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Captured on paper: fish books, natural history and questions of demarcation in eighteenth-century Europe (ca. 1680–1820)

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CHAPTER 2

Fresh Fish: Observation Up Close in Francis Willughby and John Ray's *Historia piscium* (Oxford, 1686)

Fishes were part and parcel of daily life in early modern England. This becomes clear when perusing some of the species descriptions in Willughby and Ray's *Historia piscium.* An annotated copy in the archives of the Royal Society further accentuates this. It is the Society's original, very own copy, and both Tancred Robinson and, later, Cromwell Mortimer (1693–1752) took the liberty of adding their own remarks and observations in the margins of certain species descriptions.[1] As such, it offers insight into the questions that Fellows continued to explore even after the history of fishes was published. A considerable proportion of these notes is dedicated to specifying where in London one might chance upon which species of fish. They reveal, for example, that lampreys could be seen shining in the water of the Thames before fishermen hauled them up in wicker nets, whereas London shops displayed a selection of dab.[2] A dolphin – at that time still considered a fish – taken "in our Channell; very smooth like polisht marble a long snout with 2 rows of teeth on each side, very little Eyes & c. about 4 feet long" could be encountered "at the Ship Tavern at Butcher Row's end near

* An adaptation of this chapter has appeared as article: Didi van Trijp, "Fresh Fish: Observation up Close in Late Seventeenth-Century England," *Notes and Records of the Royal Society of London* (2020), published online ahead of print, https://royalsocietypublishing.org/doi/10.1098/rsnr.2019.0051.

[1] Willughby and Ray, *Historia piscium*, RCN 18574, Library and Archives of the Royal Society (hereafter RS), London. The annotations are the remarks of Tancred Robinson (TR) as inscribed by Francis Aston; later annotations are Cromwell Mortimer's (CM). The copy is also mentioned in Kusukawa, "*Historia Piscium* (1686) and Its Sources," 328.
[2] Willughby and Ray, *Historia piscium*, RS, RCN 18574RCN, 96–97, 105 (TR).

Temple Bar."[3] The swim bladder of the cod counted as a "very luxurious" dish in the city.[4] Any strange fishes caught in the Thames, furthermore, were brought to the Lord Mayor's home.[5] Despite their ubiquitous presence, however, fish were also somewhat elusive. Some of these 'slippery denizens'[6] of the water were difficult to capture, and once caught they promptly began to falter and spoil.[7] Where and how, then, could one establish solid knowledge about these unstable objects of inquiry?

The previous chapter has explained that the aim of the *Historia piscium* was to provide accurate accounts of all fish hitherto known, and to do so in an orderly manner. It has elaborated on how Willughby and Ray focussed on the physical characteristics that fish displayed, and which they had, ideally, selected after close observation of the species at hand. We saw how the materials on which they could draw were rich, and that these encompassed earlier natural historical works, travel accounts, objects in cabinets of curiosities, drawings bound together in books, loose drawings, and observations shared in letters. We also saw how the process of creating precise species descriptions and selecting suitable accompanying illustrations every now and then provoked discussions regarding what ought to be the proper selection criteria. The aim of this chapter is to address such matters of evaluation in more detail. It looks closely at how the observation of fish took place in practice, and at how observations were assessed as reliable and credible and thence incorporated into the *Historia piscium*.

In addressing these matters, the engraved title page (**Figure 2.1**) made by the Dutch painter and printmaker Paul van Somer II (1644–1698) entreats the reader to take a closer look. Set against the backdrop of an Arcadian fishing port, several people tend to the arrival of fresh fish announced by a herald blowing a large conch shell.[8] Fishermen in loincloths haul in their nets. Two men dressed

[3] Ibid., 28 (CM).
[4] Ibid., 166 (CM).
[5] Birch, *The History of the Royal Society*, vol. 4, 42.
[6] The phrase "slippery denizens" comes from Matthew C. Hunter, *Wicked Intelligence: Visual Art and the Science of Experiment in Restoration London* (Chicago: University of Chicago Press, 2013), 69.
[7] This elusiveness is explored in Elspeth Graham, "Ways of Being, Ways of Knowing: Fish, Fishing, and Forms of Identity in Seventeenth-Century English Culture," in *Animals and Early Modern Identity*, ed. Pia F. Cuneo (Farnham: Ashgate, 2014).
[8] Anna Marie Roos has suggested that the ship on the title page is a visual nod to the one featured on the engraved title page to Bacon's *Instauratio magna* (London: John Bill, 1620). See Roos, *Web of Nature*, 325.

in tunics examine the scene, one of whom gestures at the catch. Just below them, a female figure in a helmet, possibly a reference to Minerva, the Roman goddess of wisdom and the arts, draws the specimen that is set before her. A garland of fish lines the sides and top of the frontispiece; the pufferfish, turbot, and hound shark are copied from the engraved plates of the book.[9] These depictions are decidedly different from the dolphin, taken from classical iconography, which adorns the lower left corner of the engraving. The colossal fish in the foreground, containing the book's imprint and its affiliation to the Royal Society in its gaping mouth, is rendered in a similarly stylized manner.[10] To the right of this creature, a female figure reposes on a jug from which water is pouring, adding to the sense of flow and movement of the scene. All in all, the title page conjures an image of exuberance and abundance. Considering that frontispieces of early modern works of natural history and philosophy often present a visual programme of a book's contents,[11] this one brings together the various sources available for finding knowledge about fish: classical accounts, illustration, and first-hand observation.

This chapter investigates one of the sources displayed on the title page: namely, those people practically engaged with fish such as fishermen and fishmongers. The nature and extent of the contributions of these practical men can be inferred both from the *Historia piscium* itself, and from other source materials related to the book and its authors, such as natural historical manuscripts, minutes of Royal Society meetings, and letters to and from the Fellows.[12] While recent studies of the *Historia piscium* do mention their contributions, they do so only in passing

[9] For a discussion of title pages of natural historical works on fish, see: Paul J. Smith and Didi van Trijp, "Dynamiques européennes de l'humanisme érudit dans l'histoire naturelle. Le cas de l'ichtyologie, de Belon, Rondelet et Gessner à Willughby et Ray," in *L'humanisme à l'épreuve de l'Europe (XVe-XVIe siècles)*, eds. Denis Crouzet, Elisabeth Crouzet-Pavan, Philippe Desan and Clémence Revest (Ceyzérieu: Champ Vallon, 2019), 167–181.

[10] A print proof of the engraved title page, in which both title and affiliation have yet to be inserted, can be found in NUL, Mi LM 24/170.

[11] Volker R. Remmert, "'Docet parva picture, quod multae scripturae non dicunt.' Frontispieces, Their Functions, and Their Audiences in Seventeenth-Century Mathematical Sciences," in *Transmitting Knowledge: Words, Images, and Instruments in Early Modern Europe*, eds. Sachiko Kusukawa and Ian Maclean (Oxford: Oxford University Press, 2006), 240; see also idem, *Picturing the Scientific Revolution* (Philadelphia: Saint Joseph's University Press, 2011).

[12] It was indeed often men; no fishwives figure in the sources examined here. In England, fishwives were not allowed to sell inside public marketplaces, see: Alena Buis, Christi Spain-Savage and Myra E. Wright, "Attending to Fishwives: Views from Seventeenth-Century London and Amsterdam," in *Mapping Gendered Routes and Spaces in the Early Modern World*, ed. Merry E. Wiesner-Hanks (Farnham: Ashgate, 2015), 193.

Figure 2.1 Engraved title page of *Icthyographia* (1685), Paul van Somer II | © The Royal Society

and a thorough has not as yet been undertaken.[13] Examining the interactions between fishermen and Fellows is particularly relevant to this dissertation, which seeks to examine what was considered valuable knowledge about fish, and especially who could be counted on to produce said knowledge.

This chapter consists of three parts. The first part embeds the *Historia piscium* in the broader social-cultural context of knowledge production particular to the Royal Society, which valued the (direct) experiences of trustworthy observers. It discusses how we can position fishermen and fishmongers in the Society's circle of informants. The second part examines why Fellows turned to fishermen, and argues that, in natural historical studies, a supply of fresh fish was often much preferred to examining preserved specimens or illustrations. The third part addresses how these practical men contributed to the identification of, and distinction between, particular species and remarked on specific behaviour. As such, it looks into what fishermen knew about fish, and the extent to which Willughby, Ray and the other Fellows considered them as useful and reliable sources. As we will see, experience was an important factor in evaluating these men's claims and observations. The chapter shows that the emphasis that the Society placed on direct observation as necessary in the establishment of accurate accounts of species required both a wide range of observers and an assessment of these observers on the part of the Fellows.

A Wider Cast

The variety of sources displayed on the title page of the *Historia piscium* is also reflected in the text itself, such as in discussion of the peculiar way in which the salmon every so often leaps out of the water:

> The *salmon* constantly presses forward against the stream, and when it encounters in its ascent an enclosure or another obstacle of this kind, it seizes, after it has bent its body in a circle, its tail with its mouth, and, while it holds fast to this [i.e., its tail], it, releasing [its grip] again, with

[13] Other studies of the *Historia piscium* can be found in Kusukawa, "The *Historia Piscium* (1686),"; idem, "*Historia Piscium* (1686) and Its Sources," and Raven, *John* Ray, 339–370.

