DOI 10.15826/qr.2022.3.716
УДК 542.4 + 339.9(410:470) + 629.5(410)(09)

Eyewitnesses to the Phenomenon of Russian Cold: Robert Boyle and the Accounts of Early Travelers North* **

Maija Jansson
Yale University,
New Haven, USA

This article examines the Russian cold as reflected in accounts of early travelers to the north. For his study of the phenomenon of cold in the early 1660s, Robert Boyle repurposed parts of Giles Fletcher's travel account of Russia written seventy-seven years earlier. Inspired by Sir Francis Bacon's work on heat, Boyle sought to understand the extremes of cold but found himself hampered by its absence in northern England. Consequently, he turned, among other sources, to the printed account of Ambassador Fletcher who, sailing north on a Muscovy Company ship, had kept a journal following the Instructions and Ordinances drafted for that Company by Sebastian Cabot. Boyle found verification of the accuracy of Fletcher's eyewitness description of cold through his friends and compatriots in the Royal Society who had been to Russia. Ultimately, this is the story of the impact of England's mid-sixteenth century navigational technology and commercial and diplomatic relations with Russia on Robert Boyle's late seventeenth century early scientific study of cold which, according to the author's conclusion, demonstrates how the study of the Russian north impacted the early development of natural science in England.

Keywords: traveling around Russia, 17th century, Robert Boyle, Giles Fletcher, Muscovy Company, Royal Society, cold

Статья посвящена изучению восприятия русского холода, отраженного в свидетельствах иностранцев, совершавших первые путешествия на север. Исследуя в начале 1660-х гг. физические свойства феномена холода, Роберт Бойль адаптировал под свои задачи сообщения Джильса Флетчера о путешествии по России, написанные 77 годами ранее. Вдохновленный работой сэра Фрэнсиса Бэкона о тепле, Бойль стремился понять характеристики его противоположности – холода, но обнаружил,

* I want to thank Professor Paul Bushkovitch for his helpful comments and kindness in reading this text.

** *Citation*: Jansson, M. (2022). Eyewitnesses to the Phenomenon of Russian Cold: Robert Boyle and the Accounts of Early Travelers North. In *Quaestio Rossica*. Vol. 10, № 3. P. 1057–1083. DOI 10.15826/qr.2022.3.716.

Цитирование: *Jansson M.* Eyewitnesses to the Phenomenon of Russian Cold: Robert Boyle and the Accounts of Early Travelers North // Quaestio Rossica. 2022. Vol. 10, № 3. P. 1057–1083. DOI 10.15826/qr.2022.3.716.

что его исследованиям мешает отсутствие такового в северной Англии. Поэтому он обратился, среди прочего, к печатному отчету посла Флетчера, который, плывя на север на корабле Московской компании, вел журнал, следуя инструкциям и рекомендациям, составленным для этой компании Себастьяном Каботом. Бойль нашел подтверждение точности описания холода, сделанного очевидцем Флетчером, с помощью своих друзей и соотечественников из Королевского общества, побывавших в России. В конечном счете это история о влиянии навигационных технологий Англии середины XVI в., торговых и дипломатических отношений с Россией на раннее научное исследование холода Робертом Бойлем конца XVII в., которая, по заключению автора, показывает, как изучение Русского Севера повлияло на раннем этапе на развитие естественных наук в Англии.

Ключевые слова: путешествия по России, XVII в., Роберт Бойль, Джильс Флетчер, Московская компания, Королевское общество, холод

Robert Boyle's book of *New Experiments and Observations Touching Cold* was published in London in 1665. In the introduction he gives several explanations of why he undertook to write on "so barren a subject" [Boyle; The Works of Robert Boyle, p. 208–209, 217][1]. First, he explains that cold is an instrument of nature that for the most part has been neglected by the "Classick Authors". Then, he says, that having once written on heat and flame he was now encouraged by the Royal Society to consider their opposites, cold and ice. In embracing this idea, he proposes that his examination of cold will not only be by way of experiments and empirical observations but also through accounts of "other mens Testimonies" lest some of the "Remarkablest *Phenomena* of Cold" go unmentioned [The Works of Robert Boyle, p. 218]. The reasons for this are explained below. There is a rich literature on Boyle's various experiments but less has been written about his use of early printed sources and his means of their verification. This article is about how an early account of the cold in Russia, so treacherous to early travelers, was used by Boyle. In another dimension it is the story of the contribution of England's commercial and diplomatic relations to early science. It connects England and Russia with Boyle's early scientific search for eyewitness accounts of the phenomena of cold, and how the critical reading of these testimonies led him to the comments and conclusions he explains in the Titles (or sections) of his book that are described below.

At the outset, Boyle's own interest in cold stemmed in part from his reading of Sir Francis Bacon's works on heat. Heat, of course, was easily created with fire but the creation of cold was more complicated and, in the seventeenth-century, in the absence of a frigid winter in England, snow and ice could not be artificially made. For Boyle, then, investigations into the subject of cold depended to some extent on the knowledge of others found in books

[1] Sf.: [Fletcher, 1591]. I have primarily used the modern text edition included in [Rude and Barbarous Kingdom].

whose authors then became his eyewitnesses. Peter Dear reminds us of the importance of print and libraries even for those seventeenth-century natural philosophers who stressed "first hand observation of nature" [Dear, p. 109]. One of the sources on cold that Boyle used and on which this article focuses is Giles Fletcher's book, *Of the Russe Commonwealth.* It met all of Boyle's criteria for a valid record: it was written in English by a man who had experienced Russia, was accessible by way of several print runs and, most importantly, the text was verifiable by living witnesses [Fletcher, 1951]. The story of the genesis of Fletcher's text, its relation to Sebastian Cabot's *Ordinances*, and the importance of the later compatriots of Boyle who vouched for its accuracy is told below. It begins with a conversation between the scientist himself and his contemporary friend and ambassador, Charles Howard, Earl of Carlisle, and then moves back in time to the Muscovy Company's early voyages north.

At the end of the 1665 edition of Robert Boyle's *Experiments and Observations Concerning Cold* is a note of his encounter with Carlisle, the English ambassador recently returned from Russia. They met on a London street in early spring 1664–1665. They were friends as well as neighbors, and Boyle was anxious to question Carlisle regarding the cold in Moscow and northern Russia about which he had heard and read so much. His inquiry concerned the nature of and differences in freezing water and alcohol, one aspect of his then current research. Carlisle responded by describing to his friend the bottles of wine that had been "vehemently frozen" and then unfrozen, wherein, he said, "the liquor afforded by the exterior parts of the resolved ice was very little, if at all less strong than that which was obtained from the internal parts of the same ice" [Boyle, p. 799–800]. Later, Dr. Samuel Collins, an English Doctor in the service of the Tsar confirmed the story for Boyle, and added that "he found the ice of those parts to be much harder than that of these" [The Works of Robert Boyle, p. 374; Loewenson][2].

Not only friends and neighbors, Boyle and Carlisle were also both founding members of the recently formed Royal Society [Hunter, 2009, p. 13]. Their chance meeting pinpoints the interconnection between the late seventeenth-century community of natural scientists in that Society, Fletcher's account of Russia a century earlier, and the critical part played by Muscovy Company merchant ships in bringing them together. The story is a variation of the theme that "early modern scientific discovery, technical invention and artistic creativity should be thought of as both 'inter-connected and cross-fertilizing" [Travel Narratives, p. 1–10]. In particular it illustrates how elements of Fletcher's travel and voyage narrative conceived during his experience in Russia, expanded on his return, and later edited by Richard Hakluyt, were repurposed by Robert Boyle, a natural scientist, in the 1660s to inform his writing on cold. Fletcher's work was not the first English account of northern Russia to reach England, nor the most comprehensive, but it was the first to even minimally describe climatic conditions conducing to extreme cold. While disregarding much of the general description in the text,

[2] I wish to thank Paul Seaward for sending me the research on Charles Howard prepared by the staff of the History of Parliament Trust for the volume on the House of Lords 1660–1690.

and most of the details about the towns and villages that the writer saw, and their governments and legal systems, Boyle combed Fletcher's account for meteorological description of the north and examples relevant to his own early scientific experiments regarding the phenomena of cold.

His interest centered primarily on the second chapter of *Of the Russe Commonwealth*, entitled "Of the Soil and Climate" that attributes the barrenness of the north to the "extremity of the cold in wintertime". He further relates that in winter the whole country is "under snow which falleth continually and is sometimes of a yard or two thick". Lloyd Berry and Robert Crummey in 1968 found it "one of the less interesting sections of the book" since much of the material they found derivative [Rude and Barbarous Kingdom, p. 94]. Richard Pipes, writing two years earlier had said that "the least useful contributions of Fletcher's book are the geographical and historical facts reported in the opening five chapters" because they were written on his return. Neither of these comments, however, precludes the possibility of Fletcher's writing as an eyewitness to the weather (and cold) he experienced. For Boyle the issues were not when and where the report was written but whether it was true and verifiable, and who could be trusted as a credible witness to the reported facts.

Echoing Aristotle's description of cold found in matter, Boyle questioned whether cold was "a positive quality or a bare privation of heat?" [Aristotle, Bk. IV, p. 8, 384; The Works of Robert Boyle, p. 364]. In his work, besides Fletcher's account Boyle cited at least forty-four other printed texts that mention or describe cold. Some of these authors experienced northern cold themselves and wrote about it as witnesses with an observation of detail that spoke to a scientist. By way of their own education and instruction they were keen observers and good recorders. Others described cold from earlier printed sources if they mentioned it at all. Critical to Boyle years later, however, was the fact that Fletcher's account was verifiable by living witnesses, some of whom, but not all, were connected with the Royal Society, and had themselves experienced Russian winters. Their eye-witness testimonies constituted the verbal support described by the modern analyst Julia Schleck as necessary to the validation and acceptance of a printed text [Schleck, p. 53]. In other words the authentic early travel account constituted a text based on empirical description similar to the way in which early scientific trials and experiments were built on the examination and subsequent description of empirical evidence – what Richard Yeo calls "the empirical sensibility" of the early natural scientists. And Arndt Brendecke would add that seafaring and navigation were also "practices with a strong empirical component" [Yeo, p. 87; Brendecke, p. 287]. For Boyle, then, a living eyewitness to the content of a decades old account substantiated its validity [Shapin, Schaffer, p. 55–79][3]. For him the authority of the text itself was primary, not the name of the author or the date of publication.

