CENTAURUS JOURNAL OF THE EUROPEAN SOCIETY FOR THE HISTORY OF SCIENCE

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Scientific Knowledge and Educational Board Games

From Domestic Experiments to Popular Science (1790–1850)

▼ **ABSTRACT** The second half of the 18th century saw a veritable explosion of marketable items aimed at children and their families. That was particularly true in Britain, where, by the Georgian Age, towns and streets had become populated with shops selling books, toys, dolls, puzzles, and games for young boys and girls. The Wallises' catalogue is a paradigmatic example. The aim of this paper is to analyse their hitherto little-studied science-themed board games. Examining the choice of topics, the way they were translated into images, and the explanations given to the players will allow us to delineate the way the Wallises elaborated and narrated scientific knowledge to their public. I will show, first, that the Wallises' science-themed board games internalised the pedagogical theories of the time and brought into play many of the practices used in the education of children; second, that learning science was seen as an effective way to avoid vices and instil virtues; and third, that the Wallises' science-themed games are a unique and valuable window on the shift from so-called domestic (or familiar) science (typical of the games printed in the late 18th and early 19th centuries) to popular science (as in the games published between 1830 and 1850).

▼ **KEYWORDS** Board Games; Scientific Knowledge; Science Education; Domestic Experiments; Familiar Science; Popular Science

▼ **ISSUE** Volume 66 (2024), issue 1-2

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Cite this article: Ilaria Ampollini, 'Scientific Knowledge and Educational Board Games', *Centaurus*, 66.1-2 (2024), 39–66
<https://dx.doi.org/10.1484/J.CNT.5.142124>

DOI: 10.1484/J.CNT.5.142124

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Introduction

As is well known, the second half of the 18th century saw a veritable explosion of market-worthy items aimed at children and their families. That was particularly true in Britain, where, between the late Georgian and early Victorian eras, towns and streets became populated with shops whose shelves offered books, toys, dolls, games, and puzzles for young boys and girls. If this change emerged from a period of rapid growth in commercial activity, it was also the result of a new and increasing sensitivity towards children, which led to the recognition of childhood as a space in the world in its own right. In this space, both leisure and education were fundamental: in order to play and learn, various objects had to be bought and brought home, where they could be used and enjoyed by children with their parents or with other adults who took care of them, such as governesses or tutors. Such objects were also proposed at school, where teachers employed a growing range of didactic aids.[1]

This crucial turning point has largely been investigated for its implications in social, cultural, and economic history.[2] Several scholars have analysed the content of children's books, from the first novels to textbooks, from toy-books to the "little cabinet" collections.[3] Many have also focused on the materiality of these "little pretty" volumes in the hands of boys and girls and on the interactive and immersive experiences in which young readers were engaged thanks to a rich array of tools.[4] Materiality and interaction are of course also relevant in relation to toys and dolls, as well as in relation to a heterogenous corpus of objects ranging from dissected maps for learning geography to Mogg's tiny sphere.[5] Finally, portable scientific instruments can be added to the list, considering that globes, microscopes, and small telescopes were often purchased by middle- and upper-class families to be kept at home.[6]

Within this rich ensemble of existing studies, a relevant but limited number deal with board and card games.[7] In an attempt to combine learning with amusement, as recommended by Maria (1768–1849) and Richard (1744–1817) Lovell Edgeworth's works and, earlier, by John Amos Comenius (1592–1670) and John

1 The items sold by the Dartons, which were mainly intended for schools, are an excellent example. See Shefrin (2009).

2 See the classic Plumb (1975) and the more recent volume edited by Denisoff (2016).

3 The first children's book probably was the *Little Pretty Pocket Book*, printed in London by John Newbery (1744) and sold with a pin cushion; see the detailed analysis in Klemann (2011). Several flap-books are described in Reid-Walsh (2017, esp. Chs. 4, 8). Some little cabinet collections were published by J. Wallis & Elizabeth Newbery (1797), entitled *The Cabinet of Knowledge Opened and Its Secrets Disclosed: Being a Set of Questions and Answers Explanatory of Morality, Arts, Sciences, &c. &c.: For the Improvement of Youth*. See also Heesen (2002).

4 Klemann (2011).

5 For instance, Shefrin (1999a); Dove (2016). On the copyrights of these games, see Alexander & Martinez (2020). On Mogg's sphere, see Taylor (2009).

6 As shown by texts like *The Young Gentleman and Lady's Astronomy, Familiarly Explained in Ten Dialogues Between Neander and Eudosia to which Is Added the Description and Use of the Globes and the Armillary Sphere*, by James Ferguson (1768); or *An Explanation and Description of Mogg's Celestial Sphere* by Edward Mogg (1813). Valuable primary sources in this regard are offered by the catalogues and books of the famous instrument-maker Benjamin Martin, who sold portable air-pumps, portable globes, and mathematical instruments: Millburn (1976). See also Taylor (2009, p. 362) and Turner (1987).

7 Norcia (2019); Dove (2016); Goodfellow (1998).

Locke (1632–1704), board and card games often became the favourite tool for instructing children (and sometimes adults) through play.[8] Many of these games were used to teach geography and history, where the need to memorise names, dates, and concepts otherwise made it much more difficult to make instruction enjoyable.[9] This requirement was easily fulfilled by the classic Game of the Goose and similar, suitably modified board games.[10] Cards too were very useful, as they could be shuffled and rearranged to visualise the correct sequences of kings and queens, wars and peace-treaties; chronology was one of the most boring things for a child to learn by rote, and a playful system of rewards could help children to memorise information about historical events.[11]

Science was also a common topic: examples ranged from natural philosophy to astronomy, zoology, botany, arithmetic, and geometry. Despite this, very few scholars have focused specifically on science-themed games.[12] One of the few exceptions is Melanie Keene and her outstanding paper about the 1804 board game *Science in Sport or the Pleasures of Astronomy*, published in London by John Wallis.[13] What is still lacking, however, is an overall view that takes into account a larger body of primary sources and seeks to identify common features, specific aspects, and transformations over time. Indeed, as has been amply demonstrated, the Game of the Goose and its counterparts are extremely valuable sources when exploring social and cultural contexts or practices, as well as the circulation and reception of shared knowledge.[14] Moreover, games, such as those conceived in the late Georgian and early Victorian eras and aimed at the education of young people, provide a wealth of information about the history of childhood and the history of educational practices and learning spaces.[15] All of this applies to science-themed games, but there are other points to make: science-themed games offer us unique insights and a privileged lens through

8 On the Edgeworths, see Peters (2017). On the circulation and uses of educational games, see Seville (2019, p. 70).

9 For history, see Bryant Davies & Gribling (2020); Gribling (2020). See also the games listed in Seville (2019, pp. 84–91), for the French games about Revolution, (pp. 173–176) for the English historical games. For geography, see Norcia (2019); Seville (2019, pp. 159–164, 177–183); Dove (2016); Seville (2008a); Shefrin (1999b). I do not include geography among the sciences because the Wallises' board games with geography as a main theme were designed in the wake of the Grand Tour and tourist journeys. They (or at least the ones to which I am referring) had nothing to do with geography in the sense of cartography, measurement, or the study of the earth.

10 In this well-known racing game, players have to roll the dice and move along the spiral track: depending on where they stop, they have to go backwards or forwards, stay for one or more turns, or even start the game again. The winner is the first to reach the last square, which is classically, though not always, number 63. For a general history of board games, see Parlett (2018).

11 Gribling (2020, p. 203).

12 A few paragraphs can be found in Seville (2019, pp. 183–185).

13 Keene (2011); Seville (2016).

14 As in Seville (2019, pp. 333–350), where the history of Game of the Goose is discussed in relation to cultural history.

15 See, for example, Spanos (2021); Bryant Davies & Gribling (2020); Norcia (2019); Goodfellow (1998). Choi (2021, p. 98) notes: "Critics have argued that games performed important cultural work in nineteenth-century Britain, that they promoted national ideals and more specifically, a respect for rules, a spirit of competition, and a sense of mastery over both natural and colonial worlds."

which to explore the circulation, transmission, and reception of modern sciences; their penetration into domestic contexts; and the ways in which they were taught and communicated. This leads us to ask how scientific notions were selected, transformed, and adapted; how they were translated into images; and finally how they were subjected to a set of rules.[16]

The science-themed games in the catalogue of John and Edward Wallis, who were among the most prolific publishers, booksellers, and cartographers in London at the time, offer a good, if obviously partial, starting point for answering these questions: they provide us with a broad range of visual and written narratives of scientific knowledge, from astronomy to natural philosophy, passing through arithmetic, natural history, and technological developments. The choice of which "men of science" to depict and what is included in their biographical portraits, or the themes and scientific instruments selected to suit the purposes of the games, provide us with a wealth of information on how scientific subjects and objects were incorporated into the games, how they were filtered, manipulated, and represented, and with what aims and to what extent. Finally, as the Wallises' shop remained open for 70 years, their catalogues help us to see how educational card and board games changed over the decades: these transformations, driven of course by reasons of commerce and public taste, also reveal a constantly evolving sensitivity towards scientific knowledge and its main protagonists.