> great force, leaps across it. Author of *De natura rerum* with *Gesner*. We have heard multiple times of many fishermen that this happens continually. That salmon are most agile in jumping we confirm willingly, and our daily experience confirms this: but what is told about the seizing of the tail seems to us less plausible.[14]

Several layers of observation come together in this passage. It begins with a medieval account of this phenomenon, by Thomas of Cantimpré (1201–1272), as cited in Gessner.[15] While this is illustrative of the extent to which Willughby and Ray drew on the works of earlier Renaissance authors, as has been argued in the previous chapter, they also did not take such accounts at face value. Willughby and Ray verified this account, not once, but in multiple instances, and not with one, but with many fishermen – who, furthermore, confirmed that they saw this happening all the time. This, in itself, however, still did not settle the matter of the salmon's strange behaviour. While Willughby and Ray's own, daily experiences confirmed the tenor of the report, namely that salmon are nimble jumpers, they remained sceptical about its specifics, namely the manner in which the salmon gripped and released its tail, which they had not seen themselves. The *Historia piscium* contains more passages like these, which cite observations from past and/or present sources before concluding with the authors' own verdict on the matter.[16]

The previous chapter has addressed how the publication of the book was the result of a collective effort of the Fellows of the Royal Society. They were closely involved in selecting what merited inclusion in the work. As we will see, the work can also be recognized as a product of the Society in its insistence on knowledge derived from direct experience with the object of study. This certainly did not mean that the Fellows no longer consulted texts, but that these texts

[14] Original Latin: "*Salmo* adversus fluvios perpetuo nititur, cumque in ascensu sepem vel aliud hujusmodi obstaculum invenerit, in circulum flexo corpore caudam ore apprehendit, eamque mordicus tenens, iterumque dimittens magno impetu transilit. *Author de natura rerum* apud *Gesner*. Hoc à plurimis piscatoribus assidue fieri multoties audivimus. Quod Salmones ad saliendum agillimi sunt, libenter concedimus, & experientia quotidiana confirmat: verum quod de caudae apprehensione fertur minus verisimile nobis videtur." *Hist. pisc.*, 191–192.

[15] Cf. Gessner, *Hist. anim.* IIII, 974 and Thomas of Cantimpré, *De natura rerum*, ed. Helmut Boese (Berlin: De Gruyter, 1973), 270. See also: Baudouin Van den Abeele, "Conrad Gessner als Leser mittelalterlicher Enzyklopädien," in Leu and Opitz, *Conrad Gessner*, 15–28.

[16] See also, for example, *Hist. pisc.*, 105, 229 and 342.

were not considered sufficient in themselves.[17] In the epilogue to the *Historia piscium*, Ray contended that it would "bring across exactly these things which were either observed by ourselves and our friends, or which had proper witnesses and authors, worthy of our trust."[18] While earlier authors counted as credible past witnesses, their written observations would, ideally, be corroborated with those of contemporary ones. Indications of direct observation are present in the fish book in various ways. Willughby and Ray, for example, added 'I have seen' [*vidi*] or 'we have seen' [*vidimus*] to certain species descriptions – this variation of the singular and plural form being another indication of the complicated layers of authorship discussed in Chapter 1.[19] These kinds of pithy phrases, specifying whether one had acquired knowledge of a thing with one's own eyes or from hearsay, had already been proposed by Bacon in order to indicate the reliability of a statement.[20]

In other cases, Willughby and Ray punctuated statements with appeals to 'experience' [*experientia*], as in the case of the salmon. The exact meaning of this term was far from fixed in the early modern period.[21] Although Peter Dear argued that, in the early years of the Royal Society, 'experience' was used for witnessing or participating in a particular, singular event tied to a specific moment, rather than for generalized statements on universal phenomena (in the Aristotelian sense of the term),[22] it seems that the term figures in both senses within the *Historia piscium*. The usage of the term ranges from the more general 'experience agrees' [*experientia constat*], to the collective 'experience has taught us'

[17] As discussed in Fabian Krämer, *Ein Zentaur in London: Lektüre und Beobachtung in der frühneuzeitlichen Naturforschung* (Korb: Didymos, 2014).
[18] Original Latin: " […] duntaxat tradere quae vel à nobismetipsis & amicis observata essent, vel idoneos & fide dignos testes & auctores haberent." *Hist. pisc. app*., sig. Hv.
[19] For example, *vidi* usually (but not always) refers to Ray, and *vidimus* usually to both Willughby and Ray, but sometimes only to Ray.
[20] See: Bacon, *Parasceve ad historiam naturalem*, OFB XI, 467 and Andrew Peter Langman, "'Beyond, both the Old World, and the New': Authority and Knowledge in the Works of Francis Bacon, with Special Reference to the *New Atlantis*" (PhD. diss., Queen Mary University of London, 2007), 243–244.
[21] See for example, Alberto Vanzo, ed., *Experience in Natural Philosophy and Medicine*, special issue of *Perspectives on Science* 24, no. 3 (2016): 255–379; Peter Dear, "The Meanings of Experience," in Daston and Park, *Cambridge History of Science*, vol. 3, 106–131; and Ogilvie, *Science of Describing*, 17–23.
[22] Peter Dear, *Discipline and Experience: The Mathematical Way in the Scientific Revolution* (Chicago: Chicago University Press, 1995), 13–14.

[*experientia didicimus*] to the more specific, individual 'that which my experience has confirmed' [*id quod experientia mihi confirmavit*].[23]

In the previous chapter, it has been explained that emphasis on first-hand observation (for which the terms *observatio* and *autopsia* gained currency) rose steadily from the early sixteenth century onwards.[24] It has also been remarked that Society's foregrounding of direct experience as the foundation of natural knowledge owes much to Bacon's work.[25] Experience of nature might be gained, Bacon had stated, through hunting, husbandry, gardening, shepherding, animal breeding and travelling, among other things.[26] "The materials for the intellect", he wrote, "are so widely spread out that they ought to be sought out and gathered in (as if by agents and merchants) from all sides."[27] A similar sentiment can be read from the words of Thomas Sprat (1635–1713), chronicler of the early Royal Society, when he wrote that knowledge was to be gathered "from the Shops of Mechanicks; from the Voyages of Merchants; from the Ploughs of Husbandmen; from the Sports, the *Fishponds*, the Parks, the Gardens of Gentlemen".[28]

Bacon, however, also held that one would be "forever tossed and turned on the waves of experience" when pursuing it without clear course.[29] Those who wished to interpret nature required a degree of 'literate experience' [*experientia literata*].[30] Characteristically perhaps for Bacon's at times somewhat opaque manner of formulating, historians of science have grappled with what exactly this

[23] *Hist. pisc.*, 7, 9 and 246.
[24] Gianna Pomata, "Observation Rising: Birth of an Epistemic Genre, ca. 1500–1650," in *Histories of Scientific Observation*, eds. Lorraine Daston and Elizabeth Lunbeck (Chicago: University of Chicago Press, 2011), 45–80.
[25] As it is impossible to do justice to the intricacies of Bacon's epistemology or historiography here, I mention particularly on natural history: *Francis Bacon and the Reconfiguration of Early Modern Natural History*, eds. Guido Giglioni, Dana Jalobeanu and Sorana Corneanu, special issue of *Early Science and Medicine* 17, no. 1/2 (2012): 1–271.
[26] Guido Giglioni, "Learning to Read Nature: Francis Bacon's Notion of Experiential Literacy (*Experientia Literata*)," *Early Science and Medicine* 18, no. 4/5 (2013): 409.
[27] Francis Bacon, *The Instauratio Magna Part II: Novum Organum and Associated Texts*, eds. Graham Rees and Maria Wakely (Oxford: Clarendon Press, 2004), 451. Henceforth abbreviated as OFB XI.
[28] Sprat, *History of the Royal Society*, 72; emphasis mine.
[29] Bacon, *Novum organum*, OFB XI, 16–17.
[30] A notion that Bacon developed in ibid., 158–159, according to Cesare Pastorino, "Weighing Experience: Experimental Histories and Francis Bacon's Quantitative Program," *Early Science and Medicine* 16, no. 6 (2011): 543.

kind of experience signified, and offered various interpretations of this notion.[31] Bacon himself stated that "no discovery should be sanctioned save that it be put in writing. Only when that becomes standard practise, with experience at last becoming literate, should we hope for better things."[32] Sophie Weeks has highlighted how the primary difference between literate and illiterate experience was not a matter of erudition, but rather one of mediated access to nature. This meditation entailed a disciplined examination of nature, in which it was "set down and presented in suitable order" rather than investigated in all its fecundity at random.[33] Whether this then meant that such this orderly way of probing nature was restricted to the educated or learned is another question. Deborah E. Harkness has contended that Bacon's precepts for obtaining true and certain natural knowledge harked back to the daily vernacular science that was practiced in the streets of Elizabethan London.[34]

Fishermen and fishmongers, as attentive observers of nature, were consulted broadly throughout both the classical and early modern period. In their study of nature, Aristotle and Pliny drew on the reports of those whose experience of nature stemmed from practice, such as fishermen, huntsmen, shepherds, farmers and seafarers.[35] Sixteenth-century naturalists like Guillaume Rondelet and Pierre Belon, for example, conversed with fishermen on their observations of Mediterranean marine life in addition to perusing learned books; a practice that Florike Egmond has referred to as 'fieldwork once removed.'[36] Gessner, too, stated that he benefited from the knowledge of fishermen, and attributed a higher value

[31] Cf. Dana Jalobeanu, "Disciplining Experience: Francis Bacon's Experimental Series and the Art of Experimenting," *Perspectives on Science* 24, no. 3 (2016): 324–342; Giglioni, "Learning to Read Nature," 405–434; Sophie Weeks, "The Role of Mechanics in Bacon's *Great Instauration*," in *Philosophies of Technology: Francis Bacon and his Contemporaries*, eds. Claus Zittel, Gisela Engel, Romano Nanni and Nicole C. Karafyllis (Leiden: Brill, 2008), 133–195; Lisa Jardine, "*Experientia literata* or *Novum organum*? The Dilemma of Bacon's Scientific Method," in *Francis Bacon's Legacy of Texts: 'The Art of Discovery Grows with Discovery'*, ed. William A. Sessions (New York: Ams Press, 1990), 47–67.
[32] Bacon, *Novum organum*, OFB XI, 159.
[33] Bacon, *Novum organum,* OFB XI, 215 as cited in Weeks, "Mechanics in Bacon's Great Instauration," 172.
[34] Harkness, *The Jewel House*, 213.
[35] Maclean, "White Crows, Graying Hair, and Eyelashes," 157.
[36] Florike Egmond, "On Northern Shores: Sixteenth-Century Observations of Fish and Seabirds (North Sea and North Atlantic)," in *Naturalists in the Field: Collecting, Recording and Preserving the Natural World from the Fifteenth to the Twenty-First Century*, ed. Arthur MacGregor (Leiden: Brill, 2018), 131.

to direct-hand observation than he did to natural knowledge of the textual kind.[37] Aldrovandi's correspondents wrote him about their trips to fish markets to glean information about species from fishmongers.[38] Monica Azzolini has shown how, in early seventeenth-century Rome, naturalists like Johannes Faber (1574–1629) made ample use of a plurality of oral sources including fishermen, merchants, and servants, when investigating beached whales.[39]