[3] The literature on eyewitnesses is voluminous. I shall cite here only material directly related to Boyle's study of cold.

Muscovy Company policy facilitated the keeping of accounts and descriptions of the Russian far north. We will come to that, below, in looking at Cabot's *Ordinances*. In addition, the symbiotic relationship between crown appointed ambassadors seeking privileges for English merchants in Russia, and the Company's provision of passage for those ambassadors, offer an insight into the interdependence of commercial enterprise and crown policy, the inseparability of trade and diplomacy [Phipps, p. 14, 49]. Moreover, we see the important part played by the Company as a vehicle, both literally and figuratively, in the transmission of knowledge and ultimately in cultural exchange. That the accounts begun or made on these voyages, and that of Giles Fletcher in particular, would also provide, more than a century later, information for a scientist in the Royal Society reveals how multifaceted and timeless a travel text can be. It also underscores the point that all readers of a text are not looking for the same thing. Following its third printing in 1657 it is quite clear that, contrary to Richard Pipes' comment, Fletcher's account did not fall into oblivion [Fletcher, 1966, p. 38]. And, also I add parenthetically, that the activity of the Company which to date has been written about primarily as a mercantile institution played an essential part in the development of tools for mathematical navigation, but that is beyond the purview of this article. Suffice it to say that Dr. John Dee, a pioneer in arithmetical navigation in the 1550s, devised the circumpolar chart for the Muscovy Company's first ships sailing in northern waters [Waters, p. 525]. Robert Record's *The Whetstone of Witte*, the second part of his tract on *Arithmetike*, was dedicated "To the right worshipfull, the governers, Consulles, and the reste of the companie of venturers into Moscovia". The Dedicatory Epistle wished the Company well and that they should "purchase therewith immortall fame, and be praised for ever…for openying that passage, that shall profite so many" [Record, Dedication, n. p.].

For Boyle's texts and documentation of experiments and observations on cold, as mentioned above, I have used primarily the modern edition of Boyle's work edited by Michael Hunter and Edward B. Davis and also have referred to some details about Boyle's trials and demonstrations in Hunter's biography [Hunter, 2009, p. 119]. An analysis of his library and notes can be found in the same author's volume on Boyle's manuscripts and in the Occasional Paper, no. 4, from the Boyle Project [Avramov, Hunter, Yoshimoto]. Returning now to Boyle's problem we can consider why and how he chose to use, among others, an old account of Russia.

His problem, like that for Francis Bacon almost a half century earlier, was the absence of extreme cold in England. For Bacon the study of cold was as important as the examination of heat; for "heat and cold", he said, "are nature's two hands whereby she chiefly worketh" [Bacon, Sylva Sylvarum, p. 19]. The efficacy of heat was obvious and its components were easily available while cold, he believed, could have a certain utility in the preservation of liquids, meat, and drink it was less easily created as a subject for study. Bacon argued, that for cold "we must stay till it cometh, or seek it in Caves or high mountains". Regardless, however, in England, he said,

the cold was simply not severe enough for experiments in freezing water or oil, wine or beer. "Furnaces of Fire", Bacon wrote, "are far hotter than a Summers Sun, but Vaults or Hills are not much colder than a Winters Frost" [Bacon, Sylva Sylvarum, p. 19].

Rejecting, at least partially, Aristotelian theory for the study of particular scientific phenomena and the "framing of axioms" Bacon had devised and explained a new method for the organization of natural philosophy. Within that methodology he describes the "Tryals (*sic*) and Experiments", many of them derived from printed sources, that formed the bases and sometimes practical proofs of his theories. These he cites and numbers in *Sylva Sylvarum* [Bacon, Sylva Sylvarum, p. 19–20; History of Dense and Rare, p. 144, 147; Dear, p. 60]. He often, however, fails to identify the authors of his entries and speaks only generally, for example, of "some of the ancients", or of what is "in some Mines in Germany", or how spring corn in Moscovia benefits from a wet winter, or about "divers Fruit Trees in the hot Countreys" with no mention of the sources of the information [Bacon, Novum Organum, Century VI, nos. 570, 571, 580, 581, p. 118, 571, 580, 581]. It is not clear why. Perhaps, it is because Bacon was less concerned with the tryals themselves than with the formulation of their results, or perhaps because in the mid 1620's he was simply preoccupied with the unraveling of his career in government. Bacon's other works, *Novum Organum,* for example, and the *Advancement of Learning,* also methodological and philosophic, though, are filled with multiple well identified classical and biblical references. That said, however, in the *Advancement of Learning,* he wrote that "the first distempers of learning [come] when men study words and not matter…" [Bacon, Advancement of Learning, Bk. IV, p. 2, 30]. And from this principle he conceived of "individual facts drawn from experience" [Dear, p. 61].

Boyle, following Bacon's precepts regarding the examination of scientific matter through "trial" and experiment discovered for himself that he was as hampered by the English climate as Bacon had been. Even though the seventeenth-century was in the midst of what later came to be labeled the Little Ice Age, winter temperatures varied from year to year. There was no recorded pattern of weather at that time other than marking years by way of memory of events like the freezing of the Thames in 1565 or the great snowstorm of 1579, or the chance remark of a diary keeper like John Evelyn who noted on 6 March 1658 that "this had ben the severest Winter that man alive had knowne in England. The Crowes Feet were frozen to their prey" [White, p. 9–17; Evelyn, p. 388][4]. Ironically, it was the cold temperatures at the end of 1664 that shut down the presses, thus postponing the publication of Boyle's book on cold [The Works of Robert Boyle, p. 206; Hall, p. 87]. And Boyle himself remarked that in that year there was "a notably hard winter", although the previous one had "proved so strangely mild" that his colleague, Christopher Merrett, had noted that there were no frosts

[4] Primarily about the New World experience, White includes many pages on climate generally, and on measuring climatic trends.

in England in 1663 [The Works of Robert Boyle, p. 145, 540; Loewenson, p. 474, 476]. Regardless of such variations, however, echoing Bacon, Boyle wrote that in England we are "unable to *produce* or *intend* Cold as we can do Heat". Nevertheless, as a scientist and an empiricist he could not dismiss an examination of the properties of cold the effects of which he understood to be so "stupendious" a power as "to moderate and check the Operations of Heat" [Ibid., p. 223]. As Boyle explains, "being unable to examine them here in England, all I could do, was, to report them faithfully and mention only such as were either affirmed by Eye witnesses… or, at least recommended by credible Testimony" [Ibid., p. 219][5]. And he reiterated, that when his observations could not be made in England's temperate climate that he must "either make use of other mens Testimonies, or leave some of the Remarkablest *Phoenomena* of Cold unmention'd" [Ibid., p. 218]. Later, lamenting the failure of his ability to freeze "quicksilver" or mercury at home, for example, he informed his reader of his wish that this trial or experiment could be "made in *Muscovy, Greenland, Charles-Island,* or some other of the most Icy Regions, where the Effects of cold (which here are upon Quicksilver but languid) are the most considerable, and sometimes stupendious" [The Works of Robert Boyle, p. 277; Captaine Thomas James, p. 78][6]. Boyle's only recourse, then, was to rely on the reports of those who who had witnessed such phenomena.

In the absence of a reliable system for measuring temperature Boyle wanted descriptions of those who had seen and experienced extreme cold, not some Latin text that summarized its author's concept of cold. Consequently, he turned to the accounts of northern "Voyages of our own Country-men who have written only in English" [The Works of Robert Boyle, p. 218]. Through these texts the intensity of arctic cold became real and measurable to him rather than simply an idea enhanced by the imagination. Written in English there was little chance of misinterpretation of detail in translation [cf.: Bushkovitch, 2017, p. 227–243]. The verification of the description of cold that provided authority for the old texts came in part, as we have said, from contemporary friends in the Royal Society. By the middle of the 1660s the Society had become "a formative influence" on Boyle that affected his studies and altered his intellectual method [Hunter, 1994, p. 145, 146]. In organizing his work on cold Boyle, as Hunter says, "exemplified the prescriptions of the practice of science" employed by Bacon, while at the same time he cited new sources "explaining in detail about the informants" whose testimony he was using. And it was his meticulousness in verifying the accuracy of these sources and dismissing

[5] Hunter notes that working in cold "was a prejudice to his (Boyle's. – *M. J.*) health, for the cold streams of ice and snow were too severe for so weak a body". [Hunter, Robert Boyle by Himself and his Friends, p. 29].

[6] Charles Island. The name given to a piece of land in May 1632 by the seamen with Captain James, who wrote that "the… twentieth, being Prince Charles his birthday, we kept Holy-day… and named our habitation Charles Towne; by contraction Charlton: and the island Charlton Island" [Captaine Thomas James, p. 78].

those he could not substantiate that, in turn, gave authority to his own work. He warns his reader that "tis not from every Writer, that I dare trust the Quotations he makes of the passages of other Authors", often using his own words, not theirs [The Works of Robert Boyle, p. 219]. And he further elaborates saying, "I have shunn'd to borrow" some accounts because I perceived that "the Authors had not observed the things they recount themselves, and were too easie in believing others" [Ibid., p. 221].

At the outset Boyle identifies three of the sources he will use, and why. (It is not until later that he introduces Giles Fletcher; see below.) He notes first that he will use the Dutchman, Gerrit de Veer's, account of William Barentz's voyage east to *Nova Zembla [Novaia Zemlia]* in 1595 from *Purchase His Pilgrims,* "having lost the Translation that was made of those Voyages out of Dutch into English (published in a Book by themselves) without being able to procure another", and also the *History of the Northern Nations* written by Olaus Magnus [The Works of Robert Boyle, p. 220; Heuer, p. 137–145]. Although he warns the reader that Olaus Magnus is an Author "of very suspected Credit and delivers some things upon hear say" yet, he notes, that as Bishop of Uppsala, Magnus "appears to have more learning then many that never read his Books". For his observations of ice Boyle also uses Captain Thomas James's *Journal* from the voyage to Greenland, which was not included in the collection of *Purchase his Pilgrims,* but also, and more importantly, because Captain James came "much recommended" to him by friends and "by the Esteem that competent Judges appear to have made of him". Because of his "breeding in the University and acquaintance with the Mathematicks", Boyle believed James was better able than others to observe the phenomena of cold [Ibid., p. 221].