In this paper, I argue, first, that the Wallises' science-themed board games internalised the pedagogical theories of the time and brought into play many of the practices used in children's education. Such practices include the primacy of observation, manipulation, and small experiments; the importance of reading aloud together; and the notion of knowledge as a reward. Related to this, I demonstrate how learning about scientific topics was seen as an effective way of avoiding vices and instilling virtues. Good behaviour, such as industry and diligence, reflected the values of the middle class, the audience to which the Wallises' catalogue was mainly addressed. Finally, I propose that the Wallises' science-themed games provide a unique and precious window on the shift from so-called domestic (or familiar) science (typical of the games printed at the end of the 18th and beginning of the 19th centuries) to popular science (as in the games published between 1830 and 1850).[17] This change, which affected several spheres and forms of public scientific culture, was strikingly realised in these games. As this article reveals, illustrations, depicted objects and scenes, and descriptions all combined to situate the game in a larger environment. If this environment was initially the circumscribed space of a home, it became the space of the city of London, with its array of sites dedicated or related to science and technological progress.

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16 The question here concerns the scientific knowledge that was transmitted in these spaces through the games, but it is also worth recalling those works that deal with science as produced and generated in familiar and private contexts; see, for instance, Opitz, Bergwik, & Van Tiggelen (2016).

17 On the concept of "familiar" or "domestic" science, see Peters (2017); Cohen (2016); Michals (2016); Keene (2011; 2014); Elliott (2010, p. 21). On the importance of domestic space in Georgian London, see Heller (2010).

The Wallises and their Shop

Despite the importance of John and Edward Wallis as publishers in late 18th- and early 19th-century London, little is known about them other than what we find in their catalogues, advertisements at the end of some books, or in newspapers and a few scattered notes. As far as we can tell, John Wallis probably opened his first shop in the 1770s and soon became a well-regarded map-maker. His store in Ludgate Street, called the Map Warehouse, offered, among others, a pocket map of London (1787), an atlas of France (1794), a map of the United States of America (1814), and a military map of Spain and Portugal (ca. 1810).[18]

As Linda Hannas points out, Wallis was a keen entrepreneur: he immediately recognised the enormous potential of the growing children's market and soon moved into it.[19] He enriched his catalogue with dissected maps, that is, early examples of jigsaw puzzles, used to teach geography to young boys and girls. The very first dissected map had appeared in the 1760s, so Wallis must have been one of the first publishers to join this new and original editorial venture.[20] The *New Map of Ireland* (1785), the *New and Correct Map of the Post Roads of England and Wales* (1798), or the *New Map of the World* (1800) showed "distinctly the Boundaries, principal Places, Rivers" and avoided any "crowded and confused appearance."[21] They were available in different sizes and prices and were constantly being updated: in 1819, for instance, a map of Europe "engraved according to the New Divisions, as settled by the Congress at Vienna" was introduced.[22]

The dissected maps were not the only items parents could find for their children on Wallis's shelves: as the catalogue itself stated, "A variety of Useful Publications for The Improvement of Youth" were "constantly on sale." There were books, first and foremost, many of which were designed to teach young readers, and, most importantly for us, educational board games. These came folded in beautifully illustrated boxes, accompanied by the instruction booklet—if it was not printed directly on the board—and sometimes by markers and counters. The snail-shaped structure and basic rules were quite similar to those of the Game of the Goose.[23] A cursory glance at his inventory will suffice to note that geographical board games featured prominently (as one might expect, since John Wallis was primarily a publisher of maps and

18 On the Wallises' activities, see the studies by Norcia (2019); Rovee (2015); Keene (2011); Hannas (1972, pp. 30–35).

19 Gribling (2020, p. 201): "In contrast, John Wallis began as a bookseller for adults, but saw the growing market for juvenile wares and moved into children's publishing in the 1780s, where he became known for his ability to create new games or to adapt those of competitors to make them more appealing to child audiences." Gribling paraphrases Hannas (1972, pp. 30–35).

20 Norgate (2007). John Spilsbury is credited with inventing the first jigsaw puzzle in 1767. However, Shefrin (1999b) has identified Mme. de Beaumont, who lived in London between 1748–1762, as the first to make wooden dissected maps.

21 J. Wallis (1785); Slater (1819, p. [95])

22 Slater (1819, p. 94).

23 One of the last board games printed by Edward in 1844, *The New Game of Wanderers in the Wilderness*, is an exception: the ordered, pre-determined path of the Game of the Goose gave way to the coexistence of different possible paths; see Choi (2021, p. 106).

dissected maps), such as the *Tour of Europe* or the *Tour of England and Wales*, both published in 1794, or the *Tour of the World* (1796), which appeared on the shelves 2 years later.[24] But history was also well represented. A wonderful example is the *Historical Cards Exhibiting the History of England* (between 1775–1818), consisting of a deck of 36 cards showing the monarchs of England. Confirming the popularity of this type of game, Wallis also published a card deck on the history of France (between 1789–1792), chronological tables on the history of England (end of 18th century), proposed in the form of a puzzle to be recomposed, and a sample of chronological tables on Roman history, "from the foundation of the City to the Augustan age."[25]

Edward, his son, would later reissue some of the items sold by his father, but he would also propose new subjects: for instance, a board game dedicated to the "Wonders of Art" (ca. 1820); the famous *Game of the Star-Spangled Banner or Emigrants to the United States* (ca. 1830), which was one of the first maps of the United States and contained a clear propaganda against slavery; and the pair *Wallis's Locomotive Game, of Railway Adventures* (ca. 1838) and *Wallis's New Railway Game* (ca. 1844), which show the intention to offer games with a strong connection to contemporary events and themes, whether it be up-to-date information about the New World or a rhetorical celebration of newly built railways and trains.[26]

It is a fact that, out of all the London publishers of educational and recreational tools at the time, the Wallises were the only ones who offered so many board games related to the transmission and teaching of scientific knowledge. From this point of view, no one could be considered their rival except the Dartons, whose catalogue did include several science-themed items, such as cabinets, charts, or question cards. However, only two of these were board games: *British and Foreign Animals* and *British and Foreign Birds*, both printed in 1820. Other sellers who had published dissected maps and geographical or historical board games, never came to publish science-themed games. Not only in London, but also in Britain and abroad, I have been unable to find as many examples of science-themed board games or playing cards as were published during the Wallises' decades of activity.[27] Other science-themed games, such as the board game *Astronomical Recreations* and John Bett's card deck, *The Multiplication Table in Rhyme*, did not appear until the 1850s, by which time John Wallis's son Edward had already left the market.[28]

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24 On the *Tour of Europe*, first created in 1768, see Alexander & Martinez (2020). Refer also to Rovee (2015); Keene (2011).

25 In collaboration with Newbery: J. Wallis & Newbery (1789).

26 See Norcia (2019, Ch. 4), who points out that criticism of slavery was part of a wider "race for moral leadership" that Britain had to win.

27 We should also mention the science-themed board games printed in Paris by Basset, listed in Girard & Quétel (1982, p. 188).

28 Another science-themed game published in the 1850s was titled *Why, What, & Because: Or, The Road to the Temple of Knowledge* (Sallis, ca. 1850). The booklet contained questions, many of them on scientific subjects (for example, light, oxygen, thermometers, and so on), which players had to answer correctly in order to advance. See the list in Whitehouse (1951, pp. 94–102). The last items were probably published by Edward Wallis around 1846. He ceased the activity in 1847.

We have no solid evidence as to how and why John Wallis decided to design and publish science-themed games, but it is likely that his encounter with a French teacher refugee was fundamental. Indeed, John published his first science-themed game in 1795: titled *The Elements of Astronomy and Geography*, it consisted of a deck of cards.[29] The author was Louis Michel Paris (1740–1806), an abbot and professor of Latin, Astronomy and Geography from Argentan in Normandy. During the French Revolution, Paris was forced to leave his hometown and moved to London.[30] He stayed there for 9 years, teaching in a French Catholic school, which had been founded by Abbot Carron (Guy-Toussaint-Julien Carron, 1760–1821) for the children of refugees.[31] Since we know that board games and playing cards had been used to teach students for decades, and that this tradition was very strong in France, we can hypothesise that Paris contacted John Wallis and suggested this first game.[32] This hypothesis is supported by the fact that several examples exist of educational card decks that were personally designed by teachers (private tutors or schoolmasters) and used in handmade versions before being put on the market. A subsequent encounter with Margaret Bryan, a teacher of astronomy at a private girls school, did the rest.[33] In collaboration with her, John Wallis issued the board game *Pleasures of Astronomy* in 1804.

More generally, it must be said that, at that time, extremely innovative and talented booksellers were constantly selling new items to educate children and popularise science. Ever since John Newbery (1713–1767) had released the successful *Newtonian System of Philosophy, by Tom Telescope* in 1762, more and more books were devoted to illustrating scientific topics for young readers. As the 19th century progressed, there could increasingly be found a vast range of juvenilia—printed texts, ephemera, pocket globes, cabinets—picturing the wonders of nature.[34] At the same time, more and more families and schools were added to the pool of potential buyers. John Wallis, who was a far-sighted entrepreneur, must have seen this as a unique business opportunity. His catalogue was populated with board games such as *An Arithmetical Pastime* (1798), *Science in Sport or the Pleasures of Natural Philosophy* (1805), and *The Naturalist* (1813).

When John Wallis died in 1818, his son Edward took over the business. He reissued some of the games in his father's catalogue, suggesting that they had achieved

29 Paris (1795).

30 "Paris, Louis-Michel" (1836, p. 537). A few years later, the game was translated into French and published by the Frères Brée: Paris (1807).