As we will see, these interactions take on a new meaning with the emergence of scientific societies in the seventeenth century. Learned societies of this kind emerged over the course of the seventeenth century, in Florence, Rome, Schweinfurt and Paris, amongst other places. As has been argued, most forcefully for the English context, membership of such societies, which was usually restricted to those of the upper classes, was closely linked to matters of trustworthiness.[40] This worked in two directions: if its members thought someone was credible, they selected him to figure in their midst; conversely, belonging to such a group considerably heightened one's credibility. When discussing Faber's report on the whale in the *Historia piscium*, for example, Ray noted with some insistence that the Roman was a member of the Accademia dei Lincei.[41] In the Royal Society, the existing convention of assigning reliability to those of higher social status remained in place when observing and interpreting natural phenomena.[42]

This did not mean, however, that status was the sole criterion of credibility.[43] While those from a genteel background were generally seen as trustworthy, they were also considered prone to bending their observations to fit with preconceived ideas.[44] Philippa Hellawell has argued that credibility was not the exclusive prerogative of one particular social group, but that it could be shared, albeit still attributed in various degrees, among people of various backgrounds.[45] Felicity

[37] Anthony Grafton, "Philological and Artisanal Knowledge Making in Renaissance Natural History: A Study in Cultures of Knowledge," *History of the Humanities* 3, no. 1 (2018): 43–45.
[38] Findlen, *Possessing Nature*, 176–177.
[39] Monica Azzolini, "Talking of Animals: Whales, Ambergris, and the Circulation of Knowledge in Seventeenth-Century Rome," *Renaissance Studies* 31, no 2 (2017): 318.
[40] Shapin, *A Social History of Truth*, 122–123; Shapin and Schaffer, *Leviathan and the Air-Pump*, 58.
[41] Kusukawa, "*Historia Piscium* (1686) and Its Sources," 333.
[42] Shapin and Schaffer, *Leviathan and the Air-Pump*, 58.
[43] Barbara Shapiro, *A Culture of Fact: England 1550–1720* (Ithaca: Cornell University Press, 2000), 140.
[44] Peter Dear, "*Totius in verba*: Rhetoric and Authority in the Early Royal Society," *Isis* 76, no. 2 (1985): 156.
[45] Philippa Hellawell, "'The Best and Most Practical Philosophers': Seamen and the Authority of Experience in Early Modern Science," *History of Science* 58, no. 1 (2019): 32.

Henderson has submitted that the Royal Society, as an institution, relied on "the activities and expertise of a wider penumbra of individuals" than that of the Fellows themselves.[46] Certain individuals within the Society itself blurred social boundaries, such as Hooke, who, as son of a curate, required financial support for his studies of nature.[47] Despite being employed as Curator of Experiments, regarded as a lesser position than that of Fellow because of the paid labour involved, he took part in natural philosophical debates and was elected Fellow in 1663.[48]

Experiments held a special place in the deliberations of the early Royal Society. Bacon had contended that experiments served to deliberately seek out a certain experience, as opposed to mere experience which derived from 'accident' – allotting an active role to the observer, rather than a passive one.[49] While the Fellows seem to have had their own approaches to the meaning and use of experiments, it is clear that several of them took to performing them as a way of understanding nature's intriguing properties.[50]

Regarding fish, they pondered such questions as: did they breathe? How did these creatures move in the water? How did they spawn, and how long could they go without food? The minutes of meetings found in the Journal Books of the early 1660s reveal that the Society's Operator, whose task it was to facilitate experiments and make inquiries, was ordered several times to collect and keep fish for experiments.[51] He was also instructed to ask fishermen how long they could

[46] Henderson, "Robert Hooke and the Visual World of the Royal Society," 397.
[47] Steven Pumfrey, "Ideas above His Station: A Social Study of Hooke's Curatorship of Experiments," *History of Science* 29, no. 1 (1991): 4.
[48] Steven Pumfrey, "Who did the Work? Experimental Philosophers and Public Demonstrators in Augustan England," *British Journal for the History of Science*, 28, no. 2 (1995): 153.
[49] Bacon, *Novum organum*, 131. It is important to note that he did not apply the notions *experientia*, *experimentum*, and *observatio* particulary strictly, see Lorraine Daston, "The Empire of Observation, 1600–1800," in Daston and Lunbeck, *Histories of Scientific Observation*, 83. 81–113
[50] Peter Anstey, "Philosophy of Experiment in Early Modern England: The Case of Bacon, Boyle and Hooke," *Early Science and Medicine* 19, no. 2 (2014): 103–132; Michael Hunter, "Robert Boyle and the Early Royal Society: A Reciprocal Exchange in the Making of Baconian Science," *British Journal for the History of Science* 40, no. 1 (2007): 1–23.
[51] See, for example: 25 June 1662 (OS), RS JBO/1/66; 15 April 1663 (OS), JBO/1/159; 30 December 1663 (OS); JBO/2/23. Journal Book Original, London. Richard Shortgrave (d. 1676) may have been the Operator, see: Marie Boas Hall, *Promoting Experimental Learning: Experiment and the Royal Society, 1660–1727* (Cambridge: Cambridge University Press, 1991), 27.

keep their fish alive without feeding them.[52] Furthermore, the minutes indicate that "all those [present at the Society], that had the opportun[it]y, were desired to make several Experiments in several fish, concerning their growth."[53]

Although the precise set-up of these experiments is not always disclosed in the minutes, the careful reports published in the *Philosophical Transactions* may give us an idea.[54] Around 1670, Robert Boyle (1627–1691) had a gudgeon placed into a 'Pneumatical Engin', or air pump.[55] Of course, Boyle and his company are known to have inserted various small animals into this device, including birds, mice and snakes.[56] The experiment on the gudgeon, "far from being the first" that had been done on a fish with this sort of instrument, was devised to show what happened to a fish when "it should be kept for some hours together from all supply of fresh Air."[57] Although after mostly all of the air was removed "there appeared a great store of Bubbles all about the Fish", no definitive conclusions could be drawn.[58] The specimen lived for some ten days more; Boyle's postscript that "divers Gudgeons since taken dy'd there in much fewer dayes" suggests that several trials were run. The *Historia piscium* lauds Boyle for his "most excellent experiments" on the effects of water pressure upon bodies of air.[59] It recounts an experiment to fill up a swim bladder with air and submerge it in a clear, deep vessel filled with water. The deeper the bladder was plunged, the more contracted it would become, and vice versa.[60]

[52] Entry of 18 June 1662 (OS), RS, JBO/1/66.
[53] Entry of 24 June 1663 (OS), RS, JBO/1/194.
[54] For a discussion of the early *Philosophical Transactions*, vide: Adrian Johns, "Miscellaneous Methods: Authors, Societies and Journals in Early Modern England," *British Journal for the History of Science,* 33, no. 2 (2000): 165–174.
[55] Robert Boyle, "New Pneumatical Experiments About Respiration," *Philosophical Transactions of the Royal Society of London* 5, no. 62 (1670): 2011.
[56] Anita Guerrini, *Experimenting with Humans and Animals: From Galen to Animal Rights* (Baltimore: Johns Hopkins University Press, 2003), 38.
[57] Boyle, "New Pneumatical Experiments About Respiration," 2024.
[58] Ibid., 2025–2026.
[59] *Hist. pisc.*, 8.
[60] Similar questions are asked in A.I. and Robert Boyle, "A Conjecture Concerning the Bladders of Air That are Found in Fishes, Communicated by A.I.; And Illustrated by an Experiment Suggested by the Honorable Robert Boyle," *Philosophical Transactions of the Royal Society of London* 10, no. 114 (1675): 310–311. The experiment entailed placing a specimen into a tall, long-necked vessel filled with water, and observe whether upward or downward motions of the fish caused changes in the water level.

Fellows did not only pursue their inquiries on fish within the confines of Gresham College, where their weekly meetings took place.[61] Hooke recounts coming across a porpoise displayed at Ulbars (possibly a fishmonger's shop) in November 1679.[62] He bought the specimen and transported it to Garraway's coffee house, near the Royal Exchange.[63] Here he performed a public dissection.[64] Just like demonstrations of instruments, examinations of animal species in taverns or coffee houses could facilitate discourse on natural phenomena among individuals of various stripes.[65] These might well be people possessing valuable experience regarding the subject, such as sailors. Hellawell has demonstrated, for example, how the Society considered seamen uniquely positioned to record and examine certain natural phenomena. The Fellows asked them to conduct experiments and make observations while at sea, for example recording sightings of species of birds, fish, and other animals as well as magnetic variations of the tides.[66] Her study confirms Lux and Cook's hypothesis that the Royal Society was a relatively open institution that welcomed contributions from outside of its own geographical and social reach, provided, of course, that a member vouched for the credibility of any such informant.[67]

While Hellawell proposes further, specialized case studies be conducted of the evaluation of the knowledge and skills of other occupational groups,[68] she signals that this can be difficult as such groups do not always fit "the conventional artisanal mold."[69] Like seamen, fishermen do not readily fall into those

[61] Michael Hunter, "A 'College' for the Royal Society: The Abortive Plan of 1667–1668," *Notes and Records of the Royal Society of London* 38, no. 2 (1984): 159.
[62] Robert Hooke, *The Diary of Robert Hooke, 1672–1680*, eds. Henry W. Robinson and Walter Adams (London: Taylor and Francis, 1935), 430–431. See also Hunter, *Wicked Intelligence*, 118.
[63] Rob Iliffe, "Material Doubts: Hooke, Artisan Culture and the Exchange of Information in 1670s London," *British Journal for the History of Science* 28, no. 3 (1995): 286.
[64] See: Noah Moxham, "Edward Tyson's *Phocaena*: A Case Study in the Institutional Context of Scientific Publishing," *Notes and Records of the Royal Society of London* 66, no. 3 (2012): 235–252.
[65] Adrian Johns, "Coffeehouses and Print Shops," in Park and Daston, *The Cambridge History of Science*, vol. 3, 336.
[66] Hellawell, "Best and Most Practical Philosophers," 36, 46.
[67] David S. Lux and Harold J. Cook, "Closed Circles or Open Networks? Communicating at a Distance During the Scientific Revolution," *History of Science* 36, no. 2 (1998): 201.
[68] Hellawell, "Best and Most Practical Philosophers," 33. An example of such a case study are the miners discussed in Kerrewin van Blanken, "Earthquake Observations in the Age Before Lisbon: Eyewitness Observation and Earthquake Philosophy in the Royal Society, 1665–1755," *Notes and Records of the Royal Society of London* (2020), published online ahead of print.
[69] Hellawell, "Best and Most Practical Philosophers," 33–34.

historiographical categories of workmen who have received sustained attention of historians of science over the past decades, notably invisible technicians and artisans. The work of fishermen and fishmongers was, after all, not technical in the sense that they handled (scientific) instruments – in contrast to, for example, those technicians who assisted Boyle.[70] They also do not quite resemble the self-aware artisans that we might encounter in the works of Pamela Smith and Pamela Long. These historians have reconstructed the approaches of these early modern makers towards the natural world from the texts and artefacts which have come down to us today, such as recipes, manuals, drawings, paintings, casts, or ceramics.[71] There is a lacuna of sources, however, when it comes to the attitudes of fishermen and fishmongers towards the study of nature. That makes it difficult to gauge what kinds of knowledge they possessed about fish.

