

The Scientific Crucible of Île de France: the French Contribution to the Work of Matthew Flinders

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Abstract

At the turn of the nineteenth century European investigations in geography and navigation gave rise to specific questions that contributed to the development of new scientific disciplines such as hydrography, cartography, nautical sciences, and geology. Although the continent was torn by the French wars, knowledge and new theories continued to be shared and debated with some passion in the various cultural centres and circles of Europe.

Applying David Livingstone's view that 'scientific knowledge is made of a lot of different places', and Simon Schaffer's and Bruno Latour's conceptions that in modern history scientific progress arose from transnational networks from all over the world which gather data essential to the European 'centres of calculation' and 'accumulation', this paper concentrates on the nautical and geographical work that the British naval officer Matthew Flinders carried out during the Napoleonic wars while a prisoner on the island of Île de France (Mauritius). In an attempt to put the work Flinders completed on this island in connection with the London and Parisian centres, it examines the cross circulation of knowledge between him, the learned society of the French island, and Europe. It shows that Flinders's work was part of a wider European network of nautical and geographical knowledge that transcended national boundaries and wars without overwriting them, and that overseas territories colonized by Europeans, such as Île de France, were privileged, dynamic and potentially constructive places within this network.

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Introduction

Matthew Flinders is renowned as the British maritime explorer who circumnavigated Australia and charted its coastlines in the wake of other voyages that had visited parts of the South Seas previously unknown to Europe.² His return from his last mission, the *Investigator* voyage, was significantly delayed by his long detention on Mauritius (December 1803 to June 1810) which at that time was a French island named Île de France.³ In the meantime, Europe was ravaged by the Napoleonic wars in which France and Britain were fierce enemies.

On this island Matthew Flinders maintained a tense relationship with the French governor Charles Mathieu Isidore Decaen, but experienced beneficial exchanges with French learned society and its naval officers,⁴ while his captivity provided him with the opportunity to work intensively on the construction of his fair charts, the drafting of the chapters of his *Voyage to Terra Australis*, and on the writing of two important research papers published in the *Philosophical Transactions* of the Royal Society.⁵ Indeed, detached from London and Parisian ‘centres of calculation’ and ‘accumulation’⁶ and their respective authorities, and far away from the European battlefields, the island allowed Flinders to focus on nautical and geographical⁷ sciences, and to connect, compare or confront his conceptions and hypotheses with those of his French ‘companions of misfortune’⁸ versed in sciences.⁹ In the words of

² Some of these parts, such as the northern coasts of Australia, were already known and visited by people (especially fishermen) from South East Asia (the Macassans for example).

³ Île de France was renamed Mauritius following its conquest by the British after Flinders’s return to London. The name Île de France is retained throughout this article as it is central to our analysis to keep in mind that the island was French at the time.

⁴ Especially Charles Moreau, Jean Antoine Cap-Martin and Charles Baudin, who were all officers from the French expedition under the command of Nicolas Baudin that charted Australian coastlines at the same time as Flinders’s *Investigator* voyage. Flinders developed a real friendship with Cap-Martin and a strong empathy with Charles Baudin. After he learned that Charles Baudin had lost his right arm during an action with an English frigate, he ‘made an application immediately to go to town to see Ensign Baudin’ and procured to the hospital ‘53 oranges for him, they being ordered for his common nourishment’: Private Journal, 14 April 1808. Flinders had also a lasting friendship with the business man Thomas Pitot. The only trivial teasing with Flinders’s friends that ‘persecuted a little’ him was ‘upon the subject of politics and national character’. He wrote ‘These gentlemen [Pitot and Baudin] and most other Frenchmen that I have seen, take a great pleasure in depreciating the English character; which is ungenerous in the presence of an Englishman and a prisoner. This is done by pleasantries generally, which it is best to answer by reprisals in the same way’ and Flinders to conclude philosophically ‘each nation has its manner. The populace in England throw mud at a Frenchman passing in the street, the gentleman in France augment the misfortune of an Englishman by searching to turn his nation into ridicule; though I have always found at the bottom, that they respected it; and I attribute this to their desire of shewing their wit, joined to a little envy and perhaps hatred, rather than to any want of consideration.’ Private Journal, 7 November 1808.

⁵ Matthew Flinders, ‘Concerning the Differences in the Magnetic Needle, on Board the Investigator, Arising from an Alteration in the Direction of the Ship’s Head.’ *Philosophical Transactions*, 95, 1805, pp. 186–97. Flinders, ‘Observations Upon the Marine Barometer, Made During the Examination of the Coasts of New Holland and New South Wales, in the Years 1801, 1802, and 1803.’ *Philosophical Transactions*, 96, 1806, pp. 239–66. In this article, Flinders questioned the possible atmospheric processes behind the rise and fall of the barometer that his observations showed. Flinders’s death four years after his return to London did not leave him enough time to further develop his meteorological investigations.

⁶ Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society*, Harvard University Press, 1987, pp. 215–28.

⁷ Geographical sciences is understood here in its original large sense: the description of the earth, including the construction of charts and geology.

⁸ Marina Carter, *Companions of Misfortune: Flinders and Friends at the Isle de France, 1803-1810*, London, 2003.

⁹ This statement does not at all imply that it was not painful for Flinders, after his long and exhaustive mission and the wreck of the *Porpoise*, to be unexpectedly prevented from returning to his homeland and family.

Schaffer, his friends acted as ‘go-betweens’¹⁰ for providing him with scientific information and readings, and introducing him to French theories related to his investigations. They facilitated the cross fertilization of ideas between French and British knowledge from which Flinders greatly benefited.

This article analyses how, in this process, Flinders asked for the assistance of his French friends to help him gather the information he needed to perform his work, and how he used it. In order to ‘put science in its place’¹¹ and analyse ‘the making of scientific knowledge’¹² and its extensive network, it follows a dialectical approach between the production of knowledge in Europe and its local reception by the learned society of Île de France.¹³ It shows that the island was a place where European knowledge was understood and its scientific issues discussed, and that Flinders took advantage of this particular context. The primary sources of information used in this analysis are the private journal that Flinders kept between his arrest in December 1803 and his death in 1814,¹⁴ his correspondence,¹⁵ his memoir and articles, and French voyages and scientific publications that were available in the island. In these documents, Flinders’s work appears in its progression, interactions and

Flinders was indeed very depressed during the first year of his detention, as his diary entry on 18 Aug 1805 in his private journal testifies. However, from 1805, with the d’Arifat family with whom he resided, he became more philosophical regarding ‘the vicissitudes of his own life’ while ‘a prisoner in a mountainous island in the Indian Ocean, lying under a cascade in a situation very romantic and interior, meditating upon the progress which nature is continually making towards a moderate degree of equality in the physical and moral worlds; and in company with a foreigner, a Frenchman, whom I call, and believe to be, my friend’ : Private Journal, Monday 21 Oct. 1805. He also started to spend ‘agreeable’ evenings and times in French company, at dinner parties (Sunday 3 November 1805), breakfasting (Private Journal, Thursday 15 May 1806), receiving visits and visiting, playing chess, tric trac, and music, going on excursions, going hunting, reading French literature (eclectic readings such as the work of Chateaubriant, historical books, as well as ‘light readings’, European magazines) and many travel reports... and ‘teaching the first principles of navigation to the two young sons of my hostess, Aristide and Marc’, and reading ‘French under the correction of Mesdemoiselles Delphine and Sophie [Mme D’Arifat’s daughters]; and they do the same in English to me’. By 1806, Flinders had developed a very strong friendship network (Letter to Lieut. S. W. Flinders Dec. 6 1806’, in M. Flinders, Matthew Flinders - Private letters, vol. 1, 1801–1806, *James Fairfax Matthew Flinders Electronic Archive*).