31 See *Vie de l'abbé Carron* (1866).

32 A very representative example is given by the *Jeu des Fortifications*, which had already been introduced in the 17th century, probably by the Jesuits. See Girard & Quétel (1982, p. 51). Jacobs (2012, p. 2) underlines the role played by the Jesuits in promoting games as educational aids. See Van Damme (1999, p. 181) on the heraldic games proposed by the Jesuits. Note also that in his book *Jesuits and Fortifications*, De Lucca (2021, pp. 69–184) devotes an entire chapter to Jesuits teaching the art of fortification, but does not mention any games.

33 On Margaret Bryan, see Saridakis (2012).

34 Talairach-Vielmas (2011, pp. 6–21); Shefrin (2009). Consider, for instance, John Newbery's catalogue (Secord, 2011). It is no coincidence that the first scientific journals aimed at a wide audience were published in Britain at the same time, as pointed out by Topham (2007, pp. 119–120).

a certain success with the public. However, Edward also published some original board games, which also provide valuable "litmus tests" of emerging themes and sensibilities. Titles such as *The New Game of Genius* (1830) or *Amusements at the Zoological Gardens* (1838) show in themselves that times had changed and that this meant addressing different children and different families, as Secord says.[35] Edward, like his father before him, was able to adapt to these changes.

The Wallises' shop closed its door in 1847. The stock was acquired by John Passmore and in 1848 the last of their science-themed games was published, the *Circle of Knowledge*.[36] As we shall see, this final educational game clearly reflects the cultural climate and socio-economic context of the city of London, which was to host the Great Exhibition 3 years later.

What it Meant to Be an Educational Game

The Wallises' science-themed board games carefully embodied some of the most widespread educational theories of the time—above all, as already mentioned, the necessity for children to learn while engaged in some fun activities. The Game of the Goose perfectly fit the brief: the path and rules could easily be modified and adapted from time to time, depending on the messages conveyed and the targeted audience.[37] It is not by chance that, since the first educational board games dating back to 17th century, the Game of the Goose had been the model of choice.

As with the other educational board games in the catalogue, John and Edward followed this tradition with their science-themed board games.

They replaced the iconography of the goose with ad hoc illustrations related to the subject. The squares in *The Naturalist*, for example, bore the images of both native and exotic animals; in the *Wonders of Nature* (see Figure 1), of suggestive, dreadful natural landscapes; and in the *New Game of Genius* (ca. 1830), of various types of inventions (see Figure 4).[38] Furthermore, the boys and girls who played these games would not find any dice to roll. Dice were too closely associated with gambling to enter Georgian homes because of the risk of moral corruption. Instead, one or two teetotums were required, although they were rarely included with the board. This made it clear that the games were educational and would never introduce children to games of chance or gambling.[39] Finally, the booklet that accompanied the board contained not only basic instructions for playing the game, but also accurate, didactic descriptions of the contents of the squares.

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35 Secord (2011, p. 54). See also Choi (2021, p. 98): "But through their changing themes and designs, early nineteenth-century children's board games trace another history, one of epistemological transformation in popular understandings of chance and contingency."

36 Norcia (2019, pp. 2, 184 n. 3).

37 See Seville (2019).

38 The Seville & Ciompi collection offers numerous examples of thematic Games of the Goose.

39 This has been interpreted as an indication that families usually possessed teetotums and used them for different board games.

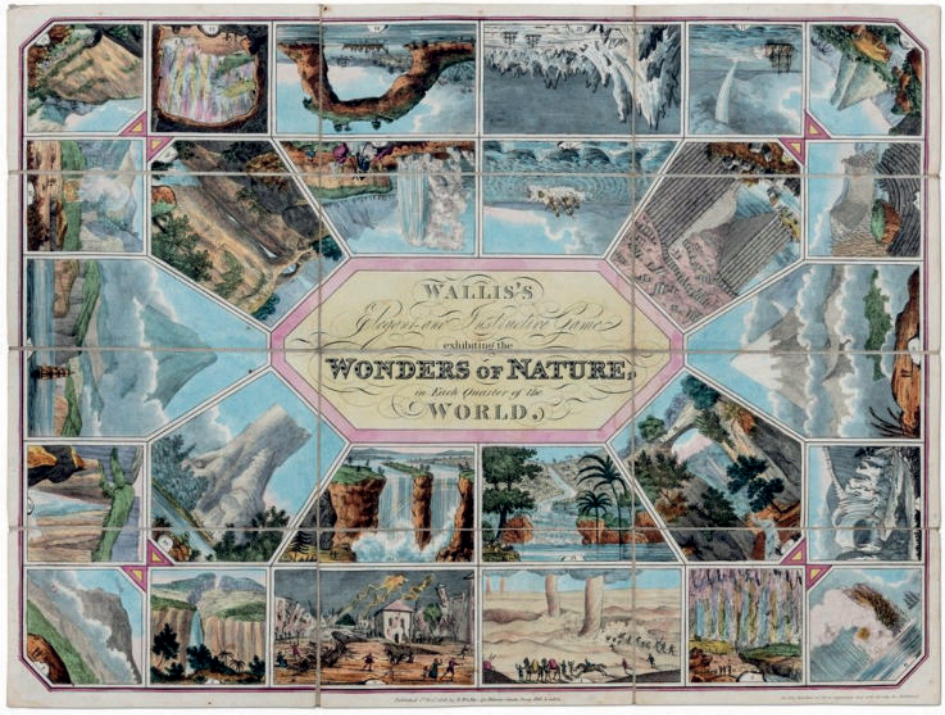

Figure 1. Game board of *Wallis's Elegant and Instructive Game Exhibiting the Wonders of Nature in Each Quarter of the World*, by J. Wallis (1818). Image courtesy of Yale Center for British Arts Online Collections, New Haven, CT (https://collections.britishart.yale.edu/catalog/orbis:13684010).

The most specific and important change, however, is that unlike the classic Game of the Goose, the race was not determined by chance alone. Since young children of both sexes were supposed to acquire new knowledge through these games, they had to prove that they had learnt the required lessons in order to advance and win. The instructions of *An Arithmetical Pastime*, for instance, list 10 equivalence tables that had to be memorised and repeated each time you arrived at a particular square.[40] Square 7 asked the player to recite the "Pence Table," square 85 the "Time Table" and square 28 the "Wine Table"; if the answer was wrong, the player had to stop for a few turns or go backwards.[41] In *The Pleasures of Astrono*my, you had to explain how the telescope, the celestial, and the terrestrial globes worked, or skip two rounds.[42] The later *New Game of Genius* required players to read the description of a square aloud

40 The game was translated in 1798 from an earlier German version. The edition listed in the online catalogues was printed in Nuremberg in 1795 by Georg Dein. The sample lacks instructions and only the game board seems to have remained.

41 The equivalence tables were: Table of Time, Pounds Table, Shillings Table, Pence Table, Numeration Table, Long Measure Table, Dry Measure Table, Wine Measure Table, Avoirdupois Wight Table, Ale Measure Table.

42 J. Wallis (1804); J. Wallis (1805, pp. 5–8).

when they arrived there, but if the description had already been read, it had to be repeated from memory.[43]

Far from being improvised, these elements reflected many of the most widespread theories of the time on the education of the young. The fact that the descriptions and explanations in the booklet had to be read aloud corresponded to the very common practice of reading aloud in families, which was an essential part of domestic education.[44] The central role given to the memorisation of concepts, dates, and facts was reflected in the requirement to correctly repeat what had previously been read.[45] The frequent references to virtues and good behaviour, with no specific mention of religious beliefs, followed the model proposed by Maria and Richard Lovell Edgeworth in their extremely influential *Practical Education*.[46] It was the same book which, building on Locke's and Comenius's theories, recommended that children experiment directly with objects and instruments; this element recurs in Wallises' games on several occasions, as discussed in more detail below. Finally, board games were explicitly aimed at both boys and girls, thus implementing a general tendency (which would later disappear) to popularise science for the two sexes. The Wallises were undoubtedly very skilled at designing wonderful, useful, and desirable educational board games. This may have been due to their considerable ability to predict the needs and demands of the public. Contacts and collaborations also helped: working with the Abbé Paris and Mrs. Bryan, both teachers, likely taught Wallis about the fundamental characteristics that a didactic tool should have in order to be considered as such.[47] Board games could embody many of these characteristics thanks to their "dual nature," which is rarely found in other learning aids of the time. On the one hand, they had an interactive, hands-on aspect provided by the board, the markers, and the teetotum—one shared with toys, as well as scientific instruments. On the other hand, the booklet of instructions also gave them a textual aspect, which they shared with popular books and textbooks.

That said, some questions arise as to the actual use and circulation of these games. One may wonder if they were actually purchased and played for educational purposes, and how children, parents, governesses, or tutors effectively engaged with them. Unfortunately, the evidence is scarce, but the few pieces available are quite telling.

The first comes from a small manuscript volume entitled *Demonstrations*. The author, Lady Brooke-Pechell (1759–1841), had copied the cards (both illustrations and explanations) of Paris's astronomical and geographical deck. This indicates that the cards were indeed used domestically, whether for self-education or instructing chil-

43 E. Wallis (ca. 1830, p. 1).

44 See, for example, Grenby (2016, p. 188).

45 As recalled by, among others, Gribling (2020, p. 195).

46 Edgeworth & Edgeworth (1798). See Plumb (1975, p. 80); Klemann (2011); Reid-Walsh (2017, esp. pp. 107–111).

47 John Wallis also worked with Elizabeth Newbery, John Newbery's niece: see Shefrin (2004). The Newberys were famous publishers specialising in educational and popular books for young people.