There are various reasons for this scarcity. The quite obvious one is that fishermen and fishmongers have not generally left much behind in writing – with some exceptions here and there, as we will see shortly. Within these practical communities, interactions were perhaps, or likely to have been of a local and oral nature. These are precisely the kinds of connections that are difficult to reconstruct, and that tend to be overlooked as a result of the emphasis on texts when reconstructing early modern networks.[72] And yet, as Azzolini has argued, we "accord undue weight to the authority of writers" while not taking the spoken word into account.[73] While we know from the reports of scholars that they had conservations with fishermen and fishmongers, their accounts are of course edited and much condensed. They offer, therefore, only mediated access. As the passage opening this section has also highlighted, the authors and compilers of the *Historia piscium* ultimately selected what was included in the book, and what was left out.

In order to get a less one-sided view of the interactions between Fellows and fishermen, another approach is required: we must consider sources other than

[70] Steven Shapin, "The Invisible Technician," *American Scientist* 77, no. 6 (1989): 544–563; Rob Iliffe, ed., *Technicians*, special issue of *Notes and Records of the Royal Society of London* 62, no. 1 (2008): 3–148.
[71] Pamela O. Long, *Artisan/Practitioners and the Rise of the New Sciences, 1400–1600* (Corvallis: Oregon State University Press, 2011); Smith, *The Body of the Artisan.*
[72] Ruth Ahnert, "Maps versus Networks," in *News Networks in Early Modern Europe*, eds. Joad Raymond and Noah Moxham, (Leiden: Brill, 2016), 140.
[73] Azzolini, "Talking of Animals," 299–301.

the accounts of scholars. Take for example the petition (1663) of the London fishmongers held in the archives of the Royal Society. This petition, which was presented to Parliament, was read aloud during a Society meeting.[74] The fishmongers wished "that our Sea coste & rivers may swarme with the fry & brood of fish, & our Towns and Cittyes better provided for" through stricter enforcement of the law prohibiting too many young fish from being taken.[75] Although the document does not touch upon natural historical reflections explicitly, this remark shows that these fishmongers were occupied with the generation and growth of fish. It also reminds us that, while the relative inconspicuousness of fishermen and fishmongers may lead them to seem like a monolithic group, they had their own stakes and interests in the world of fish.[76] That these interests need not only be economic becomes clear from the rare manuscripts of the hands of men who caught and traded in fish while also subjecting them to closer study.[77] Willughby and Ray in fact drew on one such manuscript: that of the Strasbourg fisherman and burger Leonhard Baldner (1612–1694), entitled *Vogel-, Fisch- und Thierbuch* [Book of Birds, Fish and Animals]. It is cited throughout the *Historia piscium*. As it offers a unique entry into Baldner's own ideas about what the study of fish entailed, the last section of chapter will discuss this work in more detail.

So, while this chapter departs from the *Historia piscium*, and asks how the compilers of the work incorporated the experiences of fishermen and fishmongers, it also considers the perspective of the latter's groups where possible. This can give us a more well-rounded idea of what such exchanges may have entailed. We will, for the remainder of this chapter, reconstruct the nature, extent, diversity and significance of the contributions of practical men to the *Historia piscium*, and how these were evaluated by the Fellows.

[74] Petition, RS Cl.P.15i/8, Classified Papers. It was read on 23 September 1663 (OS) and brought in by John Graunt (1620–1674).
[75] Ibid.
[76] An overview of the various types of fishing in different European regions can be found in A.R. Michell, "The European Fisheries in Early Modern History," in *The Cambridge Economic History of Europe*, eds. E.E. Rich and C.H Wilson, (Cambridge: Cambridge University Press, 1977), 133–184.
[77] A striking example for the sixteenth century is the manuscript entitled *Visboeck* (Fish book) by Adriaen Coenen (1514–1587). For more on him, see Egmond, "On Northern Shores," 132–139.

Knowledge at the Fish Market

Fishermen take centre stage in the engraved title page, even if they are depicted as rather more genteel individuals than they probably were. Fishermen and fishmongers provided (if not always wittingly) the raw material for natural historical and philosophical investigations. Fellows considered access to fresh specimens of fish to be of great importance. This section compares the kinds of evidence that could be taken from preserved specimens, illustrations and fresh specimens. It thus picks up on themes such as field trips, illustrations, and natural historical collections that have been mentioned in Chapter 1 but thus far have not yet been elaborated on.

At his home in Middleton Hall, Willughby could examine the plants in his garden and the animals in his *vivarium*,[78] just as Ray examined the trees in his own orchard.[79] When Willughby and Ray travelled through the British Isles and across continental Europe, they frequented markets to get their hands on new species of birds and fish. As Ray put it, they "visited almost all the chief fishing ports of England, and the markets of Belgium, Germany, Italy and France; […] bought all the species new to us and described them so that the reader can easily recognize them."[80] Their daily visits to the fish market in Rome produced rich results, as they found that there was "scarce any fish to be found anywhere on the coast of Italy but some time or other it may be met withal heer [*sic*]."[81] Travel companion Philip Skippon listed no fewer than eighty-nine species of fish that they had come across at Venice's market.[82] He described, for example, finding "a little fish with a scarlet belly, called Sanguinuole" in the market of Brescia.[83] Visiting (fish) markets to spot new specimens was in fact a widely utilised practice. When stationed in Jamaica in the service of the second Duke of Albemarle (1653–1688), for example, the physician and collector Hans Sloane (1660–1753) scoured the island's markets for new specimens to examine.[84]

[78] Poole, "The Willughby Library," 229.
[79] Dániel Margocsy, *Commercial Visions: Science, Trade, and Visual Culture in the Dutch Golden Age* (Chicago: Chicago University Press, 2014), 53.
[80] As quoted in Raven, *John Ray*, 365.
[81] Ray, *Observations*, 362.
[82] Skippon, *Journey*, 496, and Kusukawa, "*Historia Piscium* (1686) and Its Sources," 323.
[83] Skippon, *Journey,* 571.
[84] James Delbourgo, *Collecting the World: The Life and Curiosity of Hans Sloane* (London: Allen Lane, 2017), 91.

The piscine wealth to be found at fish markets was further proof that the underwater world teemed with creatures that merited closer examination. In one of his physico-theological treatises, Ray marvelled – echoing psalm 104.25 – "The Sea, what infinite Variety of Fish doth it nourish!"[85] While fish were indeed wonderfully varied, Ray also believed that God had created a fixed number of species.[86] From the onset, Ray set his expectations for the *Historia piscium* at a high mark. As he wrote to Robinson in 1684: "For this history of fish, I can warrant it to be as full and perfect as to the number of species, and their descriptions […] as was the history of birds."[87] As the previous chapter discussed at length, Willughby and Ray's idea of a perfect fish book differed from those extensive volumes full of anecdotes, fables and proverbs, which certain earlier Renaissance authors had compiled. Rather, they wished to rectify the unnecessary duplication of species by plotting characteristic marks.

This was also a matter of precise language, as the previous chapter explained. Their study of fish, and of nature more generally, was carried out in the context of larger philosophical reflections on the connections between knowledge and language, an interest they shared with fellow Royal Society member Wilkins. Along with many of his contemporaries, Wilkins thought that God had greatly compromised man's ability to communicate in his judgement that followed the attempt to build the tower at Babel (Genesis 11.1-9).[88] Wilkins therefore set out to compose a universal language, by creating word tables that showed the true relation between words and things. Willughby and Ray both contributed to Wilkins' project, which eventually appeared as *An Essay Towards a Real Character, and a Philosophical Language* (London, 1668).[89] Ray, however, would later privately admit to be "ashamed and disgusted" to have been so publicly associated with a project that he, found, at its core, to be ludicrous.[90] This was not because

[85] Ray, *The Wisdom of God*, 78.
[86] Kusukawa, "*Historia Piscium* (1686) and Its Sources," 313.
[87] Ray, letter to Robinson, 13 March 1684 (OS), *Correspondence of John Ray*, 164.
[88] Kusukawa, "The *Historia Piscium* (1686)," 183. A standard work on the natural philosophical pursuits of constructing a universal language is Mary Slaughter's *Universal Language and Scientific Taxonomy in the Seventeenth Century* (Cambridge: Cambridge University Press, 1982).
[89] Ray worked on the plants, Willughby on the animals. John Wilkins, *An Essay Towards a Real Character, and a Philosophical Language* (London: S. Gellibrand and John Martyn, 1668).
[90] David Cram, "Francis Willughby and John Ray on Words and Things," in Birkhead, *Virtuoso by Nature*, 255.

he disagreed with the idea that a proper connection could – and should – be established between a word and a thing: he himself was very much concerned, as we will see, with reconciling the proper relations between fish species and their names. Ray shared Wilkins' quest for a language that was stripped of ambiguity, especially when it came to describing living things.[91] What he denounced, however, was the imposition of a pre-contrived system onto nature's rich variations. By way of contrast, Ray was convinced that true knowledge came from the senses.[92]

When deploying the senses to study a species of fish, having recourse to (more or less) fresh samples was much to be desired. For this, they need not always visit fish markets, as sometimes fishermen delivered specimens to the naturalist's doorsteps. In a letter to the Royal Society detailing his dissection of a porpoise, Ray relates how, during his visit to Wilkins in Chester in late April 1669, he had had "the good fortune to meet with a young porpess of a convenient size for dissection, brought tither by some fishermen, who caught him upon the sands, where the tide had left him […]."[93] These men seemed well aware that the novelty value of certain fish washed ashore could be converted into actual coin. Their hustling was rewarded; the bishop purchased the animal (for an unknown sum) and handed it to Ray for dissection.[94] As was shown in the previous chapter, examining animals' anatomies was in fact a key component of Willughby and Ray's research; the dissection of a flair was an exemplary piece of the kind of close observation that they held up as an ideal.