Although he acknowledges that he found "the framing of an Universal and unexceptional Hypothesis of Cold" to be an undertaking "of greater difficulty than every Body would imagine", Boyle's explanation is clear although often repetitive [Ibid., p. 221–222]. There are reasons for that, however. Boyle tells the reader in his preface that "the Sections or Titles are very unequal" and that this is because of his "Design being to set down matters of fact" and not to write "a complete and regular Treatise" [Ibid., p. 210]. Also, his notes were what Boyle described as a compilation of "loose and unpag'd sheets" which might have been difficult to assemble in useful order, particularly because he was little concerned with any system of information retrieval and "was confident that he could remember" the order and importance of any particular point or experiment. (From the mid 1650s, however, because of failing eyesight he was dependent on secretarial help for all of his writing.) [Hunter, 2007, p. 444; Yeo, p. 154, 151–173, 161; Hunter, 1994, p. LXXVIII][7]. Following the Preface and Introduction he presents three Discourses or questions addressing the nature of and the means for the study of cold. First, he examines it's effect on our bodies

[7] Hunter lists Vol. 36 as the manuscript version of Boyle's justification for writing on single sheets.

and "Organs of Feeling"; secondly, he addresses measuring it with various sorts of weather glasses. Thirdly, in seeking a standard by which to measure cold he provides instructions on how to use a weather-glass or the new hermetical thermometer, dependent on a glass bubble hermetically sealed in water of its own weight to determine why water rises in cold weather and falls in hot. But Boyle tells us it failed to indicate "what degree of Coldness or Heat there was in the Air" [The Works of Robert Boyle, p. 234–241].

With each Discourse Boyle briefly describes the dilemmas and paradoxes implicit in its content. Following the Discourses, and a short prefatory paper to the Royal Society, the *Experimental History of Cold* begins with twenty-one Titles each followed by numbered observations and descriptions of the experiments related to the subject of that Title, sometimes with an Appendix. In these Titles it is for comprehension of what changes can occur to larger expanses of cold and ice over time and at different depths of the sea and soil that Boyle is dependent on sources outside of the British Isles. He had never seen an iceberg as big as a ship nor at the time was it fully understood whether such a formation was composed of salt or fresh water [Aristotle, Bk., II, pt. 3; Hunter, Clericuzio, Principe, vol. 2, p. 256a –257a, 416][8].

Several Titles, enumerated below, indicate the nature of each section, and Boyle's choice and rationale for examining particular texts related to them. I have not mentioned every title and text he cites, primarily considering as examples several of his own stated purview, that is, accounts of his own countrymen written in the "vernacular", (i. e., not Latin) and among those the account of Fletcher who sailed north and east to Russia rather than west to Greenland[9].

Title I of Boyle's work, concerns trials or experiments touching bodies capable of freezing other bodies, air and ice, for example. These are followed by twenty-three observations and experiments concerning those bodies which are, he says, "in this climate of ours but very few', reiterating that there is "a great Difference betwixt the degrees of coldness in the Air of Frigid Regions and [that] of England" [The Works of Robert Boyle, p. 266]. Following, in Title II are five articles concerning those bodies (besides "common water") able themselves to be frozen, e. g., urine, beer, ale, milk, vinegar and French and Rhenish wine. But in England, he says in the Appendix to the Title that, "we could not reduce oyl Olive into Ice". On asking Dr. Collins, "an Ingenious Man, that not only liv'd some years in *Muscovy*, but was, and is still Physician to the great Monarch of that

[8] Olaus Borrichius (Danish experimental scientist, d. 1670) had written to Boyle on 30 March 1664 citing Macrobius's comment (Saturnalia, bk. 7, chap. 12, line 32) that "sea water is never frozen hard". The Arctic Ocean is very fresh, partially because the major Russian waterways drain in the north. See the website [The Freshwater Switchyard of the Arctic Ocean].

[9] Boyle appended several tracts to his book on cold. As disputations regarding other authors I have not included a discussion of them here. The first is "An Examen of Antiperistasis as is wont to be Taught and Prov'd"; the second, "An Examen of Mr. Hobs's Doctrine touching Cold"; and the third, a tract by; Christopher Merrett. These are followed in the [The Works of Robert Boyle, text by an additional appendix of Boyle on Cold, 459–574].

Empire", if this were possible in Moscow was told "that it did there freez much harder", but that said, even so, oil "would not, that he had observed, be turn'd into true & perfect Ice" [The Works of Robert Boyle, p. 274]. The key was that this was Collins's own observation.

Boyle had met Collins in the course of the mission of Ambassador Petr Prozorovsky to London in 1662 that brought greetings from Tsar Alexis I on the Restoration of the English Crown. Collins and the ambassador had travelled on the same ship to England by way of Riga. Although Collins was in England only for a short time to settle his deceased brother's affairs he spent time with Boyle and offered his services as an observer on his return to Russia. Collins left England in August 1663 and on 1 September wrote to Boyle from Kholmogory that he would "use his best endeavors" when the frost came to observe what concerned "your commands in these cold parts". In further correspondence of November the same year from Vologda, Collins wrote that "I shall doe my best to observe as much variety as I can of freezing, and the divers effects of cold, which may be done here (where wee are) better than in Moscow, being more northward" [Hunter, Clericuzio, Principe, Sept. and Nov. 1663].

We see here Collins's role as an eyewitness reporter for corroboration of facts about Russian cold that had been described in early journals. It is also in this section that Boyle turns to Captain Thomas James, "that Ingenious Navigator Captain" who related that while wintering over on Greenland in 1631, both vinegar and oil and "every thing else that was liquid" were frozen as hard as wood and "we must cut it with a hatchet". James came "much commended" to Boyle by "some friends" of his [The Works of Robert Boyle, p. 274, 221].

Boyle's experience in freezing "Train" or whale oil (in Title III) ran counter to the report of Olaus Magnus who describes putting it into ditches or motes to keep the water in them unfrozen thus preventing enemies from crossing over on horseback. But Boyle suspects the account and notes that "in that particular, as I fear, he has in some others, misinformed his readers" [The Works of Robert Boyle, p. 276].

In many of his experiments there is a utilitarian aspect. Descriptions regarding the preservation and destruction of bodies by cold as, for example, apples and eggs, he includes in Title VI. These, we learn, are better preserved if thawed in water (slowly) than if put directly into a fire. The same is true for frozen hands and feet, and here Boyle relies on a quotation from Captain James which he substantiates with testimony from an unnamed "intelligent person, that had been a housekeeper in Muscovy" who explained how successfully he had unfrozen cheese in cold water [The Works of Robert Boyle, p. 292]. He attributes to Fabritius Hildanus's *Treatise of Gangrenes* the story of how the whole Body of a Man "cas'd all over with ice" was successfully thawed "by being handled as our Eggs and Apples were" [Ibid., p. 292]. Without commenting on the veracity of that account, Boyle in this case provides the surrounding text "because the Narrative may prove of some use". He then returns to

Captain James regarding the utility of having meat and drink that survived in casks under the water but "not actually frozen" though in "one of the Coldest Regions of the World" [The Works of Robert Boyle, p. 292, 294]. Wine, James "our Countrey-man", mentioned "lost his virtue" because of being frozen, which takes us back to the opening of our story and the matter of the adulteration of alcohol on which Boyle had sought Carlisle's opinion [Ibid., p. 293, 294]. In the Appendix to this Title Boyle recounts Collins's experience in Moscow telling of the safest way of thawing frozen ears, noses, and fingers by rubbing them with snow. He also relates how in Moscow Dr. Collins had eaten frozen elk and beef from Siberia, and reported that when "liesurely thawed" it could be well roasted [Ibid., p. 299–300]. When he asked whether in Russia freezing beer and wine would break the containers holding them, Collins responded that he "had not observed wooden vessels to be broken", and Boyle surmised it was because of their "yielding". i. e., their expanding [Ibid., p. 330].

Boyle explains to his reader that with the experiments and observations touching Ice that constitute Title XV he is turning to "Observations we have met with in Seamens Journals, and elsewhere" [Ibid., p. 350]. The greater part of this section depends on "Collections out of Travellers and Navigators" that provide observations on ice not possible in England. Here, once again, we have reference to Dr. Collins, "an intelligent Person, that liv'd some years in Russia", repeating his observation that ice was "much harder" there than here [Ibid., p. 346][10]. Boyle then describes how on "one of our Englishmen's Voyages into the Northern Seas" in want of fresh water they took in pieces broken off of a "great Island of Ice" which made very good fresh water. And he suggests that perhaps the freshness was due to the fact that they took only from the surface of the berg which, in fact, could have been simply melted snow [Ibid., p. 351]. Regarding the "bigness" of ice Boyle reiterated that he was dependent on the best Journals, using that of a Dutch man (Gerrit de Veer) and Captain James's account of sailing by mountains of ice "far higher than our Top-Mast head". According to de Veer's account of his voyage to *Nova Zembla* there the ice was ninety-six feet high, or "above twenty foot higher, then on a certain occasion I found the Leads of Westminster Abbey to be" [Ibid., p. 352]. De Veer also spoke of a berg which "on the top it was full of earth… and there was found about forty eggs" [Ibid., p. 355]. And so Boyle interweaves the narrative accounts of earlier publications throughout this Title. He also introduces "our Famous English Seaman', Mr. W[illiam] Baffin who, in 1612, was on the expedition to Greenland, but the following year was sailing with the Muscovy Company [Ibid., p. 352–353]. Baffin describes great icebergs, estimating them to be about one seventh part above water

[10] Here Boyle again mentions the accounts he cited in his Introduction, adding William Baffin (d. 1622), early 17th c. pilot with the Muscovy Company voyage to Spitzberg. In 1617 he joined the East India Company [ODNB].