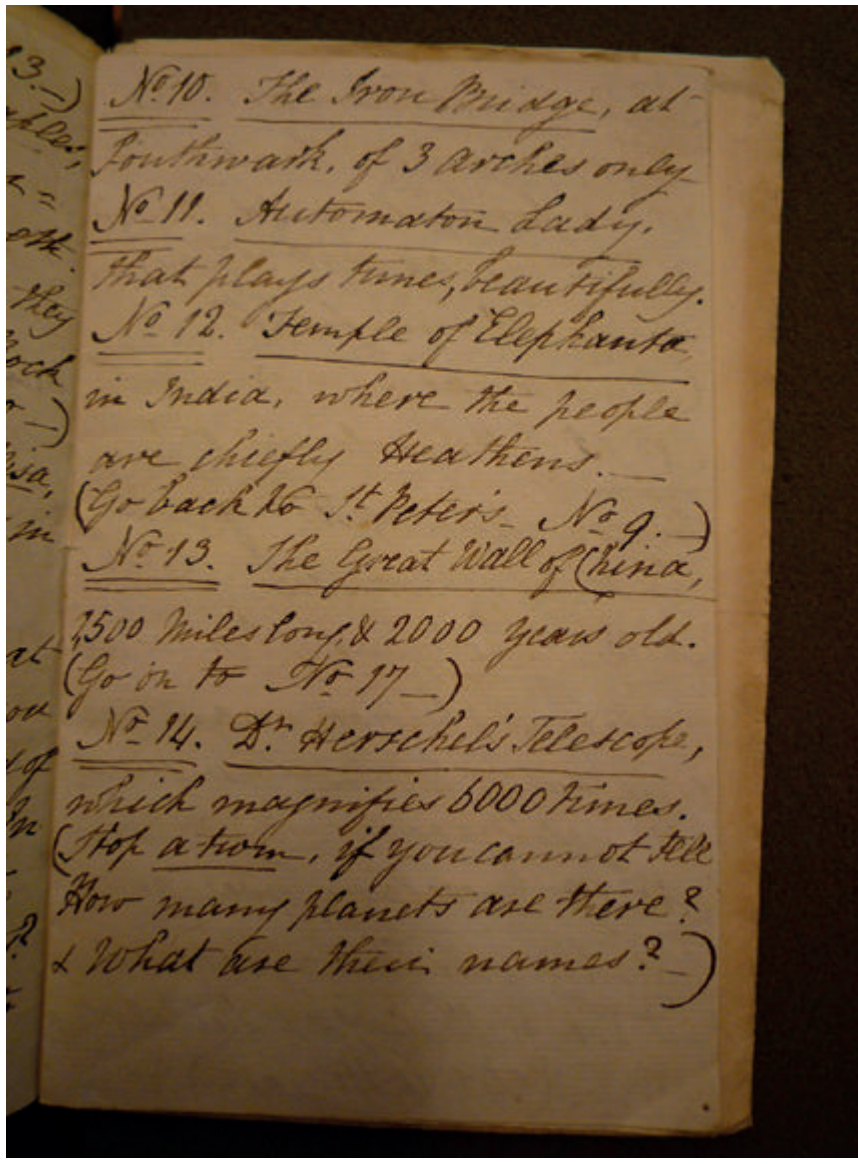

Figure 2. Handwritten instructions by an unknown purchaser, added to the booklet of *Wallis's Elegant and Instructive Game Exhibiting the Wonders of Art, in Each Quarter of the World* by J. Wallis (1820), Ciompi & Seville Collection (http://www.giochidelloca.it/scheda.php?id=2214).

dren; the latter may be the case as Brooke-Pechell had two children of school age.[48] Further manuscript records can be found on a copy of the *Elegant and Instructive Game exhibiting the Wonders of Art in Each Quarter of the World*, published by Edward Wallis around 1820. The copy, now part of the Seville & Ciompi Collection, bears a short inscription revealing that the board game was a gift from a father to his child. Other handwritten pages at the end of the booklet of instructions show that someone revised the original explanations and questions, replacing them with shorter and simpler ones.[49] For instance, at case 14, displaying Herschel's telescope, players were originally asked to answer a list of five questions:

1. What is meant by Astronomy?
2. What is the sun?
3. What are the planets?
4. How many planets are there, and what are their names?
5. Which of planets have moons, and how many has each?[50]

The handwritten version, however, only requires the number and the name of the planets (Figure 2), indicating not only that the game had circulated in a domestic context, but also that it had actually been used as an educational tool—otherwise we could not explain why someone felt the need to rewrite the questions and explanations. The original text was probably perceived as overly dense or advanced, and was modified to speed up the game and make learning easier.

Such evidence is valuable, but limited for drawing definitive conclusions. But it is at least a good starting point for imagining that these games were indeed used in the domestic environment by families to learn about science and virtues through play. In the next section, I argue that the Wallises were targeting middle-class children.

Learning Science and Virtues: Rewards for Middle-Class Children

Like many others (though not all), the Wallises' science-themed board games were quite an expensive product.[51] It is therefore not surprising that they were often given as precious Christmas gifts by parents, as evidenced, for example, by the inscriptions dated 1820 found on a copy of *An Arithmetical Pastime*.[52] Their price, usually

48 The two children were Rear-Admiral Sir Samuel Brooke-Pechell (1785–1849) and Vice-Admiral Sir George Brooke-Pechell (1789–1860). As the deck was published in 1795, it is likely that Lady Brooke-Pechell used it for their home education.

49 The copy is available on the Seville & Ciompi Collection website (http://www.giochidelloca.it/scheda.php?id=2214).

50 E. Wallis (1818, p. 10).

51 As Seville (2008b, p. 2001) puts it: "Although the game was regarded as a suitable diversion for a Dauphin of France, the game had also a popular following and was regularly played for gambling stakes by men in taverns." For the French market, see Girard & Quétel (1982, pp. 15–17).

52 "William Harrington the gift of his Father and Mother for Christmas Day 1820." The inscription is on the sample preserved in Box 1, Special Collection 27412 Board Games, Cotsen Children's Library (Princeton University Library), Princeton, NJ. We also know that, for instance, the game *Pleasures of Natural Philosophy* was printed on the December 17, 1805, as written on the board, indicating that Wallis aimed to profit by selling these items

8–10 shillings, was not easily affordable, and likely classifies them as an item for the middle classes. Indeed, in addition to the cost, there are several aspects pointing to middle-class families as Wallis's main customers.[53]

O'Malley points out, for instance, that middle-class education essentially taught children how to succeed in adult life. Parents wanted their sons and daughters to understand that hard work and dedication would bring concrete results.[54] Similarly, one of the messages—if not *the* message—conveyed by the Wallises' board games was that knowledge could overcome chance. It was knowledge that determined the winner; indeed, the game depended largely on the players' commitment and ability to learn. Conversely, it was very clear that laziness was to be condemned. In *The Pleasures of Astronomy*, square 20 represented an "Idle Boy," intent on blowing bubbles and completely unaware of the principles that made them possible. As the verses said:

> This silly Youth, with ignorant surprize,
> sees the gay bubbles in the sun beams rise;
> abut surely better were employed his care,
> to comprehend th'elastic power of the air.[55]

Rather, children who played were expected to be "industrious, obedient, constantly respectful … never too spoilt, occasionally indulged as a reward for virtue."[56]

Scientific subjects lent themselves very well to the purpose, which may help explain why John and Edward Wallis published so many science-themed board games. The emphasis on useful inventions, for instance, showed how knowledge could have tangible consequences in everyday life: lithography or engraving, steam ships and the mariner's compass, the telegraph and the mail coach, and the gas lamp, as depicted in the *New Game of Genius*, were all good examples (see Figure 4). In addition, the frequent historical digressions helped to develop a special sensitivity for progress in boys and girls. To this end, they portrayed individuals who had made fundamental contributions to the history of a discipline. The first among them was Newton, "our Great Philosopher," the illustrious Englishman who "proved the truth of the Copernican, or Solar system, by his wonderful discoveries and calculations."[57] But other names were mentioned too: Tycho Brahe, Copernicus, and Tolomeus in astronomy; Boyle, Bacon, Descartes, and Franklin in natural philosophy.[58] Historical details on the invention of scientific instruments were also provided: the construction

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during the Christmas period. Finally, as Grenby (2009, p. 194) notes, even books of reading exercises were often given to children as Christmas presents.