When no fresh specimen was at hand, they made do with preserved ones. Willughby and Ray were dependent on what their correspondents were willing and able to send them, or what they could find or buy themselves. Willughby himself amassed a collection of "Birds, Fishes, Shells, stones and other fossils,

[91] See also: Mary Slaughter's *Universal Language and Scientific Taxonomy in the Seventeenth Century* (Cambridge: Cambridge University Press, 1982), 62–64.
[92] Kusukawa, "The *Historia Piscium* (1686)," 184; the role of sensory experience in the Royal Society is discussed at length in Wragge-Morley's *Aesthetic Science*.
[93] John Ray, "An account of the dissection of a Porpess, promised numb. 74; made, and communicated in a letter of Sept. 12 1671, by the learned Mr. John Ray, having there in obser'd some things omitted by Rondeletius," *Philosophical Transactions of the Royal Society of London* 6, no. 76 (1671): 2274.
[94] *Hist. pisc.*, 32.

seeds, dried plants, coins, etc" on his estate.[95] In London, dried fish could, as we have learned in the introduction to this chapter, even be found in taverns. And as discussed in Chapter 1, the Royal Society itself possessed a repository of objects. The catalogue made from it included a section on aquatic fauna entitled "Of Fishes" encompassing the "RIB of a TRITON, or MAREMAN" alongside several kinds of whale bones, the horn of a sea-unicorn that the Icelanders called a narwhal, some seals, the claw of a lobster – all of which attests to the wide category of creatures the word 'fish' continued to encompass in this period.[96] The collection may have included a great range of species, but its value for making proper species descriptions was limited, because, as Michael Hunter has noted: "preserved exhibits were decidedly inferior to live ones".[97]

The difference in utility between that of a living specimen and a dead, prepared one was especially marked in fish because they disintegrated so easily. What is more, different species demanded different methods of preservation. Larger specimens would often be dried, and sometimes stuffed with hay so as to retain some of their shape. Smaller specimens were usually stored within glass jars filled with spirits. Each method of preservation had its merits and pitfalls; inundating specimens with spirits, for example, was rather costly and not altogether attractive for display, whereas dried specimens could become brittle so that only the sturdier parts of the fish endured.[98] Objects preserved in the latter fashion also failed to allow for any examination of internal organs. These parts of the fish would be removed along with the flesh during the process of preservation as, unlike the fish's skin, the internal organs would not desiccate easily. Regardless of the preservation strategy used, however, the fish in question would often lose much, if not all, of its original colour in the process.

[95] Poole, "The Willughby Library," 230; a part of this collection is still extant, see: Tim R. Birkhead, Paul J. Smith, Meghan Doherty and Isabelle Charmantier, "Willughby's Ornithology," in Birkhead, *Virtuoso by Nature*, 277; Charmantier, Johnston and Smith, "The Legacies of Francis Willughby," in idem, 375.
[96] Grew, *Musaeum Regalis Societatis*, 81–124.
[97] Michael Hunter, *Establishing the New Science: The Experience of the Early Royal Society* (Suffolk: The Boydell Press, 1989), 152.
[98] See also: Peter Davis, "Collecting and Preserving Fish: A Historical Perspective," in MacGregor, *Naturalists in the Field*, 149–165; Marlise Rijks, "Scales, Skins, and Carapaces in Antwerp Collections," [forthcoming in *The Matter of Mimesis: Studies on Mimesis and Materials in Nature, Art and Science*, eds. Marjolein Bol and Emma C. Spary].

That there was often a considerable discrepancy between a fresh specimen of a species on the one hand and a preserved exemplar on the other was far from lost on the Fellows of the Royal Society. Grew had written in his description of a "little SEA-UNICORNE […] sent from Brasil", not earlier described or depicted, that from the top of the fish "is prolonged a smooth (now) blackish, round, taper'd, strait Horn […]" and that the fish itself is "cover'd with a (now) blackish, thick and tough Skin, and when you draw your hand forward, also rough."[99] The insertion of "(now)" shows that Grew was cognizant of the fact that the passage of time probably had affected the look of the specimen since it had made its way over to England from the South Americas. This caveat was included into the species description of this '*Monoceros Minor Mus. Soc. Reg.* D. Grew' in the *Historia piscium*. In the description of the horn, it is noted that the blackish colour could be glimpsed "in exsiccato pisce", *viz.* in the dried fish in the Repository of the Society.[100]

Images could address this problem of deterioration – at least, to an extent, as we have also seen in the previous chapter. The importance of illustrations for the *Historia piscium* was signalled on its engraved title page by the inclusion of the helmeted artist. As Chapter 1 has discussed at length, the book included new figures that were usually based on drawings that Willughby, Ray or others in their circle had acquired. While some preliminary sketches of fish made during their trip seem exist among the Middleton Collection, these did not make it into the book.[101]

One of the sources for illustrations was a manuscript, now inscribed 'A Book of Fishes done at Hamburgh, with Mr Ray's Notes', which has hitherto received scant attention from historians.[102] As of yet, very little is known about how it came into Ray's possession, or even when or where it was produced. During their tour through continental Europe in the mid 1660s, Ray and his company

[99] Grew, *Musaeum Regalis Societatis*, 104; the interjection 'now' is found in other object descriptions too, among others on 98, 100.
[100] *Hist. pisc.*, 216.
[101] Kusukawa, "*Historia Piscium* and Its Sources," 321.
[102] Anonymous, *A Book of Fishes done at Hamburgh, with Mr Ray's Notes*, Add MS 5308c, British Library (hereafter BL), London; the manuscript stems from Sloane's collection, and I thank Sachiko Kusukawa for drawing my attention to it.

had not ventured further north in the German states than Cologne, so he must have acquired it elsewhere than in Hamburg. The manuscript contains dozens of coloured illustrations of aquatic fauna, executed in watercolour and gouache. These illustrations are accompanied by cursory descriptions in a German hand, which appears to be from the sixteenth century.[103] Certain drawings in the manuscript show an unmistakeable correspondence to a set of fish drawings within the Gessner-Platter albums recently discovered by Florike Egmond;[104] these are clues that can help throw light on the manuscript's origins.[105] Ray's annotations give insight into how he used the book. He comments, for example, on the correct identification of a species ("these are not separate species, but the front and back side of the same fish") or on the quality of certain drawings ("badly painted").[106] While, as Chapter 1 also suggested, the natural historical value of illustrations was related to the skill of the artist and the freshness of the specimen concerned, and while the former might have been reasonably simple to ascertain, the latter would remain difficult had one not personally seen a suitably lively, or at least fresh, example of the species. Fish tend to change appearance soon after being taken out of the water, and Leah Aranowsky has argued for drawings of dead fish that they reflect the interstitial time between life and death, observation and presentation.[107] The qualifying phrase "drawn from the life", with its multivalent early modern usages, thus takes on special meaning in the case of fish.

Both preserved objects and drawings, therefore, came with their own limitations for representation. This was potentially problematic, as we saw in the previous chapter, as meticulous attention to detail was highly desirable if fish were to be properly distinguished from one another. A characteristic mark might well be lost in the preservation process, or inadvertently left out of a drawing. Its is probably for these reasons that the experiences of fishermen and fishmongers were particularly handy. They saw, after all, a relatively large quantity of each species of fish, and live examples at that, as opposed to either the few dried

[103] The watermarks in the paper, furthermore, date to the mid-sixteenth century.
[104] Gessner-Platter Albums, UBA, hs. III C 22. See also footnote 28 in Chapter 1.
[105] An article on this matter is in preparation by the author.
[106] Original Latin: "Non sunt distincta species, sed ejusdem piscis pars supina & prona" BL, Add MS 5308c, f2v; "male pingitur" ibid., f5v.
[107] Leah Aranowsky, "On Drawing Dead Fish," *Environmental History* 21, no. 3 (2016): 549.

exemplars in natural historical collections or possibly imprecise drawings that were available to naturalists. As the following section will show, the larger 'sample size' of specimens that these fishermen had observed proved useful for Willughby and Ray for drawing conclusions about demarcating species.

Before fish could be captured on paper, they first needed to be caught. One can easily forget this when looking at the engraved plates in the *Historia piscium*, which present the fish as if untouched by human hands, exhibiting none of the tell-tale marks left by hooks or nets.[108] One exception to this rule is the engraving of a species of flatfish which does convey obvious traces of its capture: a thin black cord has been tied from its head to the peduncle of its tail.[109] The engraving was based on one of the drawings (**Figure 2.2**) in the 'A Book of Fishes done at Hamburgh.'[110] This particular manner of tying up flatfish is depicted in various fish still lifes by seventeenth-century Netherlandish painters such as Abraham van Beijeren (1620–1690), Isaac van Duijnen (1628–*c*.1680) and Jacob Foppens van Es (1596–1666). These still lifes often show fish specimens acted upon in one way or the other: they are cut, sliced, smoked or tied. This way of binding a flatfish head to tail seems to have served a very practical purpose, namely to facilitate its transport, or delay the spoiling process.[111] The illustration serves as a reminder that fish had to be caught, carried, stored and preserved before they could be subjected to scrutiny; and thus were subject to the attentions of many individuals, fishermen, fishmongers and other handlers, before they could be subjected to the gaze of the naturalist.