It is in Title XVIII, Section 16, that Boyle introduces the reader to Dr. Fletcher, the late sixteenth-century English ambassador to Russia, by citing his comment on how breath becomes "stark, and even stifling" in the cold, so "powerfully and nimbly" does intense cold work on the "Organs of respiration" [The Works of Robert Boyle, p. 75; Fletcher, 1591; Fletcher, 1966]. This, in fact, was confirmed by Dr. Collins who, "being ask'd by me (Boyle. – *M. J.*) concerning the truth of what is reported, sometimes to happen at Musco" he said that "the eminentist proof" of extreme coldness is seeing water thrown into cold air coming down as ice [The Works of Robert Boyle, p. 387]. After references to various others, Boyle begins his first proof "shewing that in Countries where it is very cold in winter, it may nevertheless be hot in summer". With a long testimony from Fletcher's second chapter, he then quotes it extensively from the abridged Purchase edition. The section concludes with the observation that in Russia "as the Winter exceedeth in cold, so the Summer inclineth to over much heat… being much warmer than the Summer Air in England" [The Works of Robert Boyle, p. 393–394; Purchase, Bk. 3, pt. 2]. In this case Boyle confirms Fletcher's text by citing Olearius, who, he explains, accompanied the Duke of Holstein's embassy to Russia in 1633–1634, and therefore could serve as another "eyewitness" to the intensity of extremes in the seasons there [Olearius, p. 117–119]. The size of the melons, Olearius says, indicates the warmth of the summer sun, and proof of the intensity of winter's cold can be seen in the congealment of spit before it reaches the ground. Such temperature ranges even in the most northern parts of England were not possible.

Approaching the end of his Titles Boyle tackles the "Strange Effects of Cold" that are unfamiliar to the Englishman "in this temperate Climate of ours". He then repeats a similar story from "our already divers times mention'd English ambassador", Giles Fletcher, of how one's fingers will stick fast to a cold metal pot and how, as Olearius also recounted, there are many times "Travellers brought into the Towns sitting dead, and stiff in their sleds" and of others that "lose their Noses, the Tips of their Ears, and the Balls of their Cheeks, their Toes [and] Feet, etc.". And he describes how in such cold bears and wolves enter the villages driven by hunger [The Works of Robert Boyle, p. 403, 405].

Ultimately Boyle adds several appendixes and includes a full paragraph from Chapter 2 of Fletcher, about the "fresh and speedy growth of spring there" (in Musco. – *M. J.*) from the beneficial aspects of snow replenishing ground water. He marvels at the temperature ranges in the country and "the great alteration and difference betwixt the winter and summer" there [Ibid., p. 441]. These comments interested Boyle but the more so coming from an educated and observant source.

Giles Fletcher's Account

The background to the story of why and how Boyle used Fletcher begins with the early voyages to Russia and the kind of record keeping employed on the ships. Fletcher had sailed north with the Muscovy Company in

1588 as a Special Ambassador from Queen Elizabeth to Tsar Feodor I and returned to England in little more than a year. His mission was "to do battle for the Company" at the Tsar's court, and the privileges of the merchants depended on his success [Rude and Barbarous Kingdom, p. 114; Sokolov]. In 1591 he first published his general account of *The Russe Commonwealth,* an edited and expanded version of his original "observations" made on the voyage following Cabot's paradigm explained below. Dedicated to Queen Elizabeth, Fletcher wrote that "I observed the State, and manners of that country. And having reduced the same into some order by the way as I returned, I have presumed to offer it in this small book" [Rude and Barbarous Kingdom, p. 109].

That "small book", however, based on the number of its printings, 1591, 1643, and 1657, and the inclusion of a highly edited version of it in Hakluyt, was probably the most widely read of early travel accounts to Russia, and is described by Berry and Crummey as "unquestionably the most important English work on Russia before the reign of Peter the Great" [Rude and Barbarous Kingdom, p. 108; Hakluyt; Purchase; Arel, p. 171–172, 186 note 88]. It was a natural source for Boyle in his examination of cold, although it is not known how or when Boyle was introduced to Fletcher's work and because of the dispersal of Boyle's library at his death we may never know [Avramov, Hunter, Yoshimoto][11]. Before naming this source, Boyle, as we have seen, told his readers that he had collected information from "navigators of our own Country-men", who wrote only in English what was "most material concerning cold" [The Works of Robert Boyle, p. 218]. And he relates how important this particular source is as others are "long out of print". Over the years, however, historians have focused on Fletcher's political comments on Russia, and on his description of the relations between Elizabeth and Feodor and the general strained reception of the embassy, which were of little concern to Boyle whose interest was limited to the nature of cold there. Unlike the changing patterns of the marketplace and the expansion of trade over the decades, the climate of the far north had altered imperceptibly over the long run. The cold that Fletcher had experienced in 1588, with the exception of a few annual fluctuations, as we have said, had changed little, a key fact verifiable by living witnesses.

Moreover, Fletcher's rank of ambassador assured a certain trustworthiness in his text. He had come to his ambassadorial post as a scholar, and perhaps already a poet, although it is unclear exactly when he began writing poetry, having studied at Eton and King's College, Cambridge [The English Works of Giles Fletcher, p. 155–160]. There, as a young man, he became lecturer in Greek but left the position when he married in 1581. Three years later, in 1584, he was elected to parliament and thereafter appointed to several diplomatic posts through the patronage of Sir Francis Walsingham, Sir Thomas Randolph, and later William Cecil, Lord Burghley. He came to the

[11] Giles Fletcher and Sir Thomas Smith are not mentioned in the article identifying and locating 125 books that Boyle was "likely to have owned".

diplomatic world, then, an educated man. He also evidently knew, or learned along the way, some Russian, although how much remains a question [Rude and Barbarous Kingdom, p. 88]. Knowing the Greek alphabet would have helped with Cyrillic. As the representative of Queen Elizabeth to the court of Feodor I, Fletcher carried himself, as Remigio Nannini wrote in 1601, as was requisite for a successful ambassador: "with gravitie and reputation" [Nannini, chap. 8, p. 123]. The deportment and carriage of an ambassador fulfilling his duties to the Crown is described by Jean Hotman in his 1603 compilation of various earlier texts [Hotman]. He reveals little, however, about an ambassador's activities outside of court. From Hotman's text we learn nothing about how an ambassador's time was spent when not engaged in government business. We can only guess at how much of the observation in Fletcher's text came from his experiences of simply living in Moscow, when not engaged in designated diplomatic duties.

Immediately on his return to England Fletcher provided Elizabeth with a draft of his conceived treatise on Russia and then during the following two years expanded and revised the work, adding details from printed histories and cosmographies, which he used selectively, rejecting what to him seemed "without all good probability" [Rude and Barbarous Kingdom, p. 110]. His first brief chapter is a general description of the country itself compiled from various sources and descriptive of places in which Fletcher never set foot. In Chapter 2, "Of the soil and Climate", as we have said, he writes of the barrenness of the north and the winter cold and further describes how the whole country lies under snow and "the rivers and other waters are all frozen up a yard or more thick" [Ibid., p. 113–114].

In his analysis of Fletcher's text, Berry provides a bibliographic discussion of Fletcher's "primary" sources, including, for geographical description, the Jenkinson map of 1502, and for other aspects of government, church, and commonwealth, some earlier writers as well as the first-hand stories of Jerome Horsey who, having himself served as an ambassador, returned from Russia on the same ship with Fletcher. Berry believed, however, that "there is no indication that these sources had any influence on Fletcher's conception of Russia" [The English Works of Giles Fletcher, p. 146]. Horsey, in his own account, alludes to cold now and then but provides neither details of weather as such nor a description of general climatic conditions.

Fletcher had been displeased with his reception in Russia. When he returned he wrote as much to Lord Burghley on 21 September 1589 [The English Works of Giles Fletcher, p. 367–375; Sokolov, p. 593–594]. The letter explains Russian concern to bring trade from the port of Narva to St Nicholas (Archangel), which they believed the English objected to. Over this issue and also that of granting privileged trade to Englishmen an antagonism had grown between the countries that persisted through the whole of the embassy. Regardless of these policy differences, however, Fletcher compiled an account of the country that he said was meant to "note" things "of more importance than delight, and rather true than strange" [Rude and Barbarous Kingdom, p. 109]. The completed book, however, was

not received without, often warranted, criticism but nevertheless is believed by modern authorities to be "a priceless record of a society that soon was [to be] overwhelmed by civil war" [Rude and Barbarous Kingdom, p. 108]. The point here is that for all of the criticisms of Fletcher's account by literary scholars, economists, and historians none of them even remotely touch on the matters that brought even a small part of the book to Boyle's attention.

That Boyle had a copy of Fletcher at all, indeed, that the book existed, goes back to the origins of the first English accounts of the northern voyages which, as we have touched on, and which we might say in modern jargon were market driven from the outset. The English desire for new markets in the East and the success of their ventures there were related to a simultaneous shift in Russian commercial interests. Over the whole of the previous century the quantity of Middle Eastern goods traded through the port of Kaffa in the Crimea in Russia gave way to increased English and Dutch goods arriving and leaving through Archangel, thus circumventing the Hanseatic ports and paving the way to assuring the success of the new northern European ventures [Bushkovitch, 1980, p. 19, 22, 26, 29–30; Veluwenkamp, p. 262]. Because of the complications of the route and the danger at every juncture sailing along the western coast of Norway and then eastward to Archangel, followed by a long and circuitous inland route south by land and river, the Crown came to depend on the expertise of the Muscovy Company. Its seamen had, only after serious early losses, developed experience with northern winds and tides, frozen harbors, spring melts and surging rivers [The First Forty Years of Intercourse between England and Russia 1553–1593, p. IX–XIII, XXIV–XXXI; Willan, p. 48–51][12]. In turn, their experience provided the Muscovy Company with a virtual monopoly of English ships going to the Russian north.

Eventually, after full formal diplomatic relations were established and a system of travel passes instigated, a Russian conductor would meet an English ambassador in the north and lead the whole entourage from Archangel to Moscow [Arel, p. 63, 65–78]. In the beginning, however, merchants had guided them. And it was on this leg of the journey south that merchants and diplomats like Fletcher were introduced to the Russian countryside and experienced first hand local cultural and religious traditions as well as social customs and household habits. Some also learned Russian, at least rudimentarily, enough to negotiate with innkeepers along the route. Even so, the journey was not without difficulties. The complications, for example, in sending an embassy from England to continental Europe, France, Italy, or even Germany, in the middle of the sixteenth century were minimal in comparison, where routes were long but well known and well

[12] Richard Chancellor, for example, sailed from England with three ships of which only one arrived in Russia, The other two were later found wrecked off the coast of Lapland. After Chancellor's first voyage in 1553 Company ships began transporting English emissaries to the Tsar's court and sometimes bringing Russian diplomats to the English court on the return trip. Osip Grigorievich Nepea in 1556, Ivan IV's Ambassador to Edward VI and Andrew Grigorievich Sovin, Ambassador to Queen Elizabeth in 1569, arrived in England by way of Muscovy Company ships.

traveled, and languages were written in the Latin alphabet. Russia was different and those who survived the northern trip wanted a record of what they had encountered on the way in order to inform future merchants, travelers, and those emissaries sent by the Crown.