53 See also Norcia (2019, Introduction), who talks about geographic board games for middle-class children.

54 O'Malley (2003).

55 J. Wallis (1805, p. 11).

56 Plumb (1975, p. 80).

57 J. Wallis (1805, p. 14); J. Wallis (1804, p. 16).

58 Curiously, no mention was made of Galileo. The only reference to the Italian astronomer appears in the board game *The Pleasures of Natural Philosophy*, with the anecdote "Galileo and the Gardener of Florence": J. Wallis (1805, p. 10). However, the anecdote concerns air pressure; Galileo's astronomical discoveries were not mentioned.

of the first telescope was attributed to the Dutch Zacharias Janssen (1580–1638), while the Dutch Cornelis Drebbel (1572–1633) was said to have created the first microscope in 1621.[59] Finally, remarkable discoveries were recalled, like William Herschel's (unknowing) detection of Uranus in 1781. Noteworthy experiments or events were also described extensively, such as the first flight of a hot-air balloon, performed "before the late King of France, at Versailles" with a sheep, a rooster, and a duck on board, or Benjamin Franklin's famous experiment regarding "electric fluid" conducted using a paper kite.[60] In illustrating the air-pump, an *excursus* explained that the very first turning point was the work of Otto von Guericke and his "curious experiments" in 1654.[61]

A further point, as Keene and Secord, among others, have shown, is that it was commonly believed that the study of science could elevate the spirit and promote good conduct.[62] This aspect is fully reflected by *The New Game of Human Life*, which was translated from French: although it was not a science-themed game in the strict sense, some men of science were depicted along the game path. While in the original edition the victory space, named "The Immortal Man," portrayed the philosopher Voltaire, in John Wallis' edition, Newton was represented instead. In this way, a relationship between immortality and scientific knowledge was tacitly established: science, and in particular Newtonian mechanics and mathematical physics, gave access to an eternal memory. Celestial mathematics, applied to the study of the Cosmos, consigned the soul to eternity; a life dedicated to science was therefore desirable. But Newton also represented the value of a moral life: only when natural philosophy was combined with morality could immortality be effectively guaranteed.[63] Thus, it was not only knowledge that was rewarded in the Wallises' board games, but also virtue.[64] This is especially true for their very first board games.

In *An Arithmetical Pastime*, some moves depended on the players' behaviour in their everyday lives. Space number 9, for example, asked the children if they had already done their "business": if the answer was yes, they could take a piece of plum-cake and spin again; if not, they had to stop for a turn.[65] Similarly, space 26 said: "The lark rises early to sip the sweet dew, /Lay your band on your heart—do you rise early too? / If you do, take a dozen, I love to reward." Space 81 outlined the importance of truth, that had to "pervade" every word, "clear as the sun:" "if from the truth you've erred to-day" the player who answered "yes" had to stop for three

59 E. Wallis (ca. 1848, pp. 3, 8).
60 J. Wallis (1804, p. 4); J. Wallis (1805, pp. 7, 8).
61 J. Wallis (1805, p. 11).
62 Keene (2011, pp. 539–540); Secord (2011).
63 Secord (2011, p. 35). See also Shapin's (2003, pp. 162–167) definitions of the "Godly Naturalist" and the "Moral Philosopher." On Newton's immortality, see the fundamental work by Fara (2002).
64 As suggested by Locke, virtues were to be rewarded. See O'Malley (2003, p. 14).
65 "Was all your business done to day, / In time, and well, not spoilt by play? / Then take your plumb-cake and a spin; / If not, stop here a turn and grin." *An Artihmetical Pastime* (1798, square 9).

turns.[66] In this way, the predetermined path of the Game of the Goose opened up alternative routes that depended on the players' willingness to be honest about their behaviour: in front of the friends, siblings, or even parents, they had to confess that they had not told the truth or done their business. The last space, numbered 100, instructed the player how to behave in case of a win: crowned with "the laurel of victory," they were not to be "insulting" or to "triumph with spite." They also had to remember that they might lose the next game. The board game thus aimed to produce concrete and immediate effects on the players' conduct, influencing their reactions before a possible victory. Thanks to these expedients, the rewards usually promised by games became innocuous; the only real reward was knowledge itself, along with moral improvement.[67]

Interestingly, the moral virtues for children introduced in early scientific board games were later replaced by moral judgements about the consequences of scientific and technological progress. Indeed, in the *New Game of Genius*, the instructions to roll the dice again, move backwards, or miss a turn were linked to the "morality" of an invention; for instance, if you landed on the artillery space, "terrible engines of war," you had to start the game over.[68] Likewise, if you landed on the gunpowder space, you lost the game and you could only spend your time "in lamenting the waste of human life occasioned by this composition"; conversely, the space dedicated to lifeboats, which had saved "thousands of valuable lives," allowed the player to roll the dice again.[69]

This shift was part of a wider series of differences between the science-themed board games of John Wallis in the late Georgian period and those by Edward Wallis in the early Victorian age. The change in visual and textual content is symptomatic of a change in the way science was narrated and taught outside of learned circles. That is, it was this transition from a familiar, domestic science, as represented by the practice of conducting small experiments at home, to popular science that would eventually find some of its greatest expressions in the 1851 Great Exhibition in London.

John Wallis and Domestic Experiments

The science-themed board games published by John Wallis between 1795, the date of the *Astronomical and Geographical Cards*, and 1813, the year in which *The Naturalist* appeared, wonderfully reflect the way scientific knowledge circulated and was enjoyed by the London middle class and, more generally, those outside learned circles. In particular, what they seem to narrate and depict is a "domestic science," which was indeed deeply characteristic of the late Georgian period.

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66 "When the sun shines, the dial's shade / Shews the true time, nor ever lies. / Let truth your every word pervade, / Clear as the sun, and you'll be wise. / If from the truth you've err'd to day, / Stop thrice—if not, you need not stay." *An Artihmetical Pastime* (1798, square 81).

67 O'Malley (2003, p. 30).

68 E. Wallis (ca. 1830, p. 7).

69 E. Wallis (ca. 1830, pp. 9, 10).

As has been widely demonstrated, the domestic environment played a fundamental role in the circulation, the realisation, and even the teaching of scientific knowledge.[70] This was not only because children (especially girls) were often educated at home, but also because scientific instruments (such as thermometers, barometers, and celestial or terrestrial globes) were common in many homes and people were accustomed to electrical experiments and optical spectacles. One of the most significant examples are the "itinerant lectures" that spread in England thanks to prominent figures like Martin Benjamin and James Ferguson. These lectures were frequently held in the private residences of gentlemen, as the paintings of Joseph Wright of Derby (1734–1797) attest.[71] Additionally, there was a long tradition of mathematical and physical recreations, which found their ideal place in the home: riddles with numbers, experiments with water or light, and instructions for homemade clocks and camera obscuras made sense when proposed in the context of a domestic leisure.[72] It is no coincidence, then, that many popularisers of science in the first half of the 19th century set their books in a domestic environment.

Therefore, John Wallis was implementing a very common feature in the field of science dissemination and education, and this feature involved and affected his games in several respects.

First, it was relevant to the choices of subject-matter and the ways they were represented, which had to be suitable for families. When played in domestic contexts, educational board games were expected to give a certain well-defined image of science. Scientific content had to be curious but harmless, engaging but not disturbing, as well as virtuous and inspiring. Indeed, it was the "acceptable face" of science, as Secord calls it, or "safe science," if we follow Topham, that had to be conveyed.[73] This is clearly visible in the *Pleasures of Natural Philosophy* (see Figure 3). Square 22 showed the air-pump and its functioning and uses, but nothing was said about how it had been employed in the famous and popular experiments on animals.[74] On the contrary, it was stated that the most frequent experiment was that involving a feather and a guinea (coin), which were shown to fall at the same speed in a void. After all, love and respect for animals were repeatedly emphasised in the Wallises' board games.[75]

Second, the material elements of the home itself were repeatedly called into play, as the domestic environment and its objects were actively and physically involved in the course of the game. This was particularly true for the squares that represented scientific instruments and optical devices. Telescopes, microscopes, and mechanical

70 See, among others, Elliott (2010, Ch. 1); Secord (2011). For a broader perspective on domesticity and the history of science, see Opitz, Bergwik, & Van Tiggelen (2016).

71 They were also held in the lecturer's home. See Millburn (1983).

72 Heeffer (2006).

73 Secord (2011); Topham (1992).

74 Wright of Derby's work, showing two girls crying while watching an experiment with the air pump and a bird, is again deeply significant in this regard. See Johnson (2016).

75 As in *The Naturalist: A New Game, Moral and Instructive* (1813), but also in *An Arithmetical Pastime: Intended to Infuse the Rudiments of Arithmetic, Under the Idea of Amusement* (1798).

Figure 3. Game board of *Science in Sport or the Pleasures of Natural Philosophy*, by J. Wallis (1805), Ciompi & Seville Collection (http://www.giochidelloca.it/scheda.php?id=1260).

orreries were often found in middle-class homes, as portable versions were a popular purchase.[76] Thermometers and barometers, as Elliott points out, were also widely available, thanks to a growing interest in meteorology.[77] Magic lanterns and portable camera obscuras, for their part, were highly valued and popular devices and were central to many spectacles held in the salons.[78] Thus, objects described in the board games' booklets of instructions were often familiar to children, who might be able to operate them with the help of an adult. Conversely, board games showed middle-class families which scientific tools they should possess to be respectable and how they should use them, in the wake of the close relationship between science and polite society. Not only were scientific board games a rational pastime (or "philosophical toy"), but they also illustrated what could be considered as such.