Detail and Distinction

Fishermen did not only supply the goods for natural historical research, but were also sources of knowledge in themselves. For Willughby and Ray, the fishermen embodied several different types of evidence, all of which could be recorded. First

[108] Cf. the drawing of a spiky blowfish that Gessner had drawn, including a hook and tasseled string, into and its printed counterpart in *Hist. anim.* IIII, 155, where these have not been represented, although a trace is still visible through a slight bump on the body. See: Egmond, *Eye for Detail*, 160–163.
[109] *Hist. pisc.*, tab F1.
[110] BL, Add MS 5308c, f4v.
[111] Julie Berger Hochstrasser, "From the Waters: Fish Still Life," in *The Magic of Things: Still-life Painting, 1500–1800*, ed. Jochen Sander (Berlin: Hatje Cantz, 2008), 188; "Description of Isaac van Duynen's 'Stilleven met vissen op een tafel'," *Hoogsteder Journal* 3 (1997), 21.

of all, fishermen shared the techniques they used to catch the fish. Willughby's and Ray's interest in these techniques is evident from some of the species descriptions in the *Historia piscium*, which explain the intricacies of catching herring or trapping tuna.[112] The latter is even rendered in one of the few diagrams in the book, which elucidates the ingenious system they saw in Marseille.

Figure 2.2 Drawing of a species of flat fish, inscribed 'Eÿn Terbott' and 'Rhombus' in unknown hand(s) | MS 5308c f4v | © British Library Board

When in Sicily, Ray and Skippon took the opportunity to examine fishing from up close. In his travel account, Ray relates that they had hired a boat so that they could better understand how swordfish were caught.[113] While they did not witness the capture of any such fish, they did take this opportunity to study the harpoons that the fishermen had brought along for the occasion. Similarly, the *Ornithology* was furnished with several pages expatiating the art of fowling.[114] This attention to techniques for catching and trapping animals is on par with the

[112] *Hist. pisc.*, 220 and 178.
[113] Greengrass, Hildyard, Preston, Smith, "Science on the Move," 183.
[114] This had not been part of the Latin original; Birkhead, Smith, Doherty, and Charmantier, "Willughby's Ornithology," 283.

broader interest of the Fellows in various trades, for which the Royal Society set up an official program.[115]

Secondly, Willughby and Ray recorded common words in various languages and dialects during their travels through the British Isles. For example, when visiting the West Country of England in 1667, they noticed that Cornish differed only a little from Welsh and also that it was much akin to the Breton language. The similarities were such "that they [the Cornish and the Bretons] understand one another, as we found by severall Fisherman of that countrey w[hi]ch were then drying of cartilagineous Fish at Pensans & St Ives."[116] Thus, Willughby and Ray talked to fishermen to learn more about which words were used for what things in different regions. This was not tangential to their project. In fact, being attentive to the words for fish in various dialects was key to their ambition to bring order to the world of fish, as will be elucidated below.

Last not but not least, fishermen were asked about their knowledge of the occurrence of species. When Ray toured through the British Isles in 1662 with Willughby, he compiled catalogues of English birds, fish, metals and minerals.[117] He noted down several fish taken around Pensance and Saint Ives in Cornwall, presented to him by "one of the ancientest and most experienced fishermen", who remains nameless.[118] Ray here stressed his informant's decades-worth of experience; other Fellows used similar phrasing while asserting the seniority of the seamen they had consulted.[119] The first entry on Ray's fish list was a whale, which the old fisherman had spotted from the coast. Ray added that he could not tell them of what sort it was, remarking that "*vulgus enim non distinguit* – the common people, after all, do not distinguish.[120] In the *Historia piscium* it is similarly declared that fishermen do not really discern the mackerel from any

[115] Kusukawa, "*Historia Piscium* (1686) and Its Sources," 329. For this interest, see: Kathleen H. Ochs, "The Royal Society of London's History of Trades Programme: An Early Episode in Applied Science," *Notes and Records of the Royal Society of London* 39, no. 2 (1985): 129–158.
[116] John Ray, *Further Correspondence*, 262–263.
[117] John Ray, *A Collection of English words, not generally used ... in two alphabetical catalogues, ... northern ... [and] southern counties, with catalogues of English birds and fish, and an account of preparing ... metals and minerals* (London: Thomas Burrell, 1674).
[118] Ibid., 97.
[119] Hellawell, "The Best and Most Practical Philosophers," 44.
[120] Ray, *A Collection of English Words*, 97.

other fish that may look like it.[121] These men's seeming lack of interest on in the categorization or classification of fish ran very much in opposition to Willughby and Ray's asserted aim, namely to precisely distinguish between species.

Ray's remark was somewhat unjust. Not only did the diversity to be found in fish present a complex puzzle, as species often closely resembled each other and could thus only be differentiated through subtle variation, but Ray actually drew on fishermen's own distinctions in trying to solve such conundrums. Consider the following passage, in which Willughby and Ray deliberate on whether sprats formed a separate species or were nothing else than the offspring of herring:

> A certain senior fisherman from *Cornwall*, whom we have consulted about this matter and other things, has told us that two kinds of *Sprats* are caught in the sea which flows near to Cornwall, one of Herring, another of Pilchards or the offspring of Celerini, which can in turn easily be distinguished from another. Pilchards frequent the shores of Cornwall and Devon, they very rarely progress further to the east in the British sea; from whence elsewhere around England only one type of Sprat is found.[122]

Here, yet again, a fisherman – possibly that same wise and experienced individual – imparts his knowledge. His answers did not make matters simpler, as he explained that there are, in fact, different kinds of sprats, which stem from at least two different species, and that these are, furthermore, not distributed equally along the coastlines of the British Isles. A looming problem in these interactions was that a fish might be accorded one name in Cornwall, and yet another in London.. The 'Scad' in Cornwall was known as a 'horse Mackrell' in London; conversely, the species of flat fish that Londoners dubbed a 'Pearle', the Cornish called 'Lug-aleaf.'[123] In keeping with Willughby and Ray's preoccupations with language, the

[121] *Hist. pisc.*, 182.

[122] Original Latin: "Piscator quidam senior *Cornubiensis*, quem super hac re aliisque consuluimus, nobis retulit duo *Sprattorum* genera in mari Cornubiam alluente capi, alterum Harengorum, alterum Pilcardorum, seu Celerinorum sobolem, quae à se invicem facile distingui possint. Pilcardi Cornubiae & Devoniae littora frequentant, ulterius in mari Britannico orientem versus raro progrediuntur; unde alibi circa Angliam unicum tantum Sprattorum genus invenitur." *Hist. pisc.*, 221.

[123] The names 'Scad' and 'Lug-Aleaf' are those listed in the species descriptions in *Hist. pisc.*, on page 290 and 95 respectively; the 'horse Mackrell' and 'Pearle' are handwritten additions in the Royal Society's copy of Willughby and Ray, *Historia piscium*, RS, RCN 18574, on the pags mentioned (both TR).

Historia piscium and its related writings abound with attempts to establish which fish was called by which name where, and by whom.

The taxonomies of fishermen did not always overlap with those of the naturalist. This added a linguistic layer to the already intricate puzzle presented by the relationships between the various species. Ray wrote to Lister: "Of the flat cartilaginous [fish] I have seen and described four or five sorts, but I am to seek what our fishermen mean by the Skate, and what by Flair, and what by Maid – as Skate-maid, Homelyn-maid, Thornback-maid, &c. &c."[124] Distinctions between (or even within) species by people that engaged with fish in a more practical sense also appear to have been based on attributes with particular relevance to their commerce. In the species description of the herring, it is explained that the people who washed, salted and dried this fish, and who were called Towers, separated it "into six species or rather grades".[125] These encompassed the 'fat herring', which was large and fat, and the 'meat herring' which was equally large and rich in meat but less fat.[126] 'Pluck' was the name used for herring damaged or torn from being stuck in the nets, while a 'shotten herring' had emptied itself of its roe.[127] We thus find, subsumed in Willughby and Ray's natural historical taxonomy based on characteristic marks, a further taxonomy drawn up from properties stemming from commercial practice.

Ray's erstwhile fellow Cambridge student and vicar of Brignall Ralph Johnson (1629–1695) wrote to complain of how difficult it was to decide whether dissimilar-looking exemplars of salmon were truly different species, or rather one and the same species at different stages of growth.[128] He said that in "the mouth of Eden in Cumberland the fishers have four distinctions of yearly growth (after the first summer, when they call them free, or frie, as we smowts, or smelts) before they come to be lackes; and this, they say, they have curiously observed, by fixing so many pins in the fins of yearlings, or two years old, and after taking them again;

[124] Ray to Martin Lister, 19 December 1674 (OS), *Correspondence of John Ray*, 113.
[125] Original Latin: "[i]n sex autem species seu potius ordines […]" *Hist. pisc.*, 220. I thank Hans Aili for sharing his translation of this passage.
[126] Ibid.
[127] Ibid.
[128] Johnson also shared observations on and specimens of birds and plants. Raven, *John Ray*, 319. A biographical note can be found in *Teesdale Record Society* 15 (1945): 9–32.