The establishment of the habit of daily record keeping that began on the first ships of the Muscovy Company and resulted in the first extensive accounts of Russian peoples and geography by Englishmen is due in a large part to Sebastian Cabot. In considering the background to the circumstances that compelled Cabot to draft those *Ordinances* that would guarantee a written record of the voyage we can begin to understand why these very early first hand accounts, even though often later expanded, contained material that could be used by Boyle more than one hundred years later.

Cabot's *Ordinances and Instructions*

From the start, the design of sixteenth-century geographical expansion shaped the collecting, organizing, and classifying of facts related to discoveries and the subsequent construct of written records about them. Over time schemes designed to serve as aids in seeing and recording began to appear, first in Spain and Portugal and later throughout Europe, leading to a "huge expansion in the development of guidance for travelers, merchants, and explorers" [Carey, p. 37 and notes 1–2]. By the 1570's works like William Bourne's *A book called the treasure for traveilers* and the English translation of Hieronymus Turler's, *The Traveiler* were on the book stalls in London [Bourne; Turler]. By 1589 Albrecht Meyer's book had been translated into English, offering in each of twelve sections a compendious list of what and how to look for what was important in new places. Moreover, it included instructions for gentlemen, merchants, and other travelers working abroad [Meyer]. Sebastian Cabot was himself part of the expanding universe of the sixteenth century. He had circulated with explorers and merchants in Seville and later in Bristol and London, and was familiar with the growing genre of travel literature. Like the early scientists, he knew the importance of records and eyewitness accounts as well as the limitations of cosmography. As one author has pointed out, cosmography was no match for Cabot's "empirical experience, that most certain Master of all worldly knowledge" [Sandman, Ash, p. 813, 835]. Here we can also see the reasoning for Boyle's distrust of cosmographies that often failed as eyewitness accounts.

Cabot, sometimes called the "father of English navigation", was born in Venice and later moved to Bristol before entering the service of Spain where he was employed from 1512 until his return to England in 1548 carrying the Spanish title of Pilot Major [Winship, p. XXIV, XXXIII; Waters, Frontispiece; Quinn, p. 30]. From his Spanish contacts and his own shipboard experiences, particularly on the voyage that took him up the Rio de la Plata in 1526, Cabot had learned the importance of records. For these early voyages were, as Heather Dalton writes, "cumulative experiences" where "captains and navigators built their expertise on the maps and logs of previous voyages" [Dalton, p. 75]. Keeping navigational logs had been

part of the customary routine of trading ships in the ancient world but did not become a required practice in Spain until 1575 and not generally in England, France and Holland until a century later [Schotte, p. 287, 294].

In 1553, Cabot, as Governor of the Mysterie and Company of the Merchants of the City of London, proposed a voyage to discover a route to reach Cathay by sailing North and East. In preparation for that voyage he compiled *Instructions and Ordinances* to be followed on shipboard during the voyage. Cabot called for keeping a descriptive account written by merchants and other professionals on board separate from and fuller than the captain's concise log of stars, latitudes, temperatures, and winds. This journal would provide descriptions of land formations and as well as peoples seen on islands and coasts. Three ships were outfitted and left England, none of which reached Cathay. One, the *Edward Bonaventure*, captained by Richard Chancellor, came to a place he described as having "no night at all but a continual light and brightness of the sun… [and] learned that this country was called Russia" [Rude and Barbarous Kingdom, p. 3–4]. Thus from Chancellor's notes written after Cabot's *Instructions* we have the first record of England's discovery of the place called Russia. Two years after this "discovery", in 1555, a royal charter was granted creating the Russia, or Muscovy Company. Cabot was named Governor of that company for life and his *Ordinances and Instructions* were used on subsequent voyages north and also adopted by other trading companies.

Out of Cabot's thirty-three numbered *Instructions* there are two that directly address the creation of a habit of daily record keeping. Items 7 and 27 called for a pattern of writing that would ultimately guarantee an eyewitness account for the Company and, as time has proven, for future travelers, later historians, and early scientists as Boyle.

The first of the two, Item 7, specified that "the marchants and other skilful persons in writing, shal daily write, describe, and put in memorie the Navigation of every day and night, with the points, and observation of the lands, tides, [and] elements…" and "the same so noted by the order of the Master and pilot of every ship to be put in writing".

Then the captain general once a week was to assemble together the masters of the ships of the fleet "if winde and weather shal serve) to conferrre [on] all the observations, and notes of the said ships, to the intent it may appeare wherein the notes do agree, and wherein they dissent". And then, upon "good debatement, deliberation, and conclusion determined, to put the same into a common leger, to remain of record for the company".

Ultimately this collaborative effort would serve future navigators while, perhaps more importantly, providing a record of decision making that could be cited in a court of law [Hakluyt, vol. 1, p. 232, 234].

Item 27 of the *Instructions* called for the names of the coastal peoples of the islands "to be taken in writing" along with an account of the "commodities and incommodities" of their places. Also a record was to be made of the peoples' "natures, qualities, and dispositions" and what they are "most desirous of" and what "commodities they wil most willingly depart with, and what metals

they have in the hills…" And apparently bearing all of these instructions in mind the merchants and the other persons skillful in writing continued their accounts on the overland trip to Moscow [Hakluyt, vol. 1, p. 238].

The written records produced in response to these ordinances would come to complement the visual depictions of the mapmakers and cosmographers who often themselves had not travelled. In Spain and Portugal this idea of an expanded log book had taken hold before Cabot drafted his *Instructions* for the English voyage north. Christopher Columbus in 1492 had enlarged his log to include geographical description as well as marine meteorological data. He had noted at the outset that he would "write down this entire voyage very precisely, everything which I may do and see and experience day by day" [Hakluyt, vol. 1, p. 281]. Forty years later the pilots of Seville formulated their contention that "someone who has sailed and possesses experience has a different understanding than the one who boasts about having mere theory at his command". This, they said, was because "theory and not experience deceives". Moreover, the eyes that see the matter seldom deceive [Brendecke, p. 197][13]. The idea, then, of a regular diurnal account kept by eyewitness observers was not new to Cabot, although compiling it as a joint exercise and comparing the observations to create a single text may have been.

Cabot himself, at seventy-nine years of age, did not sail on Chancellor's northern voyage in 1553 but "taking as a model the regulations given to Spanish navigators and explorers" and, according to the historian of English navigation, David Quinn, adding some precepts from the executive, governor, consuls and assistants of the Muscovy Company, he "compiled, made, and delivered", the thirty-three *Ordinances, Instructions, and Advertisements* for the captains, seamen, and other travelers on the three ships bound for Cathay [Hakluyt, vol. 1, p. 232; Waters, p. 85, 287; Quinn, p. 30]. From that time on, continues D. H. Waters, another noted historian, the *Ordinances and Instructions* were understood by seamen and merchants alike to constitute a general guide for record keeping, and "so sound were they that they became an integral part of every subsequent English voyage of repute" [Waters, p. 90]. It seems likely, then, that these *Ordinances* had a direct bearing on Fletcher's collecting of "observations" that became the basis for the account he wrote that was eventually expanded, printed, reprinted, and read by Boyle. And from this we can also conclude that The Muscovy Company, was a pioneer in northern navigational record keeping.

There are various theories about the origin of the idea of the *Ordinances,* all of them predicated on the need for eyewitness reporting. In 1554 Franciso Falerno had suggested to the Casa de la Contratación in Seville that was responsible, among other things, for naval cartography and the nautical training of pilots, that what sometimes happened informally should be regularized and that "pilots should keep daily records" [Brendecke, p. 198; Carey, p. 27]. Later, we see the outline of enumerated points that grew out

[13] I want to thank Professor James Boyden of the Department of History, Tulane University, for his comments and bibliographic suggestions relating to Spanish and Portuguese maritime offices.

of the interrogative technique of Spanish law employed in cases of maritime dispute. These "question lists", as they were called, were modeled on the formulation of heads of inquiry drawn up for the administration of new world territories. Cabot would have been well acquainted with them [Brendecke, p. 222]. Using them as an example, the Spanish devised a question list as an aid for record keeping on voyages. The first points in the list were addressed to the Captain and Pilot regarding the navigation of the ship –winds, water, stars – all elements of the log. The entire second section addressed questions regarding topography – land, rivers, and mountains; the third concerned elements of natural history – animals, trees, plants, and finally cities, peoples, and religions that provided a framework for organizing a descriptive account of new geographic areas and peoples. Such question lists were drawn up and used from 1530 through the middle of the seventeenth century [Brendecke, p. 219–222; Dalton, p. 74–76 and note 5, p. 72–109, 159–156][14].

Fletcher's account was not the first to reflect the admonitions of the *Ordinances*. They had been devised for Chancellor's trip, as mentioned, in 1553[15]. His is the earliest first hand account of that part of northern Russia written by an Englishman but there was nothing in it relating to cold and the vernacular was lost in the Latin translation; hence it was of no interest to Boyle. Another emissary to Russia, Anthony Jenkinson, spent the winter of 1566–1567 in Moscow as a Company Agent on a part commercial and part diplomatic mission [Bell, p. 221; Rude and Barbarous Kingdom, p. 43–58; ODNB]. His account was first printed by Hakluyt in 1589, and in subsequent editions of the *Principal Navigations*. It was not controversial and consequently published pretty much as it was written. On the other hand, Hakluyt edited the cosmographical parts of Fletcher's account, although not the meteorological parts which he felt were unimportant. The material excised was to satisfy the Muscovy Company's concern that negative remarks would influence investment [Helgerson, p. 153–181; Dalton, p. 200–201; Stout, p. 153–163; Simmons, p. 161–167]. But more importantly to a scientist, from Boyle's perspective, although on occasion he used Hakluyt's texts, the altering of them destroyed their validity as eyewitness accounts [Helgerson, 153][16].