Finally, game squares frequently displayed typical domestic experiments, or even invited players to carry them out. This is what Keene has termed "familiar science," referring to the fact that it generally required the use of common and readily available

76 Such as those constructed and sold by Benjamin Martin. See Millburn (1976).
77 Elliott (2010, pp. 33–36).
78 Stafford & Terpak (2002, pp. 184–190, 309–313).

objects, which were well known to children and parents.[79] Keene has examined some examples from *The Pleasures of Astronomy*. Other examples can be found in *The Pleasures of Natural Philosophy*. For instance, when landing on space 27, players learned that electricity was "that property of some substances, as Amber, Glass, Sealing wax, &c, whereby they attract, or repel, all kinds of light bodies." Then they were told to "stay one turn and make the experiment." There was no mention of spectacular electrical experiments; on the contrary, the instructions outlined a very simple experiment within everyone's reach:

> Rub a piece of sealing wax on woollen cloth, and hold it near a small feather, or a piece of thin paper, and you will perceive the feather, or paper, attracted by the wax, which attraction is one instance of the nature of Electricity.[80]

The same can be said of square 26, which explained that the colours produced by a prism could easily be seen "in the rainbow and on the surfaces of bladders of water and soap."[81] Similarly, square 21 outlined the principles that made it possible to "descend beneath the water" in a diving bell by describing an experiment with a drinking glass:

> If you invert a glass rummer which is quite dry, in a bowl of water, and press it down as steadily as possible, you will find that the inside of the rummer will not be wet, because the pressure of the Air within, keeps the water from making it rise.[82]

The fact that children were encouraged while playing to use familiar objects to personally test the scientific notions they were to acquire added an important element of materiality to the learning process. Observing, touching, and manipulating were considered essential for a good and solid education, as demonstrated by all the interactive items—dissected maps and globes, flap-books, and so on—that could be found on the market.[83] The search for interactivity led to the creation of board games that went beyond the board itself and involved the entire home environment. Players were not only expected to move the pyramids from one square to another or to handle the teetotum; they and their senses were fully involved in the game and learning activity. This immersion is also evident in the instructions, which asked the boys and girls to "meditate upon" a certain theme or to learn the meaning of words or expressions not explained in the booklet.[84] The games spread into the surrounding space, producing tangible effects and transcending the material boundaries of the game. In this way, these games not only found their proper space in the home, but also their ideal extension.

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79 This is one of the characteristics of familiar science as defined by Keene (2011; 2014): a science taught about everyday life and objects and experienced through materials within everyone's reach.

80 J. Wallis (1805, p. 15).

81 J. Wallis (1805, p. 14).

82 J. Wallis (1805, p. 12). See Klemann (2011, pp. 226–229).

83 Reid-Walsh (2017); Klemann (2011); Shefrin (2009); Taylor (2009); Heesen (2002); Shefrin (1999b).

84 "Stay here one turn to meditate upon this subject"; "Stay one turn to learn what is the meaning of SPECIFIC GRAVITY": J. Wallis (1804, pp. 10, 4).

Edward Wallis and Popular Science

When Edward Wallis took over from his father in 1818, he republished many of the items from John's catalogue: some were updated, others simply reprinted without significant variations. However, this only accounts for the first years of his activity, as he increasingly released more original items as the early Victorian period went on. Edward's scientific board games not only incorporated the latest inventions and discoveries, but also reflected new ways of communicating and disseminating scientific knowledge. The domestic setting was replaced by the city of London, its sites and buildings, while the chosen themes embodied science in its relationship with economic and technological progress. This shift was evident in both the text of the instruction booklets and the visual content of the spaces.

The first board game of this kind was *Amusement in the Zoological Gardens*, issued by Edward in 1828.[85] The London Zoological Gardens were founded in 1828 by the Zoological Society of London, providing the occasion for Edward to publish a book, *A Stroll in the Gardens of the London Zoological Society*, and a puzzle.[86] Located in Regent's Park, the Gardens were opened to the public in 1847; until then, only members of the Society, their relatives, or guests could visit. The game gave children the opportunity to take a virtual tour and introduced many of the activities they would do if they were there. Accurate and vivid descriptions immersed the players in the park and led them to discover animals in cages: "This pleasing and picturesque building salutes the visitor on his entrance with a strong, peculiar, and unpleasant odour, proceeding from a Chinese Civet Cat opposite the right hand entrance."[87] Some squares required players to stay for one turn and feed the animals in the lake or stop at the Menagerie to greet the monkeys.[88] In addition, the winner was "invited to visit the interesting collection of preserved animals at the Museum in Bruton Street."[89] It is clear that home and familiar science were no longer the focus of the game; rather, children and families were encouraged to learn about animals and their habits through a recently established institution.

A similar pattern can be identified in two other board games: the *New Game of Genius*, published in the 1830s, and the *Circle of Knowledge*, published in 1848 by John Passmore, after he acquired Wallis's stock. The *New Game of Genius*, as the title suggests, celebrated scientific and technological progress and emphasised inventions that had a tangible impact on British life and the economy. The booklet's explanations praised the importance of new ideas and creativity and the development of useful machines, in all fields of endeavour from printing to transport, commerce to communication. The final square, placed in the centre of the board, depicted

85 There is no date on the board game. However, we do know that the book was published in 1829 and printed by Samuel Bentley, together with Robert Bentley. Since we know that the two stopped working together in 1829, the game must have been published in 1828.

86 Such repackaging was common. See Shefrin (2009, p. 96).

87 E. Wallis (1828, p. 4).

88 E. Wallis (1828, p. 6). "Go back to No. 5 and visit your brethren in confinement" (p. 9).

89 E. Wallis (1828, p. 11).

"the most striking inventions of modern genius." These included "a manufactory worked by steam," "a steam-vessel" following "its rapid course," and a train "of those wonderful locomotive engines" passing over a "chain-bridge," capable of transporting "the most enormous burdens at the almost incredible speed of thirty miles per hour" (see Figure 4).[90]

No longer were children asked to experiment with electricity or pressure in the safe environment of their homes. The focus was now on useful knowledge and practical science, and children were invited to reflect on the positive (or negative) consequences of innovations in the context of their country's history. The proliferation of public schools certainly reduced the role of home education. At the same time, London became populated with new forms of entertainment and educational spectacle, which gradually replaced the domestic dimension with that of popular science.[91] The private experiences offered by microscopes or telescopes were increasingly overshadowed, if not supplanted, by the collective experiences made possible by panoramas and cycloramas, as well as by exhibitions at the Adelaide Gallery (1832) or the Royal Polytechnic Institution (1838).[92] Science strengthened its social and public side, as evidenced by the creation of various institutions that promoted the dissemination of scientific knowledge.[93]

All these elements emerge clearly from the visual narrative of the *New Game of Genius*, especially when compared with John Wallis's games. The most paradigmatic example comes from the representation of the orrery. In the *Pleasures of Natural Philosophy*, a mechanical orrery was depicted on square 12: it stood alone at the centre of the picture, with nothing around it (see Figure. 3). In a sense, it was abstracted from its concrete use and illustrated as if it were a geometric figure. In the *New Game of Genius*, everything is different. The orrery depicted is vertical: it was basically a projection obtained thanks to the mechanism of the magic lantern.[94] This device, once used in the home, had now moved into the theatre to show the movement of the planets in front of a large audience, as illustrated in the square.[95]

Even experiences that had always been performed in public, such as the flight if hot-air balloons, were not depicted in the same way in John's and Edward's board games. In the *Pleasures of Astronomy*, the hot-air balloon was pictured in the sky with a level of abstraction similar to that used for the orrery. In the *New Game of Genius*, in contrast, the hot-air balloon was admired by a crowd (square 17).[96] Domestic scenes also were populated: images of the magic lantern, the camera obscura, and the

90 E. Wallis (ca. 1830).

91 Much has been said about the term "popular science," and a lively debate had developed among scholars; for an overview, see Topham (2009). It is nevertheless agreed that the term was first used in the 1830s: Lightman (2007, p. 11).

92 Fyfe & Lightman (2007).

93 For instance, in 1826 the Society for the Diffusion of Useful Knowledge was founded; in 1831 it was the turn of the British Association for the Advancement of Science.

94 For the mechanism behind vertical (or transparent) orreries, see Golinski (2017).

95 E. Wallis (ca. 1830, Square 3).

96 Hot-air balloons are known to have been protagonists of events attended by large crowds, as shown in the English context by Keen (2006); but see also Lynn (2006, pp. 123–147). Orreries were also often used for public

Figure 4. Game board of *The New Game of Genius*, by Wallis (ca. 1830), Liman Collection of Board Games & Puzzles, John Hay Library, Brown University, Providence, RI (https://library.brown.edu/create/limangames/walliss-new-game-of-genius-or-compendium-of-inventions/).

kaleidoscope (invented in 1816 by David Brewster) all contained groups of three or more people.

In this way, children learnt about the scientific enterprise as something that was first developed, and then enjoyed, collectively. At the same time, they could familiarise themselves, through a virtual and controlled path game, with the latest inventions, innovative forms of entertainment, and specific locations in London. If the visual parts of the board games offered realistic representations, the textual parts provided players with a theoretical framework to ensure a proper understanding of the concepts. Children had to be aware of the importance of scientific and technological progress and at the same time be virtuous, which also entailed being able to judge the morality of a given invention with sufficient detachment.

