was Berkhey; in 1775 he 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 honor of the fishermen and seamen of the Low Countries, especially those of Holland and Zeeland, who deserve this honor for their ancestral knowledge*, published in Lieden by Heyligert and Hoogenstraaten. Berkhey (1729–1812) was lecturer of natural history at Leiden University. According to his 19th-century biographer,¹¹ his *Serious Reproofs* "was pervaded with a vehemence unworthy of a scientist." 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 be freed from prejudice and brought to a satisfactory degree of certainty by the carrying out of philosophical experiments. But who is to decide, Berkhey exclaims, whether the reports Lelyveld collected in his *Berichten* are based on dubious prejudice or real experience? Berkhey himself fully accepts the reliability of Dutch seamen as a matter of course: The Dutch have known for ages how to avoid shipping dangers by pouring oil into the sea. He therefore acclaims Lelyveld's suggestion that more stories in the style of Hoogerduin's be published. But he does not agree that such stories would be but imperfect empirical material to be "civilized and perfected" by learned men. There is, he says, 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. Lelyveld's idea of imperfect notions goes against the honor of both the fishermen and the correspondents who forwarded their reports, as if they have just been driveling.

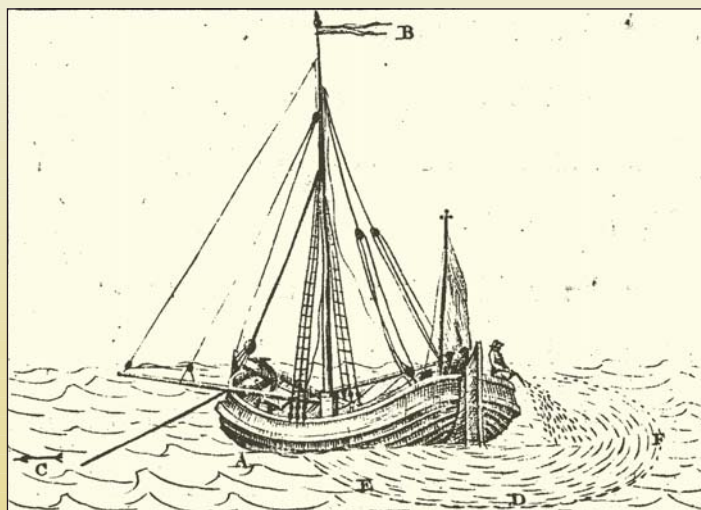


Figure 5. An experiment in the North Sea. The drawing depicts an experiment conducted by Isak Kalisvaar, one of the few nonscientists to experiment at sea. As reported in a letter he wrote to Frans van Lelyveld in 1776, Kalisvaar left the village of Vlaardingen on 4 January 1776 in search of cod but ran into a violent storm that drove him against the Dogger Bank. There he carried out experiments with whale oil. In the illustration, A is Kalisvaar's ship, B is a flag indicating the wind direction, C shows the current direction, and the arc EDF identifies a circle of oil spreading behind the anchored ship. (Adapted from ref. 6, p. 197.)

In fact, Berkhey goes on to say, the knowledge involved is ancient. As it relates to the Dutch, its origins must be traced to the Nordic and Gothic peoples who knew the use of oil and fat originating from whales, seals, and other marine animals. When, in the ninth century, those nations made their voyages to the German, Dutch, and Italian shores, they passed that knowledge on to the local inhabitants. In evidence of the antiquity of that practical know-how Berkhey quotes Valerianus, who in his *Hieroglyphica* (1602) quotes a monk 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.¹² Berkhey concludes his argument 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.

The knowledge of the vulgar

The story that begins with Franklin's theoretical explanation of the effects of oil on water and ends with Berkhey's defense of traditional knowledge shows that in the 18th 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, and the electrical machine had not been developed as a technological tool but as a scientific instrument.¹³ 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 experience, which, moreover, touched on 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 honor of Dutch seamen, that is, against the respectability and reliability of Dutch ancestral knowledge. Lelyveld's natural philosophy was far too weak to criticize that practical knowledge. It was presumptuous to do so. What would Lelyveld have said, and what would Kool have said, if some pre-Lavoisier chemist had suggested that the methods they followed in their factories for dyeing cloth in Leiden or producing vinegar in Beverwijk were based on prejudice?

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.

This article is a condensed version of a larger work that appears online as part of the Benjamin Franklin Tercentenary website <http://www.benfranklin300.org>.

References

1. B. Franklin, *Philos. Trans.* **64**, 445 (1774). The letter is also available online at, for example, <http://www.historycarper.com/resources/twobf3/letter12.htm>.
2. For more information on Pringle, Brownrigg, and the Derwent Water experiment, and Franklin's theory of oil on water, see C. 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 U. Press, New York (2004).
3. Pliny the Elder, *Natural History*, vol. 1, H. Rackham, trans., Harvard U. Press, Cambridge, MA (1938), p. 361.
4. Bede, *The Ecclesiastical History of the English Nation*, E. P. Dutton, New York (1910), book 3, chap. 15, available at, for example, <http://www.fordham.edu/halsall/basis/bede-book3.html>.
5. W. B. Wilcox, ed., *The Papers of Benjamin Franklin*, vol. 21, Yale U. Press, New Haven, CT (1998), p. 373.
6. F. van Lelyveld, *Berichten en Prijs-vragen over het storten van olie, traan, teer, of andere dryvende stoffen, in zee-gevaren*, 2nd ed., Johannes le Mair, Leiden, the Netherlands (1776).
7. Plutarch, *Moralia*, vol. 11, L. Pearson, F. H. Sandbach, trans., Harvard U. Press, Cambridge, MA (1965), p. 177.
8. D. C. Hoogerduin, *Singulieren of Byzonderen Historien, wegens het verongelukke van het Groenlands Schip, De Juffrouwen Anna Cornelia en Anna*, W. A. Leeuwendaal, Amsterdam (1774).
9. A. R. Kool, *Beschryving en Onderrichtingen behorende tot de Nieuwe Platte Paskaart der Hollandsche Stranden*, Gerard Hulst van Keulen, Amsterdam (1773).
10. W. B. Wilcox, ed., *The Papers of Benjamin Franklin*, vol. 21, Yale U. Press, New Haven, CT (1998), p. 519.
11. A. J. van der Aa, *Biographisch Woordenboek der Nederlanden*, vol. 5, J. J. van Brederode, Haarlem, the Netherlands (1859), p. 196.
12. I. P. Valeriani Bellunensis, *Hieroglyphica seu De Sacris Aegyptiorum aliarumque gentium Literis Commentarii*, Frelon, Lyons, France (1602) [reprinted by Garland, New York, 1976], p. 562.
13. G. Pancaldi, *Volta: Science and Culture in the Age of Enlightenment*, Princeton U. Press, Princeton, NJ (2003). ■