---

[14] Dalton suggests the inspiration for the Ordinances may have come indirectly from Martin Fernandez de Ecisco's Summa de Geographia, published in Seville in 1519. The text was popular and combined the attributes of "a navigational manual with a description of the known world". It was written in the vernacular, accessible to seamen and translated and expanded by Roger Barlow, an English merchant who had been part of the Seville community and sailed to the spice islands with Cabot 1526–1528.

[15] On Chancellor's return to England Clement Adams (engraver of Cabot's word map of 1544), with Chancellor's collaboration, set down a much expanded Latin text of the shipboard notes, to which he added material from other European printed sources, perhaps with the idea of capitalizing on the popularity of travel literature and cosomographies. The expanded account was first printed in Frankfurt with the title Anglorum navigatio ad Muscovita and was then translated, edited, and published n English twenty-eight years later by Hakluyt in Principal Navigations (London, 1589) and subsequent editions. For full bibliographic material on Chancellor, see: [Rude and Barbarous Kingdom, p. 7–8].

[16] Muscovy Company carriage of ambassadorial personnel literally underscores Helgerson's concept of the nation or state as "universal voyager."

The long run impact of Cabot's *Ordinances and Instructions* as a mandate for record keeping can be seen in the annals of other trading companies and even in the work of earlier natural scientists. For example, in 1614 the East India Company ordered that a journal be kept "by the lieutenant, merchant, purser, pilots and master's mates" of each day's navigations" who "are from time to time to compare their notes" [Waters, p. 287]. One of the best examples of Cabot's design is the two part record kept by the botanist, John Tradescant, Sr., when he sailed north on a Muscovy Company ship with the embassy of Sir Dudley Digges in 1618. The first part of his diary recounts the voyage itself – winds and weather – for both the outgoing and return passages. The second part, precisely titled "Things by me observed", describes towns, houses, furniture, food, and the flora and fauna of the Russian countryside. The parts are not lengthy but are descriptive and, most importantly for later scientists, constitute an eye witness account [Konovalov, 1950–1951, p. 130–141; Leith-Ross, p. 59–71][17].

From the beginning, as we have seen, the facilitator of English travel north and eyewitness reporting of cold was the Muscovy Company itself. It played a major role in the exchange of personnel and ideas beyond the world of trade goods. The sea route to Russia was both shorter and cheaper than going overland through Europe. Between the promulgation of its Charter in 1555 and the death of Queen Elizabeth in 1603 full diplomatic relations between England and Russia were begun and two Company agents and nine ambassadors had sailed north and made the journey south to Moscow. Already by 1591 in the eyes of the Tsar the northern sea route on Company ships had become "the ordinarie way" for the English to reach Russia [The First Forty Years of Intercourse between England and Russia 1553–1593, p. 397]. On the return trips, as we have seen, the ships often carried Russian emissaries or full ambassadors to England. Under the early Stuarts, James I and Charles I, the Company transported five ambassadors and five agents to Russia[18]. The first audience of an English ambassador with the Tsar after the regicide was with Boyle's friend, Charles Howard, 1st Earl of Carlisle, on 11 February 1664. It was primarily Carlisle and Dr. Collins (see above) who, from their experiences in Russia, could verify Fletcher's account of cold expanded in print from his early shipboard notes.

The Carlisle embassy from Charles II to Tsar Aleksei Milchailovich was carried on two ships, a government Man of War and "a merchant ship". Both left Gravesend in mid July 1663 and arrived in Archangel in late August. On 12 September they left for Vologda where they spent three months before taking sledges to Moscow, finally to arrive in the city by early February. Carlisle's first audience with the Tsar took place on the eleventh of that month. All of this is to explain that, among other things, Carlisle and his

[17] The diary is printed in full in [Konovalov, 1950–1951, p. 130–141]. See also Prudence: [Leith-Ross, p. 59–71].

[18] Sir Thomas Smith, SA, d. 10 June 1604; John Merrick, d. 19 April 1613; third voyage, Sir John, Ambassador Extraordinary, d. 18 June 1614; Sir Dudley Digges, SA, d. 1 April 1618; Sir John Merrick, fourth voyage SA, d. 24 June 1620.

entourage experienced the height of a Russian winter. In fact the whole assembly was eyewitness to the manifestations of its cold, particularly in the north [Konovalov, 1962, p. 60–104; Dukes, Herd, Kotilaine, p. 104–111; Hennings, p. 139–159].

Andrew Marvell, Carlisle's Secretary, wrote reports of the official business of the mission, copies of many of which remain in the Russian State Archives [cf.: РГАДА. Ф. 35. Оп. 2]. Guy Miege, the undersecretary, kept a more general journal and travel account in accord with what Cabot had earlier instructed. The first pages, written in English on shipboard, describe the weather in general, the winds in particular, and the amount of fog, sun, etc. [Miege, p. 1669]. The remainder is a description of what Miege saw, for he says he has been an "ocular witness" to a country so "little known" that he would write "as exactly as was possible of the nature of that country and its inhabitants". [Miege]. After their return to England, Miege almost immediately went to France, his homeland, where he expanded the account from his original notes, borrowing from other travelers and cosmographers (who, however, he rarely identifies). In 1668 he returned to England and the completed book was licensed for publication in London. It includes recurring references to the cold in Russia where he says the winters are long and "the Frosts exceeding violent especially in the most northerly provinces". Obviously the book did not yet exist when Boyle met Carlisle on the street in 1665, but through diplomatic channels and meetings of the Royal Society Boyle knew that his friend had endured a Moscow winter, making him too, as was his undersecretary, an "ocular witness". For later readers Miege's account could substantiate Carlisle's comments on cold. The account was reprinted in English, French and German[19].

We have already mentioned Samuel Collins's travels and experience in the north as well as in Moscow. He was not a member of the Royal Society but during his stay in England in 1664 had formed a relationship with Boyle. Most important, as we have said, was their correspondence after Collins returned to Russia. He provided Boyle with yet another eyewitness to the phenomenon of cold. So close was their friendship that Collins dedicated his book, written as a letter to a friend and entitled *The Present State of Russia, to* Boyle [Collins][20].

Many of Boyle's friends and professional acquaintances were members of the Royal Society, where, he wrote, "I have the Happiness not to be hated" [The Works of Robert Boyle, p. 210]. It was at the moment in which Boyle was assembling his materials on cold that the Society was beginning to publish materials relating to the work of its members. Their interest was in the exposition of empirical data rather than in a "discussion of metaphysical principles" [Shapiro, p. 19]. The first number of the

[19] Rouen, 1669; Amsterdam and Rouen, 1670; Amsterdam 1672, 1700, and in Paris, 1857.

[20] Collins died in 1670. Published posthumously the text was possibly heavily edited by the publisher. See Michael Hunter, The Boyle Papers Understanding the Manuscripts of Robert Boyle: [Hunter, 2007, p. 242–243].

publication of the Society was compiled by Henry Oldenburg and appeared on 6 March 1665, introducing itself as a publication to encourage those who "delight in the advancement of learning" to "impart their knowledge to one another and contribute what they can to the Grand design of improving Natural Knowledge", and announcing that it was to be international in scope [Philosophical Transactions]. Reflecting this mission, it was entitled *Philosophic Transactions, Some Accompt of the Present Undertakings, Studies, and Labors of the Ingenious in many considerable parts of the world,* and in it Boyle's work on cold was first advertised. The book itself followed in 1665, with a second edition in 1683. A fuller description of it was provided in the *Transactions* in May 1667.

In conclusion, we have seen it was a long trajectory from Cabot's *Ordinances and Instructions* drafted for regular record keeping on the first Muscovy Company ships to the accounts of early Russia from Fletcher and others, and from there to the Royal Society and Boyle's published analysis of cold. From this study of cold we learn the importance of Boyle's manner of verification of phenomena observed by eyes other than his own. His procedure, as he titled it, was experimental and observational. Sometimes he "offered hypotheses, conjectures, explications and theories in conjunction with his work". But these points "he readily admitted would not yield the certainty of mathematics" [Shapiro, p. 53]. In short, we learn more about Boyle from this work, how he thought and wrote, than about any final analysis of cold.

Although centered on Boyle's experiments, ultimately his work on cold is a page in the story of empiricism and the importance of eyewitness accounts. It also demonstrates the impact of the climate of the Russian north on the early study of natural science in England. On a grander scale it is also a story of the transmission of knowledge that touches on many aspects of the periodization of the early modern world – the Age of Discovery, Early European Expansion, and the beginning of the Scientific Revolution.

Список литературы

РГАДА. Ф. 35. Оп. 2.

Arel M. S. English Trade and Adventure to Russia in the Early Modern Era, The Muscovy Company 1603–1649. Lantham, Md. : Roman and Littlefield, 2019. 349 p.

Aristotle. The Works of Aristotle : 12 Vols. Oxford : Clarendon Press, 1931. Vol. 3. Meteorologica / ed. by E. W. Webster. 485 l.

Avramov J., Hunter M., Yoshimoto H. Boyle's Books: The Evidence of the Citations // Occasional Papers. 2010. № 4. L. : The Robert Boyle Project.

Bacon F. Of the Advancement and Proficience of Learning or the Partitions of Sciences IX Bookes. Written in Latin by the Most Eminent Lllustrious & Famous Lord Francis Bacon Baron̄ of Verulam Vicont St Alban Counsilour of Estate and Lord Chancellor of England. Interpreted by G. Wats. Oxford : Printed by Leon Lichfield Printer to the University, for Robert Young and Edward Forrest, 1640. (ESTC / 1167.7).

Bell G. M. A Handlist of British Diplomatic Representatives 1509–1688. L. : Offices of the Royal Historical Society, 1990. 224 p.

Bourne W. A Booke Called the Treasure for Traveilors, Divided into 5 Books. L. : [By Thomas Dawson] for Thomas Woodcocke, 1578.

Boyle R. New Experiments and Observations Concerning Cold // An Experimental History of Cold. L. : [S. n.], 1665. (EEBO : ESTC B3996).

Brendecke A. The Empirical Empire Spanish Colonial Rule and the Politics of Knowledge / transl. by J. Riemer. Berlin ; Boston : De Gruyter Oldenbourg, 2009. 322 p.