The last game to be considered, the *Circle of Knowledge*, did not focus as much on the morality of progress. Or rather, progress and knowledge were described as "moral" in themselves, while immorality was attributed to ignorance and superstition. Such a perspective finds its fulfilment in the description of the magic lantern. The space devoted to optics illustrated how a "combination of magnifying glasses" produced an image "of an immense size" on a wall. It was then pointed out that, if "in ancient times they were used to deceiving the ignorant … science had abolished

its superstitious use." In light of this change, it was argued that they should be called "optical lanterns," since the term magic was "founded wholly in untruth."[97] In a celebratory historical narrative, it was claimed that science had finally defeated superstition and magic, so that even what was not scientific could now be explained scientifically.

Conclusions

At a time when a flourishing market was largely based on goods for children and their families, educational card and board games were the right objects in the right place at the right time. Indeed, Wallises' science-themed games became very popular with the public and helped to spread interest in science and its teaching. They were "philosophical toys," as they were called, a valuable educational and amusing aid. In this sense, they seem to have inherited the tradition of mathematical and physical recreations, which had been so successful between the 17th and 18th centuries, in offering rational pastimes, that is, a respectable way of spending leisure time in a domestic environment.[98] But besides being philosophical toys in themselves, they also showed children and their families what—and where—philosophical toys were. Squares depicting magic lanterns, kaleidoscopes, and camera obscuras suggested to them how to spend their leisure time safely at home; the Zoological Gardens, Greenwich Observatory, and vertical orreries in theatres suggested where to go in London.

On the other hand, these games emerged in the wake of the commercial success of books for the popularisation and education of science, not to mention the wide circulation of scientific instruments and optical devices. They were, in fact, at the crossroads of books and instruments. They were visual and concrete objects that, like scientific instruments, required an interactive realisation based not only on manipulation, as was the case with some innovative books of the time, but also on continuous trespassing beyond the board, into the domestic space and beyond. Unlike scientific instruments, board games were not only a valuable eye (just as a telescope is an eye for the cosmos) for discovering science and its images through play. They were also, like books, capable of conveying moral content. In this dimension, straddling two different pedagogical tools, science-themed board games were able to capture the attention of young players, thanks to their beautifully engraved squares; to entertain their minds, thanks to the challenge of the game; to physically involve boys and girls, thanks to the teetotum, the markers, the materiality of the boards or cards,

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lectures, as illustrated by Wright of Derby. The orrery depicted in Wallis's board game is by all accounts Walker's Eidouranion, a large transparent orrery that allowed for theatrical performances: Golinski (2017).

97 E. Wallis (ca. 1848, p. 13)

98 For example, the experience of the camera obscura has been widely transmitted through the tradition of rational recreations since the first decades of the 17th century (Heeffer, 2006, p. 32) and has been quite common in cabinets of experimental philosophy since the early modern period (Bennett & Talas, 2013, pp. 54, 180).

and sometimes the experiences to be reproduced; and finally to teach, thanks to the instructions and the rich digressions provided.

They were, so to speak, kaleidoscopic devices. They reflected scientific images in their composite boards, just as mirrors in a kaleidoscope reflect colourful and symmetrical patterns. At the same time, they looked at the world around them, be it the house or, later, the city of London—in this respect, they were similar to a teleidoscope. This variant of the kaleidoscope, as described by Brewster, had a lens and an open view, so that it could be applied to any external object (at any distance) and form kaleidoscopic images of it. Similarly, children could play with these board games as simple toys, or they could use them to look beyond. At the same time, board games guided their gaze, like the kaleidoscope tube; in this way, science was safe and fun to learn.

Taken together, the Wallises' science-themed board games tell us a lot about the development of the circulation of scientific knowledge in Georgian and early Victorian London. As I have shown, there was a gradual shift from the domestic science of the early games to the popular science of the later ones. This shift closely reflected the changes in science education and popularisation, as well as in science itself. At the end of the 18th century, scientific developments found their ideal place in homes, salons, and scientific societies. By the mid-19th century, however, this was no longer enough: British science became a matter of Empire; the word scientist was coined by William Whewell in 1834 and scientific progress was now a collective enterprise to be celebrated collectively.[99] The overview of inventions and discoveries presented in the *New Game of Genius* and the *Circle of Knowledge* was very similar to the display of scientific and technological knowledge that would characterise the Great Exhibition of 1851. By that time, the Wallises' shop no longer existed. It was another publisher, William Spooner, who devoted two board games in his catalogue to the Crystal Palace. However, his *Illustrative Game* and his satirical *Comic Game* had nothing to do with the educational board games by John and Edward Wallis.

But that is another story.

Vie de l ´Abbé Carron par un Bénédictin de la Congrégation de France. (1866). Paris, France: Douniol.

Acknowledgements

I want to thank Luigi Ciompi and professor Adrian Seville for sharing their beautiful collection of board games (www.giochidelloca.it) and for sending me the images I needed.

Funding Statement

This research was funded by the post-doc programme Laboratoire d'excellence HASTEC (EPHE-PSL), ANR-10-LABX-85 - Institut d'histoire moderne et

99 For the British Empire as represented in board games, see Norcia (2019).

contemporaine (UMR 8066) / Université Paris 1 Panthéon - Sorbonne. https://labexhastec.ephe.psl.eu/.

References

Alexander, I., & Martinez, C. S. (2020). A game map: Object of copyright and form of authority in eighteenth-century Britain. *Imago Mundi: The International Journal for the History of Cartography, 72*(2), 163–180. https://doi.org/10.1080/03085694.2020.1748375

An arithmetical pastime: Intended to infuse the rudiments of arithmetic, under the idea of amusement [Board game]. (1798). London, UK: J. Wallis.

Bennett, J., & Talas, S. (Eds.). (2013). *Cabinets of experimental philosophy in eighteenth-century Europe*. Leiden, The Netherlands: Brill.

Bryant Davies, R., & Gribling, B. (2020). Introduction. In R. Bryant Davies & B. Gribling (Eds.), *Pasts at play: Childhood encounters with history in British culture, 1750–1914* (pp. 1–22). Manchester, UK: Manchester University Press.

Choi, T. Y. (2021). *Victorian contingencies: Experiments in literature, science, and play*. Stanford, CA: Stanford University Press.

Cohen, M. (2016). "Familiar conversation": The role of the "familiar format" in education in eighteenth- and nineteenth-century England. In M. Hilton & J. Shefrin (Eds.), *Educating the child in Enlightenment Britain* (pp. 99–116). Abingdon, UK: Routledge.

De Lucca, D. (2012). *Jesuits and fortifications*. Leiden, The Netherlands: Brill.

Denisoff, D. (Ed.). (2016). *The nineteenth-century child and consumer culture* (2nd ed.). London, UK: Routledge.

Dove, J. (2016). Geographical board game: Promoting tourism and travel in Georgian England and Wales. *Journal of Tourism History, 8*(1), 1–18.

Edgeworth, M., & Edgeworth, R. L. (1798). *Practical education*. London, UK: J. Johnson.

Elliott, P. A. (2010). *Enlightenment, modernity and science: Geographies of scientific culture and improvement in Georgian England.* London, UK: I. B. Tauris.

Fara, P. (2002). *Newton: The making of genius*. New York, NY: Columbia University Press.

Ferguson, J. (1768). *The young gentleman and lady's astronomy, familiarly explained in ten dialogues between Neander and Eudosia to which is added the description and use of the globes and the armillary sphere*. Dublin, Ireland: Boulter Grierson.

Fyfe, A., & Lightman, B. (2007). Science in the marketplace: An introduction. In A. Fyfe & B. Lightman, *Science in the marketplace* (pp. 1–17). Chicago, IL: University of Chicago Press.

Girard, A., & Quétel, C. (1982). *L'Histoire de France contée par le jeu de l'oie*. Paris, France: Balland-Massin.

Golinski, J. (2017). Sublime astronomy. *Huntington Library Quarterly, 80*(1), 135–157.

Goodfellow, C. G. (1998). The development of English board game (1770–1850). *Board Game Studies, 1*, 70–80.

Grenby, M. (2016). Delightful instruction? Assessing children's use of educational books in the long eighteenth century. In M. Hilton & J. Shefrin (Eds.), *Educating the child in Enlightenment Britain* (2nd ed., pp. 181–198). Abingdon, UK: Routledge.

Gribling, B. (2020). Playing with the past: Child consumers, pedagogy and British history games, c. 1780–1850. In R. Bryant Davies & B. Gribling (Eds.), *Pasts at play: Childhood encounters with history in British culture, 1750–1914* (pp. 193–220). Manchester, UK: Manchester University Press.

Hannas, L. (1972). *The English jigsaw puzzle, 1760–1890*. London, UK: Wayland Publishers.

Heeffer, A. (2006). *Récréations mathématiques* (1624): A study on its authorship, sources and influence. *Gibecière, 1*(2), 77–167.

Heller, B. (2010). Leisure and the use of domestic space in Georgian London. *The Historical Journal, 53*(3), 623–645. https://doi:10.1017/S0018246X10000221

Heesen, A. te (2002). *The world in a box: The story of an eighteenth-century picture encyclopedia*. Chicago, IL: University of Chicago Press.

Jacobs, R. (2012). *Playing, learning, flirting: Printed board games from 18th-century France. Catalogue exhibition of French 18th-century board games, 28 March–28 October 2012*. Waddesdon, UK: Rothschild Collection.

Johnson, L. (2016). Animal experimentation in 18th-century art. Joseph Wright of Derby: An experiment on a bird in an air pump. *Journal of Animal Ethics, 6*(2), 164–176.