¹⁰ Schaffer, Simon, Lissa Roberts, Kapil Raj, and James Delbourgo, *The Brokered World: Go-Betweens and Global Intelligence, 1770–1820*, ed. H. Otto Sibum, Vol. 35, *Uppsala Studies in History of Science*, Sagamore Beach, MA, Science History Publications, 2009.

¹¹ David N. Livingstone, *Putting Science in Its Place: Geographies of Scientific Knowledge*, University of Chicago Press, 2010. Livingstone shows that ‘scientific knowledge is made of a lot of different places’ (p. 1), and investigates the spaces and scales of scientific activity. Drawing on Livingstone’s idea that micro-geographical spaces and their societies are significant places in the construction of sciences, this article shows that the learned society of Île de France was a dynamic part of the shaping of scientific knowledge in European centres.

¹² *Ibid.*, p. xi.

¹³ On the make-up of sciences in the seventeenth and eighteenth centuries, see Simon Schaffer. Schaffer shows how European men of science proceeded by trial and error and worked in association to gather sufficient information from all over the world. He analyses the global network of information on which Newton relied for his *Principia Mathematica* without undertaking any overseas travel or being ‘on the beach’ to collect information: ‘Newton On The Beach: The Information Order Of Principia Mathematica’, in Simon Schaffer, *La Fabrique des sciences modernes*, Seuil, 2014. As with Livingstone, this article also draws on Schaffer’s approach to the history of sciences and their making-up. Like Schaffer, it addresses Flinders’s charting and scientific work and his geological observations in the form of an investigation, taking stock of Flinders’s achievements with regard to the social context in which his work was embedded. In other words, Flinders’s captivity on Île de France is analysed from the standpoint of the significance of his work considered from the perspective of the global social network that provided information on which European knowledge developed.

¹⁴ Matthew Flinders, *Matthew Flinders private journal from 17 December 1803 at Isle de France to 10 July 1814 at London*, ed. Anthony Brown and Gillian Dooley, Adelaide, Friends of the State Library of South Australia, 2005.

¹⁵ See James Fairfax Matthew Flinders Electronic Archive : <http://acms.sl.nsw.gov.au/item/itemDetailPaged.aspx?itemID=153830>

interfaces with French works, and in its ambivalence, as Flinders belonged both to the community of seamen united by the sea, and to the Royal Navy under the authority of the British Admiralty, whose interests were at that time in conflict with those of the French.

The first part of this article discusses the different stages in the construction of the map of Madagascar. It highlights how Flinders acquired information from his friends and inserted it progressively into his drawing to produce the fair map that he ultimately delivered to the British secretary of state for the colonies. The second part focuses on the links between the *Voyage of Etienne Marchand*, edited by Fleurieu and read by Flinders while on the island, and the publication of his own *Voyage to Terra Australis*. The third part investigates how Flinders developed a theory concerning the causes of the deviation of the compass on ships, and it shows how his exchanges with his friends facilitated this work. The fourth part explores how he interpreted the geology of the island, drawing on European theories that were discussed among his French contacts.

1. The construction of the map of Madagascar

The Indian Ocean waterways were much used by European seagoing ships, and its islands were coveted as stopovers on the way to India, the Spice Islands, and China. Hence, European maritime powers were seeking reliable charts of the Indian Ocean region to secure trade routes, and to inform or support military or colonial purposes. In this quest, captains and their officers frequently updated existing charts by comparing, completing and recompiling previous documents and observations with fresh bearings and results. This compilation was often coupled with private exchanges of information between British and French hydrographers. For example, in the late eighteenth century, Alexander Dalrymple¹⁶ and Jean-Baptiste d'Après de Mannevillette¹⁷ corresponded on the 'evidence of dangers on the route to India'¹⁸ across the Indian Ocean.

Consequently, the construction of charts and their updating were based on fresh surveys and pre-existing charts that were purchased, copied (with or without authorization), seized during naval actions, or provided by hydrographical offices and renowned mapmakers.¹⁹ On the whole, charts were constantly reviewed, corrected, and complemented with new additional information. This method of gathering and synthesising was used by Flinders to construct a chart of Madagascar although, obviously, he did not have the opportunity to survey this large island to the west of Île de France. Thus, compared with the charts of his atlas that accompanied *A Voyage to Terra Australis*, which were based on his own observations and discoveries, this map was a work of compilation based on available information, published maps and descriptions of travels on Madagascar that his friends supplied to him. Mr Froberville provided Flinders with his own historical research, together with the travels of Mr Mayeur on Madagascar; Mr Cap-Martin furnished Flinders 'with some materials' to draw the chart; and his great friend Pitot 'put all his nautical friends under contribution' to inform Flinders about the geography of Madagascar. Part of this information may have included consultation of the map on the 'isles and dangers situés au nord-est de l'isle de Madagascar' that Mannevillette constructed,²⁰ that Dalrymple corrected in 1778, and

¹⁶ When Dalrymple was officer and hydrographer of the East India Company. Dalrymple later became, in 1795, the first Hydrographer to the Navy.

¹⁷ Jean Baptiste D'Après de Mannevillette was an officer and hydrographer of the French Compagnie des Indes who edited the atlas and sailing directory *Neptune Oriental*.

¹⁸ James R. Akerman, *Cartographies of Travel and Navigation*, Chicago, University of Chicago Press, 2006, p. 81. See also Manonmani Filliozat, 'J.-B. d'Après de Mannevillette et la cartographie de la nouvelle route des Indes', *Le Monde des cartes*, 175, 2003, pp. 6–16.

¹⁹ Such as the Blaeu family, who worked for the Dutch VOC, and Arrowsmith in Britain.

²⁰ <http://nla.gov.au/nla.map-rm1885>

that the hydrographer of the ‘dépôt des cartes de l’Île de France’, Michel Sirandré, also revised.²¹ It has been suggested that other subsequent documents (captains’ reports) from this dépôt had been transmitted to Flinders.²²

Accordingly, on 7 December 1807, Flinders produced ‘a sketch of Madagascar’,²³ then in January 1808 constructed ‘a chart of the north part of Madagascar to contain the or rather explain the travels of Mr. Mayeur’. By February 1808 Flinders was working on finishing his chart of Madagascar, and on 15–16 February he apparently ‘sent back the books and charts lent [him] for the construction of [his] chart of Madagascar’.²⁴ In fact he returned to his chart a week later when he received ‘from the obliging Mr Froberville two journeys in Madagascar by Mr Dumaine, and several papers explanative of Mr Mayers travels in Madagascar’.²⁵ Accordingly, in March, he laid down ‘the routes of M. Dumaine in the interior of Madagascar’ but ‘the inaccuracy of the geographic information’ gave him ‘much difficulty’.²⁶ Then in April Flinders occupied himself ‘with the memoir upon my chart of Madagascar’.²⁷ In October 1809 he asked the astronomer Quénot for ‘any geographical or astronomical communications [he] can make me relative to Madagascar and the Mozambique Channel, Cape St. Andrew and Cape Amber’ as this information would provide ‘important points in the construction of a chart of Madagascar, but do not appear to have been settled by any capable navigator, unless it has been done within these few years’.²⁸

²¹ Manonmani Filliozat, ‘J.-B. d’Après de Manneville et la cartographie de la nouvelle route des Indes’, *Le Monde des cartes*, 175, 2003, pp. 6–16.