[…]."[129] This procedure, of fixing pins into individual specimens and tracing their growth over a period of time, was effectively an experiment. Like the experiments conducted by the Fellows, it was designed to allow for certain observations to be made. Fishermen's distinctions between salmon of different ages were deemed dependable enough to be included into the book:

> And what is handed down by authors about the quick *growth* of small salmon in the sea does not find faith with us: for our fishermen distinguish salmon by each year of their age, as we have said above, and they say that they are not full-grown before the sixth year of their life.[130]

Willughby and Ray here plainly stated that they placed their trust in the collective account of 'their' fishermen rather than in the written knowledge transmitted by various earlier authors (whom they do not specify here). This sentence can also be read as a rhetorical phrasing reminding the reader that relying on ancient authors is a matter of faith, whereas believing the fishermen is a matter of lived experience.[131]

How could one tell whether a specimen was exemplary for its species? Fishermen and fishmongers had a good sense of irregularities and averages. Willughby and Ray were told by a fishmonger that bigger specimens of salmon weighed around six pounds.[132] They also drew, albeit indirectly, on the observations of the Cambridge fishmonger, Mr. Mayfield, who went down to the London market every Friday to procure species not readily available in his own town.[133] The physician Peter Dent (*c*.1628–1689) wrote to Ray that "Mr. Mayfeild [*sic*] could not procure any dried *Mayds* or *Thornback* at the mart. He helped me to a fresh *Thornback*, which he said was full grown: its weight was ten pounds."[134] Dent added the fishmonger was "acquainted with the Tamworth carrier and will undertake to send you any of these [fishes] fresh into the country […]",[135]

[129] Ralph Johnson to Ray, 16 April 1677 (OS), *Correspondence of John Ray*, 127.
[130] Original Latin: "Quae de celeri Salmunculorum in mari *auctu* ab Autoribus traduntur apud nos fidem non inveniunt: nostratis enim piscatores Salmones annuatim ab aetate distinguunt, ut superius diximus, neque ante sextum aetatis annum perfici aiunt." *Hist. pisc.*, 192.
[131] I thank Pete Langman for this observation.
[132] *Hist. pisc.*, 196.
[133] Raven, *John Ray*, 393.
[134] Peter Dent to Ray, 15 February 1674 (OS), *Correspondence of John Ray*, 15–17.
[135] Dent to Ray, 15 February 1674 (OS), passage omitted in Lankester's *Correspondence of John Ray* but reproduced in Gunther, *Further Correspondence of Ray*, 113.

and thus could also do deliveries. He had furthermore told Dent that he once sold an exceptionally large specimen of flair to the cook of St John's College in Cambridge, and it ended up feeding all those attending lunch that day. Dent sought verification of the story from the cook in question, and having received it, he passed it along to Ray who then inserted it into the *Historia piscium*.[136] The reader could rest assured that the fishmonger Mayfield was of trustworthy character [*fide dignus*].[137]

Fishermen and fishmongers could furthermore tell whether a certain specimen was male or female, and how particular species procreated. The dependable Mayfield, for example, assured Dent that flairs were viviparous.[138] While Dent doubted whether this was true, he resolved to observe the alterations of the fish's eggs on a weekly basis and give Ray a full account.[139] Although Dent's ultimate findings cannot be found in Ray's correspondence, the letter underscores the fact that the statements of fishmongers, like that of fishermen, merited further research and that their claims invited both validation and repudiation.

The *Historia piscium* frequently cites from Leonhard Baldner's manuscript *Vogel-, Fisch- und Thierbuch*, mentioned earlier in this chapter as a suitable source to reconstruct the experiences of those who worked with fish on a daily basis. Baldner is the first fisherman mentioned by name in the *Historia piscium*; rarer still, his portrait has come down to us.[140] This is probably because Baldner was not a 'typical' fisherman. He was born into an established Strasbourg fishing family (whose crest consisted of three crossed fish), must have received some education as he could read and write, and combined his occupation as fisherman with a seat in the city council.[141] Baldner produced several, largely similar, manuscripts in quarto describing the quadrupeds, birds, fish and insects of his home region,

[136] Where it was now claimed that the flair had fed all College's hundred-twenty alumni. Kusukawa, "*Historia Piscium* (1686) and Its Sources," 331 and *Hist. pisc.*, 69.
[137] *Hist. pisc.*, 69.
[138] Dent to Ray, without date, *Correspondence of John Ray*, 120.
[139] Ibid.
[140] The portraits are at NUL, Mi LM25/80 and Brown University Library, RARE 3-SIZE QL41 .B3 1653 v.1; see also: Kusukawa, "*Historia Piscium* (1686) and Its Sources," 320.
[141] Hans-R. Fluck and Albert Scharbach, "Leonhard Baldner – Zu seinem Testament and Nachlassverzeichniss," *Revue d'Alsace* 142 (2016): 293–294. He also collected duties on the Rhine: Armin Geus, "Leonhard Baldner: A Strasbourg Fisherman," *Isis* 55, no. 2 (1964): 196.

most of which were skilfully illustrated and painted by the painter Johann Georg Walther (1634–1697). While some of these manuscripts have sadly been destroyed or lost, 4 copies are known to be preserved in libraries and archives.[142] Both the descriptions and the drawings in these manuscripts as of yet await detailed analysis, and a comparison between the extant editions would be most welcome to offer insight into Baldner's approaches to the study of nature as well as how, through these diligently produced works, he presented himself as a naturalist.

This chapter focusses on the copy in the British Library. Willughby seems to have bought this manuscript, the preface to which is dated 31 December 1653, from Baldner himself during the continental tour.[143] It contains very fine watercolours, and the descriptions are carefully calligraphed; certain details of both the text and the images have been accentuated with gold. Willughby and Ray used the manuscript as a source for their studies of both birds and fish: the *Ornithology* contains 37 drawings from Baldner (making up a little over a tenth of the total illustrations in their work),[144] whereas the *Historia piscium* includes 25 of Baldner's illustrations and cites from it in several species descriptions.[145] We will now discuss how these English naturalists used the manuscript, and what Baldner's own intentions for it were.

In the preface to the *Ornithology*, Ray expressed his appreciation of the high quality of the manuscript's illustrations, praising their great exactness and excellent hand.[146] It struck him that Baldner had taken and described these fish himself, and had them drawn at his own charge and cost. Such curiosity, Ray thought, was "much to be admired and commended in a Person of his Condition and Education."[147] He also acknowledged that he had received "much light and information from the Work of this poor man", which had enabled him to "clear

[142] Besides the aforementioned copies at the British Library and Brown University, Library, there is one at the University Library of Kassel, 2° Ms. phys. et hist. nat. 3; and one at the Bibliothèque Nationale Universitaire de Strasbourg, call number unknown. For a discussion of the various copies see also Birkhead, *The Wonderful Mr. Willughby*, 101–103.
[143] Leonhard Baldner, *Vogel-, Fisch- und Thierbuch* [Book of Birds, Fish and Animals], BL, Add MS 6485.
[144] Birkhead, Smith, Doherty, and Charmantier, "Willughby's Ornithology," 295.
[145] Kusukawa, "*Historia Piscium* (1686) and Its Sources," 320.
[146] Willughby, *Ornithology*, preface, sig. A6v.
[147] Ibid.

many difficulties, and rectifie some mistakes in *Gesner*."[148] Ray furthermore wrote to Robinson: "though it is not to be supposed, that a man of his education should be able to describe animals well, yet so much might be gathered from the notes he gives, as might lead an understanding and attentive man into the knowledge of them, and with the figures (which are in all very exact) give him so much light as to enable him to determine the species."[149]

On the title page of his manuscript, Baldner proclaimed that both the species descriptions and illustrations conformed to nature.[150] Looking at a drawing that Willughby purchased from Baldner alongside the manuscript, a watercolour of a carp (**Figure 2.3**), one can see why Ray was so enthused.[151] The artist has drawn the fish from a slight bottom perspective view, and diligently rendered the scales, and fins, which in particular show fine brushstrokes. By subtly applying a greyish light blue pigment to the edges of the gills and scales, a technique known as heightening, the artists conveyed the glistening of a fish that has just been taken out of the water. The drawing was used for the *Historia piscium*.[152] Baldner's intention was that the descriptions and images in his manuscript would complement one another. He stated, for example, that "[t]he species of 'Rothaug' are not dissimilar to that of the 'Rotel', but they are more beautiful in colour and of more rubescent eyes, and fins, as can be seen from the illustration […]."[153] In their description of the 'Rootaug', Willughby and Ray used the same distinctive marks.[154]

The authors looked to Baldner's manuscript for a wider range of observations, copying, for example, his statements on whether a certain species was rare or common, how its appearance could vary along with time or place, when and

[148] Ibid. Ray did not read German, and used Frederick Slare's abridged translations of the species descriptions, BL, Add MS 6486, ff12r–23v. That Ray also engaged directly with Baldner's manuscript is evidenced by the Latin names he added to some of its descriptions.
[149] Birch, *History of the Royal Society*, vol. 4, 390.
[150] Original German: "Recht Naturliche Beschreibung Und abmahlung […]," BL, Add MS 6485, f1r; inserting the word "recht", Baldner modestly says they are "almost" natural.
[151] NUL, Mi LM 25/51.
[152] *Hist. pisc.*, Tab Q1. The other loose drawings are a perch (Mi LM 25/58) and a portrait (Mi LM 25/80). The former is represented in Kusukawa, "*Historia Piscium* (1686) and Its Sources," 321.
[153] Original German: "Die Rothaugen sehen den Rottlen nicht ohngleich, seind aber von farben hüpscher, und Rothere Augen, und Schwümfedern, wie von dem abgemahlten zu sehen […]." Add MS 6485, f135v.
[154] *Hist. pisc.*, 249. Some confusion around the identification of this species is related in Birch, *History of the Royal Society*, vol. 4, 390.

how it procreated, and when it was best to eat, in the descriptions of no fewer than twenty species.[155] To focus on only those parts of the manuscript that were included in the *Historia piscium*, however, is to miss out on Baldner's own questions and approaches in studying fish. Among the volume's fascinating observations is his account of having caught a sturgeon of "about the thickness of a man", and subsequently finding its bowels to weigh 130 pounds.[156] Like Willughby, Ray and their peers, Baldner thus dissected fish and studied their internal anatomies; he even counted the thousands of eggs in the roe of pike and burbot.[157] He noticed that the species of wood trout took on the colours of their environment: they turned completely white when placed in a white tub, and black once put in a black tub.[158]

Figure 2.3 Watercolour of a species of carp, inscribed 'Cyprinus' in Willughby's hand | © NUL Mi LM 25/51 | © University of Nottingham Manuscripts Collections

He disagreed with Gessner that carp were (sometimes) born from mud, and said that they all came from roe.[159] On the whole, Baldner's manuscript shows that he aimed to discern species from one another, to examine their anatomies, to understand how they behaved and procreated, and that he compared the reports of earlier authors with his own observations – again, much like Willughby and Ray.

[155] Baldner's manuscript is referenced on the following pages: *Hist. pisc.*, 105–107, 118, 201, 125, 227–228, 236, 238, 248, 249, 250, 252–254, 259, 260–262, 265, 266.
[156] Add MS 6485, f119r.
[157] *Hist. pisc.*, 201 and 125, cf. Add MS 6485, f121r and f134r.
[158] Add MS 6485, f125r.
[159] Add MS 6485, ff121v–122r. In his German history of fishes, a loose and much abbreviated translation from the Latin, Conrad Gessner copies Rondelet's statement that carp are sometimes born from chaos and dirt, and sometimes from seed and roe, see: Gessner, *Fischbuch*, 164–165.