Keen, P. (2006). The "Balloonmania": Science and Spectacle in 1780s England. *Eighteenth-Century Studies, 39*(4), 507–535.

Keene, M. (2011). Playing among the stars: Science in sport, or the *Pleasures of Astronomy* (1804). *History of Education, 40*(4), 521–542. https://doi.org/10.1080/0046760X.2011.562870

Keene, M. (2014). Familiar science in nineteenth-century Britain. *History of Science, 52*(1), 53–71. https://doi.org/10.1177/007327531405200103

Klemann, H. (2011). The matter of moral education: Locke, Newbery, and the didactic book-toy hybrid. *Eighteenth-Century Studies, 44*(2), 223–244.

Lightman, B. (2007). *Victorian popularizers of science: Designing nature for new audiences*. Chicago, IL: University of Chicago Press.

Lynn, M. R. (2006). *Popular science and public opinion in eighteenth-century France*. Manchester, UK: Manchester University Press.

Michals, T. (2016). Experiments before breakfast: Toys, education and middle-class childhood. In D. Denisoff (Ed.), *The nineteenth-century child and consumer culture* (2nd ed., pp. 29–42). London, UK: Routledge.

Millburn, J. R. (1976). *Benjamin Martin: Author, instrument-maker, and "country showman."* Leyden, The Netherlands: Noordhoff International Publishing.

Millburn, J. R. (1983). The London evening courses of Benjamin Martin and James Ferguson, eighteenth-century lecturers on experimental philosophy. *Annals of Science, 40*(5), 437–455. https://doi.org/10.1080/00033798300200321

Mogg, E. (1813). *An explanation and description of Mogg's celestial sphere*. London, UK: E. Mogg.

Newbery, J. (1744). *Little pretty pocket book*. London, UK: J. Newbery.

Norcia, M. A. (2019). *Gaming empire in children's British Board Games, 1836–1860*. New York, UK: Routledge.

Norgate, M. (2007). Cutting borders: Dissected maps and the origins of the jigsaw puzzle. *The Cartographic Journal, 44*(4), 342–350. https://doi.org/10.1179/000870407X241908

O'Malley, A. (2003). *The making of the modern child: Children's literature in the late eighteenth century*. New York, NY: Routledge. https://doi.org/10.4324/9780203504314

Opitz, D. L., Bergwik, S., Van Tiggelen, B. (Eds.). (2016). *Domesticity in the making of modern science*. Basingstoke, UK: Palgrave MacMillan.

Paris, Abbé. (1795). *The elements of astronomy and geography* [Card game]. London, UK: J. Wallis.

Paris, Abbé. (1807). *Jeu d'astronomie et de géographie avec notice explicative* [Card game]. Falaise, France: Brée frères.

"Paris, Louis-Michel." (1836). In A. Rabbe, C. A. Vieilh De Boisjolin, & C. C. Sainte Preuve (Eds.), *Supplément de la Biographie universelle et portative des contemporains* (p. 537). Paris, France: Levault.

Parlett, D. (2018). *History of board games* (2nd ed.). Brattleboro, VT: Echo Point Books.

Peters, E. A. (2017). Observation, experiment or autonomy in the domestic sphere? Women's familiar science writing in Britain, 1790–1830. *Notes and Records, 71*, 71–90. https://doi.org/10.1098/rsnr.2016.0018

Plumb, J. H. (1975). The new world of children in eighteenth-century England. *Past & Present, 67*, 64–95.

Reid-Walsh, J. (2017). *Interactive books: Playful media before pop-ups*. London, UK: Taylor & Francis.

Rovee, C. (2015, March). The new game of human life, 1790. *BRANCH: Britain, Representation and Nineteenth-Century History*. Retrieved from https://branchcollective.org/?ps_articles=christopher-rovee-the-new-game-of-human-life-1790

Saridakis, V. (2012). For "the present and future happiness of my dear pupils": The astronomical and educational legacy of Margaret Bryan. *Culture and Cosmos, 1*(1–2), 241–253.

Secord, J. A. (2011). Newton in the nursery: Tom Telescope and the philosophy of tops and balls, 1761–1838. In L. Tailerach-Vielmas (Ed.), *Science in the nursery: The popularisation of science in Britain and France, 1761–1901* (pp. 34–54). Newcastle-upon-Tyne, UK: Cambridge Scholars Publishing.

Seville, A. (2008a). The geographical Jeux de l'Oie of Europe. *BELGEO, 3–4*, 427–444. https://doi.org/10.4000/belgeo.11907

Seville, A. (2008b). The sociable game of goose. *Proceedings of Board Game Studies Colloquium XI*, 1000–1014. Retrieved from http://www.giochidelloca.it/storia/lisbona.pdf

Seville, A. (2016). The game of the sphere or of the universe: A spiral race game from 17th-century France. *Board Game Studies Journal, 10*, 1–16. https://doi.org/10.1515/bgs-2016-0001

Seville, A. (2019). *The cultural legacy of the royal game of the goose: 400 years of printed board games*. Amsterdam, The Netherlands: Amsterdam University Press.

Shapin, S. (2003). The image of the man of science. In R. Porter (Ed.), *The Cambridge history of science* (pp. 159–183). Cambridge, UK: Cambridge University Press. https://doi.org/10.1017/CHOL9780521572439.008

Shefrin, J. (1999a). "Make it a pleasure and not a task": Educational games for children in Georgian England. *Princeton University Library Chronicle, 60*(2), 251–275. https://doi.org/10.25290/prinunivlibrchro.60.2.0251

Shefrin, J. (1999b). *Neatly dissected for the instruction of young ladies and gentlemen in the knowledge of geography: John Spilsbury and early dissected puzzles*. Los Angeles, CA: Cotsen Occasional Press.

Shefrin, J. (2004). Elizabeth Newbery. In *Oxford Dictionary of National Biography, 40*, 570–571. Oxford, UK: Oxford University Press.

Shefrin, J. (2009). *The Dartons, publishers of educational aids, pastimes & juvenile ephemera, 1787–1876: A bibliographical checklist*. Los Angeles, CA: Cotsen Occasional Press.

Slater, E. (Ed.). (1819). *Sententiæ chronologicæ: Or, a complete system of ancient and modern chronology contained in familiar sentences accompanied by a chronological chart. Intended for the use of schools and private students*. London, UK: E. Wallis.

Spanos, A. (2021). *Games of history: Games and gaming as historical sources*. London, UK: Routledge.

Stafford, B. M., & Terpak, F. (2002). *Devices of wonder: From the world in a box to images on a screen*. Los Angeles, CA: Getty Research Institute.

Talairach-Vielmas, L. (2011). Introduction. In L. Talairach-Vielmas (Ed.), *Science in the nursery: The popularisation of science in Britain and France, 1761–1901* (pp. 1–33). Newcastle-upon-Tyne, UK: Cambridge Scholars Publishing.

Taylor, K. (2009). Mogg's celestial sphere (1813): The construction of polite astronomy. *Studies in History and Philosophy of Science, 40*, 360–371. https://doi.org/10.1016/j.shpsa.2009.10.005

Topham, J. R. (1992). Science and popular education in the 1830s: The role of the Bridgewater Treatises. *British Journal for the History of Science, 25*(4), 397–430.

Topham, J. R. (2007). Publishing "popular science" in early nineteenth-century Britain. In A. Fyfe & B. Lightman, *Science in the marketplace* (pp. 135–163). Chicago, IL: University of Chicago Press.

Topham, J. R. (2009). Introduction. *Isis, 100*(2), 310–318. https://doi.org/10.1086/599551

Turner, G. L'E. (1987). Scientific toys. *British Journal for the History of Science, 20*, 377–398.

Van Damme, S. (1999). Le collège, la cité et les livres: Stratégies éducatives jésuites et culture imprimée à Lyon (1640–1730). *Littératures classiques, 37*, 169–183. https://doi.org/10.3406/licla.1999.1428

Vie de l´Abbé Carron par un Bénédictin de la Congrégation de France. (1866). Paris, France: Douniol.

Wallis, E. (1818). *Wallis's elegant and instructive game exhibiting the wonders of nature in each quarter of the world* [Board game]. London, UK: J. Wallis.

Wallis, E. (1820). *Wallis's elegant and instructive game exhibiting the wonders of art* [Board game]. London, UK: J. Wallis.

Wallis, E. (1828). *Amusement in the Zoological Gardens*. London, UK: E. Wallis.

Wallis, E. [ca. 1830]. *The new Game of Genius* [Board game]. London, UK: E. Wallis.

Wallis, E. [ca. 1848]. *The circle of knowledge* [Board game]. London, UK: J. Passmore.

Wallis, J. (1804). *Science in sport or the pleasures of astronomy* [Board game]. London, UK: J. Wallis.

Wallis, J. (1805). *Science in sport or the pleasures of natural philosophy* [Board game]. London, UK: J. Wallis.

Wallis, J. (1813). *The naturalist: A new game, moral and instructive* [Board game]. London, UK: J. Wallis.

Wallis, J., & Newbery, E. (1797). *The cabinet of knowledge opened and its secrets disclosed: Being a set of questions and answers explanatory of morality, arts, sciences, &c. &c.: For the improvement of youth*. London, UK: J. Wallis and E. Newbery.

Whitehouse, F. R. B. (1951). *Table games of Georgian and Victorian days*. London, UK: Peter Garnett.