²² When Lislet Geoffroy replaced Sirandré: Huguette Ly-Tio-Fane Pineo, *In the Grips of the Eagle. Matthew Flinders at Ile De France 1803-1810*, Mauritius, Mahatma Gandhi Institute, 1988, pp. 130–31.

²³ Flinders, *Private Journal*, p. 194.

²⁴ *Ibid.*, p. 201. Although it seems that Flinders failed to give back all the information lent by his friends, as is pointed out in the draft of a letter to Monsieur Froberville, Au Refuge le 4 Janr. 1809. Flinders answered Froberville that they were probably in a trunk ready to be sent to London. A few months after Flinders’s death, his wife Ann wrote to the Admiralty with regards to Froberville’s lost manuscripts as Froberville was very anxious to get them back, but this was without success (TNA ADM 1/Pro F 382). It is difficult to say whether or not Flinders did this to provide intelligence to his nation or by mistake.

<http://acms.sl.nsw.gov.au/item/itemdetailpaged.aspx?itemid=403868>.

Unfortunately, Flinders’s map of Madagascar is not listed in the National Archives’s catalogue.

²⁵ *Ibid.*, p. 203, 24 February 1808.

²⁶ *Ibid.*, pp. 204–5.

²⁷ *Ibid.*, p. 210, 19 April 1808.

²⁸ <http://acms.sl.nsw.gov.au/item/itemdetailpaged.aspx?itemid=403984>
<http://acms.sl.nsw.gov.au/album/albumView.aspx?acmsID=413404&itemID=823220>
 Digital Order No. a053219.

M. Quénot - chez M. Puget - Marchand - Rue Nationale - au Port-Napoleon

Melhous Plains October 23 1809

Sir

I yesterday received with much pleasure your letter of the 25.th and had a particular satisfaction in finding that the letter I had the honour of presenting you with during the time I was a prisoner on the *Maison Despeaux*, had been a means of procuring for you the merited consideration.

Be pleased to accept my thanks for your communication relative to the eclipses and the observations that have been made for the longitude of Port Napoleon. Notwithstanding that the nature of the eclipses forbids almost all hope of obtaining a satisfactory ^{result}, I had the curiosity to make the calculation of the longitude from it this morning. Supposing the observation of *M. Malas* was to have been correct, the true time of eclipsic conjunction should have been at $25^{\circ} 29' 50''$, which being compared with that under the first meridian as deduced from the tables, would give the longitude of the port $5^{\circ} 27'$ east of Paris which is evidently much too little. [The observations for the longitude made by me whilst on the *Maison Despeaux* in 1806, were not numerous. I have no longer any books by me, but remember that from twelve sets of distances of stars east and west of the moon, the numbers on each side being equal, I deduced the longitude $57^{\circ} 11'$ east of Greenwich, and that from twenty-four sets of distances of the Deart and west of \odot , the numbers on each side being also equal, *M. Allen* my officer obtained for a mean result $57^{\circ} 45'$ east of Greenwich for the

Figure 1. Draft of the first page of the letter that Flinders addressed to M. Quénot on 23 of October 1809, showing the exchange of information between Flinders and Quénot. State Library of New South Wales: Matthew Flinders, Private letters, vol. 2, 1806–1810. Digital Order No. a053219.

Finally, Pitot expressed ‘a wish to have a copy of my [Flinders’s] chart of the north part of that island added to their collection [the collection of the Society of Emulation]’.²⁹ Whether or not this copy was ever made, back in London on 14 November 1813, at the request of the Admiralty, Flinders sent the chart, along with his manuscripts on Madagascar, to the British Under Secretary of State for the Colonies ‘for the use of the department’.³⁰

Friday 12 November Squally. All day and evening at the quire, and finished it. Recd. a letter from the admiralty, requiring to know for the colonial department if I did not possess a chart and manuscripts relating to Madagascar
 Wednesday 24 November Went to Mr. Goulburn the under secretary of state for the colonies, with my chart and Manuscripts of Madagascar, which Lord Bathurst desires to have copied for the use of the department.

Hence, Flinders constructed a new map of Madagascar from the information he gathered from his French network, which completed the British collection of maps of the region.

²⁹ Flinders, Private Journal, p. 242, 20 January 1809. The Society of Emulation was a literary and intellectual society formed in 1802 which gathered together the educated élite of the island. Pitot was its secretary, but it also included Cap Martin and others scientists of the Baudin expedition.

It is not yet known if Flinders’s map was made available to the Society of Emulation.

³⁰ Flinders, Private Journal, pp. 458–9. Unfortunately, this chart is not listed in the National Archives catalogue.

At the same time his French companions familiarized him with some significant French voyages, such as the *Voyage d'Étienne Marchand* edited by Charles Claret de Fleurieu.

2. The *Voyage of Étienne Marchand* by Charles Claret de Fleurieu and Flinders's *Voyage to Terra Australis*

It was Hyacinthe Murat, who sailed as third officer under the command of Étienne Marchand on *Le Solide*,³¹ who introduced Flinders to 'the voyage of Mons. Étienne Marchand, the account of which is published by Mr Fleurieu'.³² As the journal of Marchand was not available,³³ Fleurieu compiled the journal of the second-in-command, Captain Chanal, and the various journals of the surgeon Claude Roblet, to give an account of this voyage that circumnavigated the world. He completed his knowledge by talking privately with Chanal,³⁴ and by observations sent by Roblet from Île de France.³⁵ Beyond this, Fleurieu included some nautical developments and strategic information that gave an instructive dimension to his work. Fleurieu's editing work characterized post-revolutionary France, where the exhaustive encyclopaedic knowledge of the Enlightenment became less philosophical and more specialized and methodical.

Marchand's voyage was motivated by the fur trade between Nootka (north-west coast of America) and China (Macao/Canton) that British merchants and James Cook had already

³¹ There is no mention that Murat kept a journal. However, as an officer, he must have kept some records of his observations.

³² Flinders, Private Journal, Thursday 30 August 1805. Fleurieu was an acknowledged French geographer, marine officer and hydrographer, who became the Minister of Marine in 1790. He was one of the best specialists of navigation and was thoroughly informed on the latest nautical issues and maritime affairs of the time.

Fleurieu wrote the instructions for the voyages of discoveries of Louis-Antoine de Bougainville, Jean François de Galaup de La Pérouse, and Nicolas Baudin. When Flinders was on Île de France, he was a member of the 'Institut de France' (in the statistical and geographical class) and the 'Bureau des Longitudes' whose aim was to improve the determination of longitude at sea similar to the Board of Longitudes in London, and which had under its responsibility the Observatoire de Paris. He was also appointed to Napoleon's council of state. It was in regard to his high scientific responsibilities and positions that Flinders 'wrote a long letter to Monsieur Fleurieu, Grand Officer of the legion of Honour, Councillor of State &c. intreating his interference with the government to set me at liberty or order me to France': Private Journal, Monday 11 July 1804.