The preface to Baldner's manuscript gives us a sense of how he envisioned his work. It reveals that the author thought there to be no better place to contemplate God's omnipotence than on and near the water. Since God had at the beginning created the great whales, fish had received His first blessing; and He had also called upon the fishermen to follow him. God had, furthermore, made the rivers of the Rhineland with their endless benefits to those who lived around them. It was this delight in and admiration for the Creation, Baldner submitted, that had inspired him to make this manuscript brimming with the animals that swam, flew and crept in these waters. All of the creatures described in it, he wrote, he had held in his own hands. Each of the species was drawn from life, called by its name, and after sustained study, described briefly from Baldner's own 'experience' [*Erfahrung*].[160] He admits his attempts are necessarily 'simple' [*einfältig*] and 'scant' [*gering*], casting himself as a modest fisherman and hunter, and bids those considering themselves better suited to write such a work to keep that humble background in mind.[161] At the same time, he emphasizes his three decades worth of experience with fish – although he uses the terms 'learned' [*erlernt*] and 'studied' [*studiert*] to describe this involvement.[162] Quite apart from its complicating of certain assumptions about what constitutes 'a' fisherman, Baldner's manuscript also testifies to the fluid boundaries of theoretical and practical engagements with nature.

The examples listed in this section offer an idea of the topics Willughby, Ray and their friends discussed with practical men: from distinguishing between species to noting their various names in different languages, the intricacies of procreation to deciding if a certain specimen was of a typical size for its species. The preoccupation of fishermen and fishmongers with, for example, the occurrence of certain species or the growth stages of young salmon, can likely be

[160] Original German: " […] und ich alles selbst in meiner Hand gehabt, dieselbige nach dem leben abmahlen laszen, und wird ein jdes bey Seinem Nahmen genännet, und so viel ich bey einem jeden gelernt, in Seiner Natur, Kurtzlich ausz eigener erfahrung daszelbe beschrieben." Add MS 6485, f3v.
[161] Original German: "Und so mir Einer disze meine einfältige und geringe Arbeit, besser Verstehet, der wolle mirh, wo etwas gefehlt zu guth halten, Dann es von einem geringen Fischer und Weydman herkommet." Add MS 6485, ff3v-4r.
[162] Original German: "So hab ich im Nahmen desz Herrn mein Netz und Fischerkarn ausz geworffen, und ein wenig von dem was ich erlernt, und in Dreysig Jahren dabey Studiert hab, ein wenig wollen anzeigen." Add MS 6485, f4r.

traced back to commercial considerations, but that was not necessarily the sole motivation. Baldner's manuscript presents a natural historical study in its own right. His book contains observations that are of a practical nature, like whether a certain species is edible, but also includes reflections on long-standing theoretical debates into the generation of fishes. He presents himself as a student of nature who does not strive for profit, but instead wishes to praise God through studying His Creation. This approach compares to that of other, learned, naturalists. All in all, Willughby and Ray included a wide range of the observations that they gathered from fishermen and fishmongers in their *Historia piscium*. They also qualified these observers that came from outside their own ranks: as ancient and most experienced, as trustworthy, or as possessing commendable curiosity despite lacking proper education.

Conclusions

Let us return to the *Historia piscium*'s discussions of the curious behaviours of the salmon one last time. A few lines after its peculiar matter of jumping is discussed, Ray addresses its mysterious eating habits:

> What food salmons use, because I see that authors disagree [on the matter], has to be consulted by experience.[163]

The matter of the salmon's diet had been discussed at a meeting of the Royal Society in 1678, where it was brought forth that fishmongers never found anything in the maws of salmon and that an (unnamed) lady, "very inquisitive in that kind", had observed the same.[164] The previous year, Johnson had written to Ray on the same subject. "I wonder as much that Fishers have not certainly determined whether Salmons live upon anything save Water, and what?"[165] He continued by noting that:

[163] Original Latin: "Quo cibo utantur Salmones cum Autores diffentire videam, experientia consulenda est." *Hist. pisc.*, 192.
[164] Birch, *History of the Royal Society*, vol. 3, 425. See also Felicity Henderson, "Translation in the Circle of Robert Hooke," in *Translating Early Modern Science*, eds. Sietske Fransen, Niall Hodson, and Karl A.E. Enenkel (Leiden: Brill, 2017), 17.
[165] Johnson to Ray, 16 April 1677 (OS), *Correspondence of John Ray*, 128.

> I think only the Anglers have made the Observation of finding their Stomachs always empty; but I am persuaded that, if the Net-fishers would open any considerable Number, they would find in them Food indigested, which they seldom do, but sell them whole. Perhaps I may give farther Answer to this *Quaere*, and some others about *Whitsontide*; at which Time I purpose to go to our Coasts, and gather what I can.[166]

These discourses are indicative of the sorts of questions on which the Fellows pondered, and where they expected to find answers.

The variety of places where Johnson suggests answers can be gathered fit well into recent widened conceptions on the part of historians with regard to the spaces where early moderns created (or perhaps stumbled upon) natural knowledge.[167] In London, fertile sites for assembling knowledge about fish encompassed – besides the rooms of Gresham College – coffeehouses, taverns, ports, fish markets, and the banks of the Thames.[168] Beyond the confines of the city, such locations included the coast of Cornwall and the (fish) markets of continental Europe. Each of these places allowed for the making of first-hand observations, but, even more importantly, for meeting those people whose observations of fish were informed by years of practice. These might be fishmongers, anglers, and net fishers. This chapter has tried to reconstruct the conversations between fishmongers, fishermen and Fellows so as to better apprehend what they actually consisted, and to analyze how these contributed to a deepened understanding of fish, whether individual species or as a whole. It has also emphasized how the extent and nature of these contributions might differ from person to person, relative to experience and skill. Taken together, the various examples discussed here demonstrate that exchanges with fishmongers and fishermen were not incidental, but rather were central to Willughby and Ray's project.

[166] Ibid.

[167] This historiography has become too vast to list exhaustively, but see, for example: Jim Bennett and Rebekah Higgitt, eds., *London 1600–1800: Communities of Natural Knowledge and Artificial Practice*, special issue of *British Journal for the History of Science* 52, no. 2 (2019): 183–343; Harkness, *The Jewel House*.

[168] On the port of London as (continued) source for faraway species, see: Arthur MacGregor, "Patrons and Collectors: Contributors of Zoological Subjects to the Works of George Edwards (1694–1773)," *Journal for the History of Collections* 25, no. 1 (2013): 36.

As this chapter has shown, the interactions between practical men and Fellows could be rather complicated. Fishermen and Fellows sometimes talked at cross-purposes, reminding us of similar difficulties in communication that arose in the Society's history of trades project.[169] Another issue was that while the Fellows appropriated knowledge from practical men and women for their discussions or publications, the practitioners themselves often were hidden well out of sight.[170] This also held true for other categories of fish connoisseurs, not discussed in this chapter, whose observations of fish were drawn upon for the *Historia piscium* and which merit further consideration. Anglers, for example, also knew their way around fish. Willughby and Ray consulted Leonard Mascall's (*d.* 1589) well-known angling manual, *A Booke of Fishing with Hooke & Line, and of All Other Instruments There-unto Belonging* (London, 1590) when discussing the fact that while the carp was a relatively recent introduction to the waterways of England, it was now plentiful in rivers and ponds.[171] Anglers were also aware of whether a species was common or rare, and, as Johnson implied, knew what was in a fish's stomach. Other specific knowledge of fish pertains to their consumption. As we saw, *Historia piscium* offers glimpses of fish salters and cooks; and on occasion the taste and preparation of particular species of fish received attention in this book.[172]

For Willughby, Ray and other Fellows of the Royal Society, the value of interacting with fishermen and fishmongers lay in their repeated engagement with a large quantity and wide variety of fresh fish in an either living or recently deceased state. They did not only supply raw material, but also offered information that was crucial for the central tenet of the *Historia piscium*: to distinguish one species from the other by delineating their differences. Fishermen and fishmongers did not only know how to catch fish and how to tell them apart from another, but also commented on particular behaviours of certain species. It was on the basis of

[169] Ochs, "The Royal Society of London's History of Trades Programme," 130.
[170] Jasmine Kilburn-Toppin, "A Place of Great Trust to be Supplied by Men of Skill and Integrity': Assayers and Knowledge Cultures in Late Sixteenth- and Seventeenth-Century London," in Bennett and Higgitt, *Communities of Natural Knowledge and Artificial Practice*, 222.
[171] *Hist. pisc.*, 246 and Leonard Mascall, *A Booke of Fishing with Hooke & Line, and of All Other Instruments There-unto Belonging* (London: John Wolfe, 1590), 8.
[172] See, for example: *Hist. pisc.*, 219, 320.

this sustained experience that Fellows regarded them as authorities in the world of fish. While, ultimately, the Fellows positioned themselves as prime arbiters on what passed as a credible observation and who qualified as a credible observer, this chapter has shown that they gladly ventured beyond the realm of the learned when seeking reliable and recognized authorities on fish.

As we saw in both the previous and current chapter, the *Historia piscium* was an attempt to create a universal work on the natural history of fish based on clearly defined principles, so that the proper relations between species and their names could be re-established and order restored in the wonderfully varied world of fish. Ray and Willughby's attempts to forge a new method for the study of fish were part of their broader aspiration to reform the study of nature. This ambitious agenda demanded that naturalists should privilege empirical examination of the physical characteristics of plants and animals over the claims of ancient or even more recent authorities. In this, they had to contend with all kinds of practical constraints, such as the at times imperfect evidence that drawings or preserved specimens might present. This is why they sought out first-hand observations from a wide range of collocutors. The resulting work made it clear that the world of fish was well worthy of inquiry and yet still fundamentally difficult to fix in place. The dizzying variety of species, and the heuristic challenges that the study of them posed to the naturalist, required a further, even firmer grip on the order of fish. As we will see in the next chapter, Peter Artedi sought to accomplish precisely that. He developed an 'ichthyology' that drew up new demarcations not only between fish, but also between those who handled and studied them.