Bushkovitch P. Merchants of Moscow. Cambridge, UK : Cambridge Univ. Press, 1980. 212 p.

Bushkovitch P. Words and Things : Contemporary Translations of the Russian Institutional Vocabulary (Sixteenth-Seventeenth Centuries) // Seeing Muscovy Anew; Politics – Institutions – Culture, Essays in Honor of Nancy Shields Kollmann / ed. by M. S. Flier, V. A. Kivelson, E. Monahan, D. Rowland. Bloomington, Indiana : Slavica Publ., 2017. P. 227–243.

Captaine Thomas James. The Strange and Dangerous Voyage of Captaine Thomas James, in his intended Discovery of the Northwest Passage into the South Sea. L. : J. Legatt, 1633. [6], 120, [24] p. (ESTC 14444).

Carey D. Inquiries, Heads, and Directions: Orienting Early Modern Travel // Travel Narratives, the New Science, and Literary Discourse, 1569–1760 / ed. by J. Hayden. Farnham, UK : Ashgate Publ., 2012. P. 25–51.

Collins S. The Present State of Russia, In a Letter to a Friend at London; Written by an Eminent Person Residing at the Great Czars Court at Mosco for the Space of Nine Years. L. : John Winter for Dorman Newman, 1671. [22], 141, [11] p.

Dalton H. Merchants and Explorers Roger Barlow, Sebastian Cabot, and Networks of North Atlantic Exchange 1500–1560. Oxford : Oxford Univ. Press, 2016. 241 p.

Dear P. Revolutionizing the Sciences, European Knowledge and Its Ambitions, 1500–1700. Princeton : Princeton Univ. Press, 2009. 203 p.

Dukes P., Herd G. P., Kotilaine J. Stuarts and Romanovs: The Rise and Fall of a Special Relationship. Dundee : Univ. of Dundee Press, 2009. 262 p.

Evelyn J. The Diary of John Evelyn / ed. by E. S. de Beer. Oxford, UK : Oxford Univ. Press, 1959. 1307 p.

Fletcher G. Of the Russe Commonwealth : With Variants by R. Pipes and Glossary-Index by J. V. A. Fine, Jr. : [facsimile ed.]. Cambridge, MA : Harvard Univ. Press, 1966. IX p., 116 l., 98 p.

Fletcher G. Of the Russe Commonwealth. L. : Printed by T[homas] D[awson] for Thomas Charde, 1591. (ESTC 11056).

Hakluyt R. The Principal Navigations, Voyages, Traffiques & Discoveries of the English Nation Made by Sea or Overland to the Remote & Farthest Distant Quarters of the Earth at Any Time within the Compasse of these 1600 Years : 3 Vols. L. : J. M. Dent & Sons, 1932.

Hall M. B. Henry Oldenburg: Shaping the Royal Society. Oxford, UK : Oxford Univ. Press, 2002. 369 p.

Helgerson R. Forms of Nationhood, The Elizabethan Writing of England. Chicago : Chicago Univ. Press, 1994. 367 p.

Hennings J. Russia and Courtly Europe Ritual and the Culture of Diplomacy, 1648–1725 : New Studies in European History. Cambridge, UK : Cambridge Univ. Press, 2016. 297 p.

Hotman J. The Ambassador, Translated from the French. L. : By V[alentine] S[immes] for Iames Shawe, 1603. (ESTC (2nd Ed.) / 13848).

Hunter M. Between God and Science. N. Haven : Yale Univ. Press, 2009. 366 p.

Hunter M. Robert Boyle by Himself and His Friends, with a Fragment of William Wotton's Lost Life of Boyle. L. : William Pickering, 1994. 188 p.

Hunter M. The Boyle Papers, Understanding the Manuscripts of Robert Boyle. Aldershot, UK : Ashgate Publ., 2007. 674 p.

Hunter M., Clericuzio A., Principe L. The Correspondence of Robert Boyle : 6 Vols. L. : Pickering & Chatto, 2001.

Konovalov S. England and Russia: Three Embassies 1662-5 // Oxford Slavonic Papers. 1962. Vol. 10. P. 60–104.

Konovalov S. John Tradescant's Diary of a Voyage to Russia June – September 1618 // Oxford Slavonic Papers. 1950–1951. P. 130–141.

Leith-Ross P. The John Tradescants, Gardeners to the Rose and Lily Queen. L. : Peter Owen Publ., 1984. 341 p.

Loewenson L. The Works of Robert Boyle and 'The Present State of Russia' by Samuel Collins // The Slavonic and East European Rev. 1955. Vol. 33, № 81. P. 470–485.

Meyer A. Certaine Briefe, and Speciall Instructions for Gentlemen, Merchants, Students, Souldiers, Marriners, etc… L. : John Woolfe, 1589. [8], 21, [3] p.

Miege G. A Relation of Three Embassies from His Sacred Majestie Charles II to the Great Duke of Muscovie, the King of Sweden, and the King of Denmark Performed by the Right Honorable the Earle of Carlisle in the Years 1663 & 1664. Written by an Attendant on the Embassies, and Published with his Lordships Approbation. L. : For John Starkey, 1669. 461 p.

ODNB – Oxford Dictionary of National Biography. URL: https://www.oxforddnb.com/ (accessed: 10.02.2022).

Olearius A. The Voyages and Travels of the Ambassadors. L. : Printed for John Starkey and Thomas Basset, 1662. 711 p. (ESTC O269).

Philosophical Transactions of the Royal Society. 1665, March. Vol. 1, № 6. DOI 10.1098/rstl.1665.0006.

Purchase S. Hakluytus Posthumus or Purchas His Pilgrimes. L. : By W. Stansby for H. Fetherstone, 1625. (ESTC (2nd Ed.) 20509).

Quinn D. B. Sebastian Cabot and Bristol Exploration. Bristol : Bristol Branch of the Historical Ass., 1968. 30 p.

Rude and Barbarous Kingdom, Russia in the Accounts of Sixteenth Century Voyagers / ed. by L. E. Berry, R. O. Crummey. Madison : Univ. of Wisconsin Press, 1968. 391 p.

Sandman A., Ash E. Trading Expertise: Sebastian Cabot between Spain and England // Renaissance Quarterly. 2004. Vol. 57, № 3. P. 813–846. DOI 10.2307/4143567.

Schleck J. Forming Knowledge: Natural Philosophy and English Travel Writing // Travel Narratives, the New Science, and Literary Discourse, 1569–1760 / ed. by J. Hayden. Farnham, UK : Ashgate Publ., 2012. P. 53–69.

Schotte M. Expert Records: Nautical Logbooks from Columbus to Cook // Information and Culture. 2013. Vol. 48, № 3. P. 281–322.

Shapin S., Schaffer S. Leviathan and the Air Pump: Hobbes, Boyle and the Experimental Life. Princeton : Princeton Univ. Press, 1985. 440 p.

Shapiro B. J. Probability and Certainty in Seventeenth-Century England. Princeton : Princeton Univ. Press, 1983. 347 p.

Sokolov D. Reading Diplomacy across the Archives : English and Russian Reports on Giles Fletcher the Elder's Embassy to Muscovy (1588–1589) // J. of Medieval and Early Modern Studies. 2020. Vol. 50, № 3. P. 587–608. DOI 10.1215/10829636-8626469.

The English Works of Giles Fletcher, the Elder / ed. by L. Berry. Madison, Wisconsin : Univ. of Wisconsin Press, 1964. 546 p.

The First Forty Years of Intercourse between England and Russia 1553–1593 / ed. by G. Tolstoy. N. Y. : Burt Franklin, [N. d.].

The Freshwater Switchyard of the Arctic Ocean : [website]. URL: http://psc.apl.washington.edu/switchyard/ (accessed: 09.07.2021).

The Works of Robert Boyle : 14 Vols. / ed. by M. Hunter, E. B. Davis. L. : Pickering & Chetto, 1999–2000. Vol. 4. XXIV, 594 p.

Travel Narratives, the New Science, and Literary Discourse, 1569–1760 / ed. by J. Hayden. Farnham, UK : Ashgate Publ., 2012. 256 p.

Turler H. The Traveiler. L. : [S. n.], 1575. 192 p.

Veluwenkamp J. W. The Murman Coast and the Northern Dvina Delta as English and Dutch Commercial Destinations in the 16th and 17th Centuries // Arctic. Arctic Inst. of North America. 1995. Vol. 48, № 3. P. 257–266.

Waters D. W. The Art of Navigation in England and Early Stuart Times. N. Haven : Yale Univ. Press, 1958. 696 p.

White S. A Cold Welcome, The Little Ice Age and Europe's Encounter with North America. Cambridge, MA : Harvard Univ. Press, 2017. 361 p.

Willan S. The Early History of the Russia Company 1553–1603. Manchester, UK : Manchester Univ. Press, 1956. 295 p.

Winship G. P. Cabot Bibliography, with an Introductory Essay on the Careers of the Cabots. N. Y. : Dodd, Mead and Co. ; L. : Henry Stevens, Son and Stiles, 1900. 180 p.

Yeo R. Notebooks, English Virtuosi, and Early Modern Science. Chicago : Univ. of Chicago Press, 2014. 398 p.

References

Arel, M. S. (2019). *English Trade and Adventure to Russia in the Early Modern Era, The Muscovy Company 1603–1649.* Lantham, Md., Roman and Littlefield. 349 p.

Aristotle. (1931). *The Works of Aristotle. 12 Vols.* Oxford, Clarendon Press. Vol. 3. Meteorologica / ed. by E. W. Webster. 485 l.

Avramov, J., Hunter, M., Yoshimoto, H. (2010). Boyle's Books: The Evidence of the Citations. In *Occasional Papers.* No. 4. L., The Robert Boyle Project.

Bacon, F. (1640). *Of the Advancement and Proficience of Learning or the Partitions of Sciences IX Bookes. Written in Latin by the Most Eminent Lllustrious & Famous Lord Francis Bacon Baron of Verulam Vicont St Alban Counsilour of Estate and Lord Chancellor of England. Interpreted by G. Wats.* Oxford, Printed by Leon Lichfield Printer to the University, for Robert Young and Edward Forrest. (ESTC / 1167.7).