Fleurieu started to draft the *Voyage round the world performed during the years 1790-1791-1792* by Étienne Marchand four years after Marchand's return to Marseille after the dreadful days of the Terror.

³³ Possibly, because of the difficult period of the French Revolution where traditional administrations were extremely challenged, Marchand's journal was not filed in the Toulon registry. Marchand gave it to his sister at La Ciotat (Marseille) before going to sea again and taking a new command at Île de France. Then, his brother Louis, who navigated on the *Solide* with him, held on to it. Fleurieu explained that he could neither meet nor contact Marchand, and he did not suspect that his sister had the journal. The life of Marchand after 1792 is unknown. His wife died when he was in command of the *Solide*, and their son was still a toddler. The certain facts are that he left revolutionary France in December 1792, and that he was at Port Louis, on Île de France, in 1793. There were suggestions that he died from a hunting accident, committed suicide, changed his name (mainly because of his debts), or came back to France to search for his young son and disappear with him. It may also be possible that he set out privateering against British ships. All these hypotheses are unproven, and we may assume that Murat did not know either, as Flinders wrote nothing about the person of Marchand. It is possible that Murat had observations about the voyage that he shared with Flinders. The actual journal of Étienne Marchand has been recently transcribed and published in 2 volumes: Étienne Marchand, *Journal de bord d'Étienne Marchand*, ed. by Odile Gannier and Cécile Picquoin, 2 vols, Paris, CTHS, 2005.

See information on his life in vol.1, p. 43 & vol. 2, pp. 116–19.

³⁴ Charles Pierre Claret [de] Fleurieu, *Voyage autour du monde pendant les années 1790, 1791 et 1792 par Étienne Marchand*, 4 vols, Paris, de l'Imprimerie de la République, 1797, vol. 1, p. cxliv.

³⁵ Fleurieu, *Voyage autour du monde*, vol.1, pp. cxxxvii–cxxxviii. After the voyage, Roblet became a surgeon at Île de France.

investigated.³⁶ Another voyage involved with this fur trade was circumnavigating the world at the same time as Marchand – the American voyage of Joseph Ingraham – and some parts of their respective routes followed the same itinerary. The two voyages were more successful in achieving their circumnavigation than in their fur trading business, while Marchand's voyage, which was privately funded by a trading company of Marseille, was a commercial fiasco which ruined its skilled captain. However, Marchand's voyage was the fastest voyage around the world so far, performed in less than two years (14 December 1790 – 14 August 1792) with no human life lost on board except for a death from 'apoplexy'.³⁷ As Marchand did not have chronometers, longitude at sea was determined by regular observations of the distance (angle) between the moon and a heavenly body, recorded with Chanal, and his three officers, Louis Marchand (the brother of Etienne), Infernet and Murat.³⁸ Considering the quality of their bearings and astronomical results, Flinders recognized in Marchand a skilled navigator, and he shared a 'good deal of conversation upon nautical subjects' with Murat.³⁹ He read the four volumes of Marchand's voyage from April 1808 to July 1808,⁴⁰ and he borrowed them again later, back in London, from Joseph Banks, probably in their 1801 English edition.

2.1 The dissemination and development of a shared European maritime knowledge

Alongside the duplication of charts, the other key factor in the transmission and development of a shared maritime knowledge was the publication of significant voyages, memoirs and treatises of navigation, and their translations and disseminations through Europe.⁴¹ For instance, Marchand's ship's library contained the voyages of James Cook,⁴² of Nathaniel Portlock and George Dixon, William Dampier, Samuel Wallis, and Dalrymple, as well as French publications such as Louis Antoine de Bougainville's voyage, Jean Baptiste Labat's *Voyages aux Îles d'Amérique*, Charles de Brosses's history of the Terres Australes, the Comte de Buffon's *Natural History*, Denis Diderot and Jean d'Alembert's encyclopaedia, etc. Besides the publications of the Dépôt de la marine, he had charts by John Hamilton Moore, Aaron Arrowsmith (chart of the world), Henry Roberts (Cook's atlas) and Dalrymple,⁴³ In

³⁶ Marchand was informed about this fur trade by the British captain Nathaniel Portlock who called at Saint Helena in 1788 on his way back from Canton with Chinese goods and tea, when a merchant ship with which Marchand was travelling in stopped on her way back from Bengal. Portlock was one of James Cook's crew during his last voyage, and later commanded a voyage in the Pacific that lasted three years, from 1785 to 1788. Jacqueline Carpine-Lancre, 'Fleurieu et le voyage autour du monde d'Etienne Marchand,' in *Fleurieu et la marine de son temps*, ed. Ulane Bonnel, Paris, Economica, 1992, pp. 91–120, p. 94.

³⁷ Etienne Marchand, *Journal de bord d'Etienne Marchand*, p. 296, 21–22 June 1791. During this voyage, Murat first saw and identified, from the Baye Madre de Dios, the north-west island of the 'îles de la Révolution', among the Marquesas islands, and Marchand named in honour of his third officer two high points, the 'Pics Murat'. As a matter of fact, Ingraham discovered this north-west part of the Marquesas Islands just a few weeks before Marchand.

³⁸ *Ibid.*, pp. 249–51, as an example. At the turn of the nineteenth century, the resolution of the problem of the determination of longitude in open sea navigation was solved through two methods of calculation: the lunar distance observations of the position of the moon with respect to other astronomical bodies, and the chronometers able to keep Greenwich or Paris time on board. Unlike Marchand, Flinders was able to use both methods: Michael Barritt, 'Matthew Flinders's Survey Practices and Records', *The Journal of the Hakluyt Society*, March 2014, p. 3.

³⁹ Private Journal, Friday 13 September 1805.

⁴⁰ Charles Pierre Claret [de] Fleurieu, *Voyage autour du monde pendant les années 1790, 1791 et 1792 par Etienne Marchand*, 4 vols, Paris, de l'Imprimerie de la République, 1797 ; Flinders, Private Journal, p. 213.

⁴¹ Although the sharing of nautical and geographical information was not systematic, and Fleurieu gave the example of the Spanish government who did not allow the narratives and journals of Spanish voyages to be communicated to other European countries. Fleurieu, *Voyage autour du monde*, Vol. 1, p. cxxv.

⁴² With Forster and Banks's commentaries.

⁴³ Etienne Marchand, *Journal de bord d'Etienne Marchand*, ed. by Odile Gannier and Cécile Picquoin, 2 vols, vol. 1, *Géographie*, Paris, CTHS, 2005, p. 86.

addition, Marchand was equipped with improved nautical instruments, made mostly in Britain where the most renowned instrument makers in Europe practiced their art in London. He had on board three sextants made by Hadley, Dollond and Gilbert & Wright, and a British achromatic telescope. Conversely, Flinders had on board the *Investigator* Dutch, Spanish (Mendoza) and French publications and charts, including copies of the seized charts of D'Entrecasteaux's voyage,⁴⁴ as well as the French almanac 'Connaissance du temps'. His improved sextants were manufactured in London by Troughton.

Thus, with the exception of those chronometers that Marchand could not obtain, mainly due to their high cost, Marchand and Flinders used similar instruments and methods, and their ship libraries, with crisscrossed publications of previous European voyages, were illustrative of the longstanding European construction of a common core of knowledge and practices, whereby captains inherited the experience of previous captains and then communicated, through their own publications, their discoveries to others. The information that formed the basis of these publications was systematically recorded by captains and officers in ships' journals, reports and logbooks, and delivered by captains at the conclusion of each voyage to their respective authority according to a standardized reference model.

This whole dynamic contributed greatly to placing European hydrographical and navigational knowledge at the service of European 'nautical sciences', and it developed in concert with a competitive spirit of rivalry, each navigator defending the interests of his own nation to which he provided intelligence. Fleurieu's and Flinders's works highlight clearly how their universal and national objectives were intertwined. After giving expert advice on how a vessel should anchor safely in the harbour of the island of Saint Helena – something already 'well known to the English' but not to French navigators – Fleurieu added strategic information regarding the defence of the British island and explained how problematic it was to attack it:

As the road of St Helena is little frequented by the French to whom, however, it may be important to be acquainted with it, and as it is so well known to the English, that, in the accounts of their voyages, they dispense with entering into any detail respecting the anchorage, I have thought that it would be useful to preserve the remarks which Captain Chanal was enabled to make ...

As soon as you begin to discover the flag staff of the government's house, you may let go the anchor ... It is sufficient to moor with a stream anchor which must be carried to the north-west by the compass. The sea-breezes, from the south-west to the north-west, are here very rare: and if they happen to blow, they are always very faint: only in this case, you experience a heavy swell, which causes violent surf on shore.

It will not, undoubtedly, be useless to French navigators to add to these merely nautical directions various particulars important to be known, which are neither to be found in the descriptions that have given us of the Island of St Helena, by Captain Cook, and George Forster, nor in the more ancient Journals of William Dampier, to whom maritime nations are indebted for the first accounts of voyages from which it is possible to obtain exact information.

James Town is built in the bottom of a narrow valley, commanded by two hills. A battery which occupies the whole breadth of this valley, defends the approach to it,

⁴⁴ The charts of the D'Entrecasteaux expedition were seized in December 1794 when Rossel, who was the senior officer of the expedition after the successive deaths of D'Entrecasteaux and D'Hesmivy d'Auribeau, sailed back to France with Beautemps Beaupré's charts and Labillardière's plant collections in a Dutch convoy boarded by the British. Dalrymple kept the charts in his office but gave copies of them, made in fact by Rossel himself, to Flinders for his voyage in the *Investigator*. The D'Entrecasteaux atlas was published in Paris only in 1808 when the voyage and the historical atlas of the Baudin expedition were also about to be published, which did not facilitate the publishing task of the later expedition.

and protects the anchorage. Some redoubts, towards the sea, and forts erected on the slope of the adjacent hills, add to the defence of the place and to the protection of the roadstead. A garrison of five hundred men is maintained for the guard and the duty of these different works ...Landing appears impracticable under the fire of the batteries in front, the lateral redoubts, and the commanding forts. The enemy, who should intend to attack St Helena, can do no more than attempt a bombardment, under cover of his ships of the line. The enterprise would at least be hazardous, if not altogether rash...⁴⁵

Fleurieu occasionally made open political digressions from his nautical analysis to denounce the British 'envahissement du commerce du monde'.⁴⁶ Conversely, from his personal experience of those who 'exposed themselves to the threats of the sea', he also expressed a spirit of solidarity, 'fraternity' and mutual respect that strongly unified the community of navigators and men of sciences involved with maritime voyages beyond their national affiliation:

Captain Clerke who, after the tragical death of Captain Cook, in his third voyage, had succeeded him in the chief command of the expedition, discovered, at Kamtschatka, the place of interment of a Frenchman whom love of the sciences had carried to the eastern extremity of Asia; and he took a particular interest in distinguishing by an honourable inscription, the forgotten spot of ground where the remains of La Croyère reposed so far from his natal land. La Pérouse, during the stay which he made at Petropawlovska, had an opportunity of discharging the debt of the French towards the English nation; Captain Clerke who terminated his career, when, after the second run to the northward, he returned a second time to the same harbour, was there interred; time, and the curiosity of the Kamtschadales, had destroyed the inscription borne on his tomb; La Pérouse took every pain to re-establish it, such as it is to be read in the original account of Cook's third voyage; and, in order to prolong its duration, he caused it to be engraved on copper. These mutual attentions of navigators strangers to each other, these acts of friendship and fraternity, may astonish the sedentary and unfeeling inhabitants of our cities, who, never having been tempted to expose themselves to the dangers of the sea, are ignorant with what sentiments the community of such dangers may inspire those who, without being acquainted with each other, know that they have shared them. At Kamtschatka, at seven thousand leagues from Europe, all Europeans, and especially European seamen, are countrymen and brothers: and does not the man who, by his discoveries or his labours, has deserved well of mankind, belong, through gratitude, to every nation on earth?⁴⁷

In this last sentence, Fleurieu expresses the humanist convictions that inspired the philosophy of the Enlightenment, such as the universal and beneficial values of knowledge and

⁴⁵ Charles Pierre Claret [de] Fleurieu, *A Voyage Round the World Performed During the Years 1790, 1791, and 1792, by Etienne Marchand: Preceded by a Historical Introduction, and Illustrated by Charts, Etc.*, Vol. 2, T. N. Longman and O. Rees ... and T. Cadell, Jun. and W. Davies ... 1801, pp. 176–80

⁴⁶ Fleurieu, *Voyage autour du monde*, vol. 1, p. 553. This recurrent accusation directed against Britain has its origin in the mid-seventeenth century with the Navigation Acts that were seen by European countries, or later America, as restricting their trade. It became a general leitmotif in European maritime countries against Britain, often in a disproportionate way (especially in François Péron's excessive memoir on the British settlements of New Holland, Van Diemen's Land and the Pacific).

⁴⁷ Charles Pierre Claret [de] Fleurieu, *A Voyage Round the World Performed During the Years 1790, 1791, and 1792, by Etienne Marchand: Preceded by a Historical Introduction, and Illustrated by Charts, Etc.*, Vol. 1, pp. liv & lv.

sciences,⁴⁸ where men of science at sea served the whole of humanity through their works and discoveries, charting the world in order to make navigation safer, and identifying the resources of the planet as a service to mankind in general.⁴⁹ Therefore, Fleurieu deplored the political confinements of Alejandro Malaspina and Flinders.⁵⁰

The same type of information and competitive spirit was inserted in filigree in Flinders's voyage, all inextricably bound up with his great respect for the hydrographic work of his predecessors regardless of the nation to which they belonged, and with the conviction of serving humanity by advancing the geographical knowledge of the world:

From the archipelago eastward the examination of the coast was prosecuted by D'Entrecasteaux with much care, and with some trifling exceptions very closely; but as far as the 127th degree of longitude from Greenwich no soundings were given. These have been supplied, and a more minute description given of the coast. At the 129th degree the French ships seem to have been closer in with the land than was the Investigator; and it would appear by the track that they were also closer at the 30th, and at the head of the Great Bight, but these last are not corroborated by the soundings. From thence to the bay in which we anchored on the 28th, the Dutch chart of 1627 was the sole authority; and making allowances for the state of navigation at that time, it is as correct in form as could reasonably have been expected.