Bell, G. M. (1990). *A Handlist of British Diplomatic Representatives 1509–1688.* L., Offices of the Royal Historical Society. 224 p.

Berry, L. (Ed.). (1964). *The English Works of Giles Fletcher, the Elder*. Madison, Wisconsin, Univ. of Wisconsin Press. 546 p.

Berry, L. E., Crummey, R. O. (Eds.). (1968). *Rude and Barbarous Kingdom, Russia in the Accounts of Sixteenth Century Voyagers.* Madison, Univ. of Wisconsin Press. 391 p.

Bourne, W. (1578). *A Booke Called the Treasure for Traveilors, Divided into 5 Books.* L., [By Thomas Dawson] for Thomas Woodcocke.

Boyle, R. (1665). *New Experiments and Observations Concerning Cold. In An Experimental History of Cold.* L., S. n. (EEBO : ESTC B3996).

Brendecke, A. (2009). *The Empirical Empire Spanish Colonial Rule and the Politics of Knowledge* / transl. by J. Riemer. Berlin, Boston, De Gruyter Oldenbourg. 322 p.

Bushkovitch, P. (1980). *Merchants of Moscow.* Cambridge, UK, Cambridge Univ. Press. 212 p.

Bushkovitch, P. (2017). Words and Things: Contemporary Translations of the Russian Institutional Vocabulary (Sixteenth-Seventeenth Centuries). In Flier, M. S., Kivelson, V. A., Monahan, E., Rowland, D. (Eds.). *Seeing Muscovy Anew; Politics – Institutions – Culture, Essays in Honor of Nancy Shields Kollmann*. Bloomington, Indiana, Slavica Publ., pp. 227–243.

Captaine Thomas James. (1633). *The Strange and Dangerous Voyage of Captaine Thomas James, in his intended Discovery of the Northwest Passage into the South Sea.* L., J. Legatt. [6], 120, [24] p. (ESTC 14444).

Carey, D. (2012). Inquiries, Heads, and Directions: Orienting Early Modern Travel. In Hayden, J. (Ed.). *Travel Narratives, the New Science, and Literary Discourse, 1569–1760*. Farnham, UK, Ashgate Publ., pp. 25–51.

Collins, S. (1671). *The Present State of Russia, In a Letter to a Friend at London; Written by an Eminent Person Residing at the Great Czars Court at Mosco for the Space of Nine Years.* L., John Winter for Dorman Newman. [22], 141, [11] p.

Dalton, H. (2016). *Merchants and Explorers Roger Barlow, Sebastian Cabot, and Networks of North Atlantic Exchange 1500–1560.* Oxford, Oxford Univ. Press. 241 p.

Dear, P. (2009). *Revolutionizing the Sciences, European Knowledge and Its Ambitions, 1500–1700.* Princeton, Princeton Univ. Press. 203 p.

Dukes, P., Herd, G. P., Kotilaine, J. (2009). *Stuarts and Romanovs: The Rise and Fall of a Special Relationship.* Dundee, Univ. of Dundee Press. 262 p.

Evelyn, J. (1959). *The Diary of John Evelyn* / ed. by E. S. de Beer. Oxford, UK, Oxford Univ. Press. 1307 p.

Fletcher, G. (1591). *Of the Russe Commonwealth.* L., Printed by T[homas] D[awson] for Thomas Charde. (ESTC 11056).

Fletcher, G. (1966). *Of the Russe Commonwealth* / With Variants by R. Pipes and Glossary-Index by J. V. A. Fine, Jr. [facsimile ed.]. Cambridge, MA, Harvard Univ. Press. IX p., 116 l., 98 p.

Hakluyt, R. (1932). *The Principal Navigations, Voyages, Traffiques & Discoveries of the English Nation Made by Sea or Overland to the Remote & Farthest Distant Quarters of the Earth at Any Time within the Compasse of these 1600 Years. 3 Vols.* L., J. M. Dent & Sons.

Hall, M. B. (2002). *Henry Oldenburg: Shaping the Royal Society.* Oxford, UK, Oxford Univ. Press. 369 p.

Hayden, J. (Ed.). (2012). *Travel Narratives, the New Science, and Literary Discourse, 1569–1760*. Farnham, UK, Ashgate Publ. 256 p.

Helgerson, R. (1994). *Forms of Nationhood, The Elizabethan Writing of England.* Chicago, Chicago Univ. Press. 367 p.

Hennings, J. (2016). *Russia and Courtly Europe Ritual and the Culture of Diplomacy, 1648–1725: New Studies in European History.* Cambridge, UK, Cambridge Univ. Press. 297 p.

Hotman, J. (1603). *The Ambassador, Translated from the French.* L., By V[alentine] S[immes] for Iames Shawe. (ESTC (2nd Ed.) / 13848).

Hunter, M. (1994). *Robert Boyle by Himself and His Friends, with a Fragment of William Wotton's Lost Life of Boyle.* L., William Pickering. 188 p.

Hunter, M. (2007). *The Boyle Papers, Understanding the Manuscripts of Robert Boyle.* Aldershot, UK, Ashgate Publ. 674 p.

Hunter, M. (2009). *Between God and Science.* N. Haven, Yale Univ. Press. 366 p.

Hunter, M., Clericuzio, A., Principe, L. (2001). *The Correspondence of Robert Boyle. 6 Vols.* L., Pickering & Chatto.

Hunter, M., Davis, E. B. (Eds.). (1999–2000). *The Works of Robert Boyle. 14 Vols.* L., Pickering & Chetto. Vol. 4. XXIV, 594 p.

Konovalov, S. (1950–1951). John Tradescant's Diary of a Voyage to Russia June – September 1618. In *Oxford Slavonic Papers,* pp. 130–141.

Konovalov, S. (1962). England and Russia: Three Embassies 1662-5. In *Oxford Slavonic Papers.* Vol. 10, pp. 60–104.

Leith-Ross, P. (1984). *The John Tradescants, Gardeners to the Rose and Lily Queen.* L., Peter Owen Publ. 341 p.

Loewenson, L. (1955). The Works of Robert Boyle and 'The Present State of Russia' by Samuel Collins. In *The Slavonic and East European Rev.* Vol. 33. No. 81, pp. 470–485.

Meyer, A. (1589). *Certaine Briefe, and Speciall Instructions for Gentlemen, Merchants, Students, Souldiers, Marriners, etc…* L., John Woolfe. [8], 21, [3] p.

Miege, G. (1699). *A Relation of Three Embassies from His Sacred Majestie Charles II to the Great Duke of Muscovie, the King of Sweden, and the King of Denmark Performed by the Right Honorable the Earle of Carlisle in the Years 1663 & 1664. Written by an Attendant on the Embassies, and Published with his Lordships Approbation.* L., For John Starkey. 461 p.

ODNB – Oxford Dictionary of National Biography. URL: https://www.oxforddnb.com/ (accesses: 10.02.2022).

Olearius, A. (1662). *The Voyages and Travels of the Ambassadors.* L., Printed for John Starkey and Thomas Basset. 711 p. (ESTC O269).

Philosophical Transactions of the Royal Society. (1665). March. Vol. 1. No. 6. DOI 10.1098/rstl.1665.0006.

Purchase, S. (1625). *Hakluytus Posthumus or Purchas His Pilgrimes.* L., By W. Stansby for H. Fetherstone. (ESTC (2nd Ed.) 20509).

Quinn, D. B. (1968). *Sebastian Cabot and Bristol Exploration.* Bristol, Bristol Branch of the Historical Ass. 30 p.

RGADA [Russian State Archive of Ancient Acts]. Stock 35. List 2.

Sandman, A., Ash, E. (2004). Trading Expertise: Sebastian Cabot between Spain and England. In *Renaissance Quarterly.* Vol. 57. No. 3, pp. 813–846. DOI 10.2307/4143567.

Schleck, J. (2012). Forming Knowledge: Natural Philosophy and English Travel Writing. In Hayden, J. (Ed.). *Travel Narratives, the New Science, and Literary Discourse, 1569–1760*. Farnham, UK, Ashgate Publ., pp. 53–69.

Schotte, M. (2013). Expert Records: Nautical Logbooks from Columbus to Cook. In *Information and Culture.* Vol. 48. No. 3, pp. 281–322.

Shapin, S., Schaffer, S. (1985). *Leviathan and the Air Pump: Hobbes, Boyle and the Experimental Life.* Princeton, Princeton Univ. Press. 440 p.

Shapiro, B. J. (1983). *Probability and Certainty in Seventeenth-Century England.* Princeton, Princeton Univ. Press. 347 p.

Sokolov, D. (2020). Reading Diplomacy across the Archives: English and Russian Reports on Giles Fletcher the Elder's Embassy to Muscovy (1588–1589). In *J. of Medieval and Early Modern Studies.* Vol. 50. No. 3, pp. 587–608. DOI 10.1215/10829636-8626469.

The Freshwater Switchyard of the Arctic Ocean [website]. (N. d.). URL: http://psc.apl.washington.edu/switchyard/ (accessed: 09.07.2021).

Tolstoy, G. (Ed.). (N. d.). *The First Forty Years of Intercourse between England and Russia 1553–1593.* N. Y., Burt Franklin.

Turler, H. (1575). *The Traveiler.* L., S. n. 192 p.

Veluwenkamp, J. W. (1995). The Murman Coast and the Northern Dvina Delta as English and Dutch Commercial Destinations in the 16th and 17th Centuries. In *Arctic. Arctic Inst. of North America.* Vol. 48. No. 3, pp. 257–266.

Waters, D. W. (1958). *The Art of Navigation in England and Early Stuart Times.* N. Haven, Yale Univ. Press. 696 p.

White, S. (2017). *A Cold Welcome, The Little Ice Age and Europe's Encounter with North America.* Cambridge, MA, Harvard Univ. Press. 361 p.

Willan, S. (1956). *The Early History of the Russia Company 1553–1603.* Manchester, UK, Manchester Univ. Press. 295 p.

Winship, G. P. (1900). *Cabot Bibliography, with an Introductory Essay on the Careers of the Cabots.* N. Y., Dodd, Mead and Co., L., Henry Stevens, Son and Stiles. 180 p.

Yeo, R. (2014). *Notebooks, English Virtuosi, and Early Modern Science.* Chicago, Univ. of Chicago Press. 398 p.

The article was submitted on 23.08.2021