The latitudes and longitudes of the points and islands along the coast have been either verified or corrected, for there are commonly some differences between any longitudes and those of Vancouver and D'Entrecasteaux. The observations by which certain places, taken as fixed points, are settled in longitude, are mentioned at those places, as also are the corrections applied to the time-keepers for laying down the intermediate parts; and both are more particularly specified in the Appendix to this volume.

Monsieur *Beautemps Beaupré*, geographical engineer on board *La Recherche*, was the constructor of the French charts; and they must be allowed to do him great credit. Perhaps no chart of a coast so little known as this was will bear a comparison with its original better than those of M. Beaupré. That the Plates II and III in the accompanying Atlas, are offered as being more full and somewhat more correct, does neither arise from a wish to depreciate those of my predecessor in the investigation, nor from an assumption of superior merit; there is, indeed, very little due to any superiority they may be found to possess; but there would be room for reproach if, after having followed with an outline of his chart in my hand, improvements should not have been made in all or some of those parts where circumstances had not before admitted a close examination.⁵¹

⁴⁸ This conviction characterized the Enlightenment.

⁴⁹ This universal belief that science and discoveries were committed to the service of humanity characterized the Enlightenment and European thought, but not other cultures where European expeditions were generally regarded as non-events: Romain Bertrand, *L'histoire à parts égales récits d'une rencontre, Orient-Occident (Xvie-Xviii siècle)*, Paris, Le Seuil, 2011.

⁵⁰ Fleurieu brought up 'l'intrigue ou la politique qui ont confiné dans des cachots, et le Voyageurs et le Rédacteur du Voyage [Malaspina]': Fleurieu, *Voyage autour du monde*, vol.1, p. cxxxii. In an article 'Notice sur feu M. Flinders' (Malte-Brun, 1814, vol. 23, pp. 268–71), Malte-Brun quoted Fleurieu saying that the indignity committed against Mr Flinders was without precedent in the nautical history of civilized nations 'Que les indignités commises envers M.Flinders étoient sans exemple dans l'histoire nautique des nations civilisées'.

⁵¹ Flinders, *Voyage to Terra Australis*, vol. 1, p. 102.

2.2 A comprehensive historical introduction

Fleurieu was innovative in that he gave a long introduction that systematically reviewed the geographical knowledge already produced by previous voyagers upon which he positioned Marchand's voyage.⁵² Focusing on the north-western coast of America as it was the region around which Marchand's voyage was organized, Fleurieu's introduction covered a total of one hundred and forty pages, and was far more investigative than the introductions in Bougainville and George Vancouver's voyages.⁵³ It combined the form of an exhaustive, detailed and critical book review based on the publication of successive voyages from the sixteenth to the late eighteenth centuries, whether Spanish, Portuguese, British, Russian, American, or French. It covered the main issues of sovereignty, rights of navigation and trade between Spain and Britain during the Nootka crisis. Fleurieu explained each project. He described the course of each voyage, together with its coastal surveys and the toponyms assigned to the places discovered by the expedition. He displayed his sources and references in detailed footnotes; he connected the objectives of the successive voyages; and he separated truth from fiction.⁵⁴ For each discovery, Fleurieu wrote in the margin of the text the date of the expedition and the name of the captain (for example: 1537, Cortès).

To introduce his *Voyage to Terra Australis*, Flinders adopted Fleurieu's model, gathering the existing information, carefully reviewing captains' journals and the places they discovered and named, and discussing the uncertainties in some of the places described but not clearly identified by previous navigators.⁵⁵ In addition, he made adaptations to Fleurieu's model in the particular context of Terra Australis. Firstly, while Fleurieu was chronological in his approach, Flinders classified voyages of discovery into four sections 'under the heads of the different coasts upon which they were made' to obviate 'the confusion that would arise from being carried back from one coast to another'.⁵⁶ Secondly, he developed in detail his earlier missions in New South Wales and Van Diemen's Land. Thirdly, at the end of each section, Flinders synthesised the current state of geographical knowledge, from which juncture he planned to start his surveying and charting work. Fourthly, he reviewed, like Fleurieu, the 'Prior Discoveries in Terra Australis', but reversed Fleurieu's marginal order by first naming the explorer (or alternatively the ship), then giving the date (for example: 'Torres, 1606'). Flinders' introduction covered a total of 203 pages, but as the *Voyage* was printed in a quarto format its true length was similar to Fleurieu's introduction.

⁵² Fleurieu, *Voyage autour du monde*, vol. 1, pp. i-cxlv, 143 pages in folio. This introduction was read at the Institut National in July 1797.

⁵³ In his preface, Vancouver referred to James Cook, but not the previous great navigators or other voyages of discoveries, and detailed mainly the Nootka crisis with the Spanish government about claims and rights of navigation and trade in the north-east Pacific region of North America, which had implications on his voyage and the fact he became its commander: George Vancouver, *A Voyage of Discovery to the North Pacific Ocean and Round the World*, vol. 1, London, 1798. Ed. W. Kaye Lamb, London, The Hakluyt Society, 1984.

⁵⁴ pp. xxvi-xxx.

⁵⁵ Flinders, *Voyage to Terra Australis*, Vol. I, p. x.

⁵⁶ Flinders, *Voyage to Terra Australis*, Vol. I, p. vi.

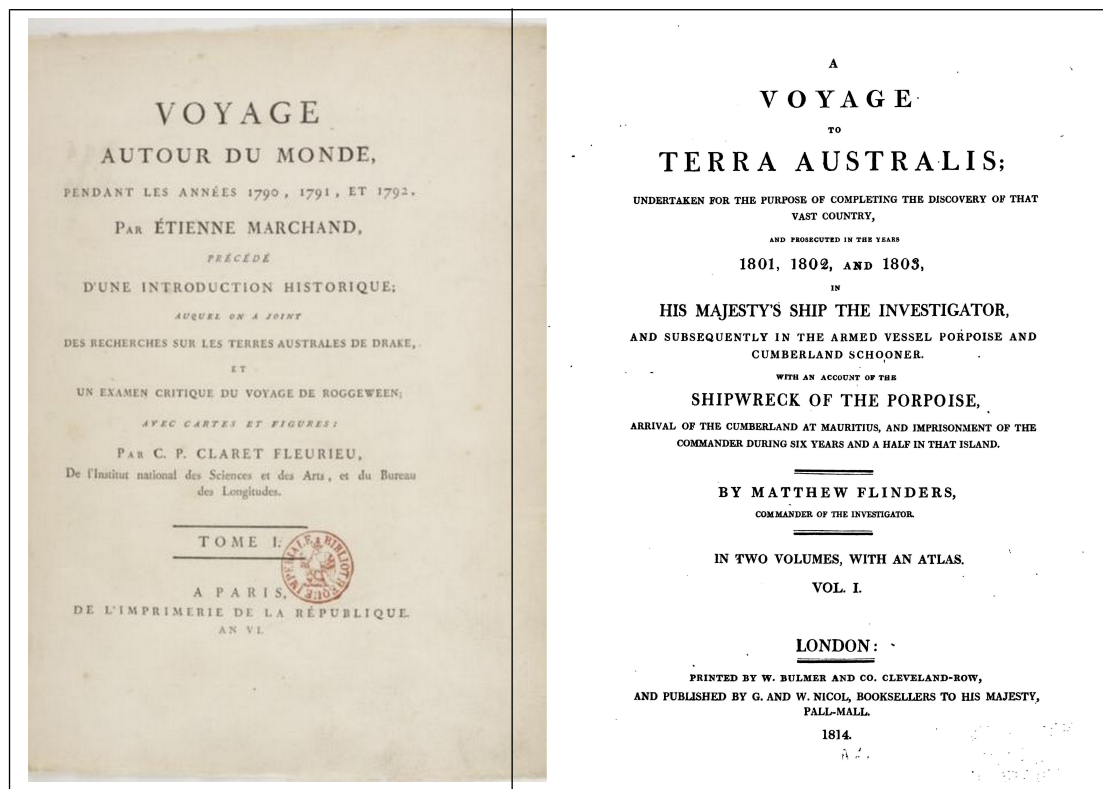


Figure 2. Title pages : Charles Pierre Claret [de] Fleurieu, *Voyage autour du monde, pendant les années 1790, 1791 et 1792, par Étienne Marchand, précédé d'une introduction historique, auquel on a joint des recherches sur les terres australes de Drake et un examen critique du voyage de Roggeween*, 4 vols, Paris, de l'Imprimerie de la République, An VI [1797]. Source: gallica.bnf.fr (Bibliothèque nationale de France).

Matthew Flinders, *A Voyage to Terra Australis: Undertaken for the Purpose of Completing the Discovery of That Vast Country, and Prosecuted in the Years 1801, 1802 and 1803*, 2 vols, London, G. & W. Nicol, 1814.

2.3 The elevation of modern nautical sciences

Fleurieu was very concerned about assisting officers and seamen in their understanding of complex nautical methods, the best use of instruments, and the latest nautical knowledge.⁵⁷ Accordingly, in the second volume of his voyage, he presented detailed surveying, hydrographical and nautical tables and developments that described through a critical and reasoned analysis the 'results of the observations for latitude and longitude made on board the ship Solide'. These nautical developments provided an educational and didactic dimension to his work. In turn, in his *Voyage to Terra Australis*, Flinders discussed, in chapter XI of his first volume, and in his appendixes, and throughout the text of his narration, the meaning of winds, currents, and other observations in a reasoned form with instructive information.

Hence, Fleurieu examined the 'changes occasioned by the currents in the apparent course and rate of sailing of the ship, in the different tracts of sea which she crossed, as well as the error in the calculation of the dead reckoning in the interval of the observations, and at the period of each land-fall',⁵⁸ reviewing the effects of oceanic currents, comparing the astronomical observations with the results obtained by the dead reckoning,⁵⁹ computing the

⁵⁷ The instructions given to La Pérouse for his voyage reflected clearly this concern: Charles Pierre Claret de Fleurieu, *Voyage autour du monde*, Vol. 1, p. lxxvi.

⁵⁸ *Ibid.*, pp. 1–6.

⁵⁹ *Ibid.*, Vol. 2, pp. 35–8 for example.

errors of the dead reckoning, and searching for the possible source of their errors.⁶⁰ He wrote about the effects of currents:

I have thought that this effect might be known, at least by approximation, if the progress in latitude and longitude, such as it was announced by the results of the astronomical observations, was compared with the progress for the same intervals, such as it was deduced from the ordinary calculation of the ship's run; and I have supposed that all the errors of the dead reckoning, indicated by the results of these comparisons, ought to be attributed to the unperceived action of the currents...⁶¹

Then he pointed out the conditions and limits of his 'supposition':

But, in order to admit that this supposition has conducted me to true results, two others must likewise be admitted : the former, that the errors of the dead reckoning depended solely on the effect of the currents ; the later, that the observations of the moon's distance from sun or stars, gave results sufficiently certain for us to be able to deduce from them, as from fixed points, the results of the calculations of the dead reckoning.⁶²

In turn, Flinders explained the method he used to calculate the rate and direction of the currents in estimating the approximate speed of the *Investigator*. He employed a standard English log-ship and line with a sandglass timer, and specified that he double-checked the log's results by comparing them with the data obtained from astronomical observations and computations of the daily position of the ship. He pointed out the important margin of error in these measurements because of the variability and instability of factors such as swell, wind rate and direction, and the changing lee-way:

The rate and direction of the currents here described are deduced from the daily positions of the ship by astronomical observation, compared with those given by a log kept in the common way, but with somewhat more than common attention. In the observations, however, there may be some errors, and a log cannot be depended upon nearer than to five miles in the distance, and half a point in the course for the twenty-four hours; and consequently this account of the currents must be taken as subject to the sum, or to the difference of the errors in the observations and log; though it is probable they may have been diminished by taking the medium of several days, which has always been done where it was possible.

Besides the difficulty there is in obtaining the exact rate and direction of a current, it is known that a continuance of the wind in any particular quarter may so far change its rate of moving, and even its direction, that at another time it may be found materially different in both. Of the probability of these changes the commander of a ship must form his own judgment, from the winds he may have previously experienced; and he will consider what is here said upon both winds and currents, as calculated and intended to give him a general notion, and no more, of what may usually be expected upon the South Coast. (*Voyage*, Vol. 1, p. 240.)

⁶⁰ Ibid., p. 64–8.

⁶¹ Charles Pierre Claret [de] Fleurieu, *A Voyage Round the World Performed During the Years 1790, 1791, and 1792*, by Etienne Marchand, p. 314.

⁶² Ibid., p. 315.

In a similar way to Fleurieu, Flinders raised hydrographical issues not yet solved, stressing for example the fact that relationships between currents and winds were more complex than suggested, for example his observation that the current set southward along the east coast of Australia while the winds blew from southerly quadrants:

It is a fact difficult to be reconciled, that whilst the most prevailing winds blow from S. E. in summer, and S. W. in winter, upon this extra-tropical part of the East Coast, the current should almost constantly set to the south ...

To conclude, although it is difficult to assess the extent to which Fleurieu's work influenced Flinders, both the *Voyage d'Etienne Marchand* and *Voyage to Terra Australis* mirrored the increasingly scientific approach that accompanied voyages, as well as the professionalization of European publications related to maritime voyages, both of which led to the development of nautical sciences. The problem of the deviation⁶³ of the compass, below, would be another example of this scientific evolution.

3. The problem of the deviation of the compass

3.1 A growing issue

Magnetic variation, which is the angular difference between magnetic north and geographical north at any point on the earth's surface, had been studied a century earlier by Edmund Halley.⁶⁴ However, the problem of magnetic deviation, which is the angular difference between magnetic north and the direction of the compass needle due to local magnetic fields (e.g. nearby sources of iron), remained a major issue that challenged navigators. Flinders discussed the unpredictability of this effect with his Mauritian friends, as well as the lack of reliable scientific theory which could lead to an understanding of these disturbing influences which so endangered safe navigation.

While some naval officers contended that such irregularities were simply due to defects in the manufacture of the instruments, others, such as Joseph Whidbey⁶⁵ and James Downie,⁶⁶ became convinced that the disrupting effects were the result of the close proximity of iron in the structure of the ship. Flinders also noted in his memoir that William Wales, the astronomer who accompanied Captain Cook on his second voyage and observed the 'irregularities' of the compass 'throughout the whole voyage', had suggested that the deviation seemed vary 'with the ship's head in different positions'.⁶⁷ Among the important nautical books that Flinders had on board the *Investigator* was the new edition of Robertson's treatise, *The Elements of Navigation*, in which the following was stated:

⁶³ In this article, the word deviation is used for convenience and clarity although it is something of an anachronism as it was not yet established as the general term to be used to define the error of the magnetic compass.

⁶⁴ Halley constructed a map showing lines of equal magnetic declination (isogonals) across the Atlantic Ocean from the observations he collected during his sea voyages.

⁶⁵ Michael Barritt, 'Matthew Flinders's Survey Practices and Records', *The Journal of the Hakluyt Society*, Mar. 2014, p.4.

⁶⁶ Downie was, in the late eighteenth century, a master in the Royal Navy. He wrote 'that the quantity and vicinity of iron, in most ships, has an effect in attracting the needle; for it is found by experience, that the needle will not always point the same direction, when placed in different parts of the ship...' : William Walker, *The Magnetism of Ships and the Mariner's Compass*, London, Piper Brothers & Co., 1853, p. 20.

⁶⁷ TNA ADM 55/76/65.

... it was found, that the deviation of the needle from the north was not a constant quantity; but that it gradually diminished, and at last, and about the year 1660, it was found at London that the needle pointed due north, and has ever since been getting to the westward, and now the variation is more than 20 degrees to the westward of the north: so that in any one place it may be suspected the variation has a kind of libratory motion, traversing through the north to unknown limits eastward and westward.. But the settling of this point must be left to time.

About the same time, it was also discovered, that the variation of the needle was different in different parts of the world, it being west in some places when it was east in others ... It was therefore found necessary, that mariners should every day, or as often as they had opportunity, make proper observations of the sun's amplitude or azimuth; by which they might be enabled to find the variation of the compass in the place they were then, and thence correct their courses properly.⁶⁸

Flinders addressed the question of the deviation of the compass needle in three major steps, to which his work on Île de France was central.

3.2 An 'observer-practitioner' at the service of the British Admiralty

In the first stage, during his voyage, Flinders acted as an 'observer-practitioner'⁶⁹ at the service of the British Admiralty, recording bearings and data in the form of tables in his logbooks and journals that had to be handed over to the Lords Commissioners of the Admiralty at the conclusion of his mission. Each observation was recorded in tabular form with its respective date, time, latitude, longitude, which particular compass was used,⁷⁰ the number of sets, the position of the compass, the supposed true variation, and the observed variation. He scrupulously followed Robertson's instructions by making 'proper observations of the sun's amplitude or azimuth ... to find the variation of the compass ...', and corrected the direction of the ship from the alteration of its course. Significantly, Flinders added another column, the ship's head, because he observed, like Wales, that compass error changed with each alteration of course, and accordingly 'judged it necessary when a set of bearing was wanted at the time of tacking the ship to take one set just before and another just after the operation'.⁷¹

In the scale of the 'information order'⁷² in which British knowledge was produced, in completing these tables, Flinders was fulfilling his mission that was to bring back precise data to London where eminent institutions were gathering, comparing, selecting and interpreting them, and assessing their liability against the researches that were underway or planned at the time. In contrast, Flinders's theorization of the deviation of the compass that

⁶⁸ John Robertson and James Wilson, *The Elements of Navigation: Containing the Theory and Practice. With the Necessary Tables, and Compendiums for Finding the Latitude and Longitude at Sea*, printed for J. Nourse, 1796, p. 233.

⁶⁹ Eva Taylor, *The Mathematical Practitioners of Hanoverian England, 1714-1840*, Cambridge University Press for the Institute of Navigation, 1966. Flinders had to endorse as well the work of the astronomer John Crosley, who abandoned his mission on the *Investigator* because of ill health.

⁷⁰ Flinders and Crosley were provided with three azimuth compasses (to take the bearing of a heavenly body) and two meridional compasses (incorporating a sundial) of Walker's construction. There was also a compass made by Adams, but used only once (TNA ADM 55/76/66), and several theodolites (for measuring both horizontal and vertical angles). Flinders used these instruments valuably during his surveys in the south coast of New Holland in 1801–02, carefully assessing their working order.

⁷¹ TNA ADM 55/76/59.

⁷² Schaffer, Simon, 'The Information Order of Isaac Newton's Principia Mathematica', in *Hans Rausing lecture*, ed. by Uppsala University Office for History of Science, Salvia småskrifter, 2008.

he developed in Île de France with the help of his French social network was not part of his duty and went beyond the objectives of his mission.

3.3 From the observation to the search for ‘the laws by which the compass and dipping needle are regulated’

In this regard, Flinders’s time on Mauritius was very productive. At the very beginning of his detention in 1804 he took advantage of the long depressing days at the Maison Despaux to write the article ‘Concerning the Differences in the Magnetic Needle, on Board the Investigator, Arising from an Alteration in the Direction of the Ship's Head’. He asked a fellow prisoner who was permitted to depart, Walter Robertson, to hand it to Joseph Banks, president of the Royal Society, who published it in the society’s, *Philosophical Transactions*.⁷³ Later, Flinders also shared the issue with the learned society of the island, and in 1807 wrote a communication for the Society of Emulation,⁷⁴ upon the changes that take place on board ship when altering the direction of the ship’s head.⁷⁵ In these papers, Flinders drew particular attention to the fact that there was ‘a considerable difference in the direction of the magnetic needle, when there was no other apparent cause for it than that of the ship’s head being in a different direction’, and that, as Captain Cook had already observed at Pier Head on the northeastern coast of Australia, iron-stone interacted with the compass.⁷⁶

In addition, Flinders addressed the issue in his *Memoir explaining the construction of the charts of Australia*, in a special chapter entitled ‘Of the variation of the compass used in constructing the charts of Australia’ (chapter V). He sent it to the Admiralty, and revised it in 1806–07.⁷⁷ In this chapter Flinders corroborated the *Investigator* observations with earlier magnetic observations made during his previous missions in the schooners *Francis* and *Norfolk* and the *Reliance*,⁷⁸ and compared his results with other available data, in search of patterns. Flinders was careful to note that he had to conform to the mission entrusted to him by the Admiralty, and consequently that he had to ‘confine’ himself ‘to the observations made on board the Investigator’.⁷⁹

In reality, in his chapter, Flinders went far beyond his instructions in searching for the various possible physical and human causes for the deviation. He consolidated the established physical and technical factors observed by him and other officers, such as, at sea, the unsteadiness of the ship, or the obstruction of the rigging masts and upper works when viewing an object and, on shore, the magnetic effect of the surrounding ground, noticing that the theodolite, when placed approximately four feet from the ground on its legs, was not so much affected.⁸⁰ In parallel, he mentioned human factors, with individual errors such as too much haste in recording the bearing ‘before the ships place was materially altered’,⁸¹ and some weak points in the data, for example, when in April 1802 a set of bearings gave an unexpected result compared to three others. Flinders wrote in his memoir, ‘I do not recollect

⁷³ Matthew Flinders, ‘Concerning the Differences in the Magnetic Needle, on Board the Investigator, Arising from an Alteration in the Direction of the Ship's Head’, *Philosophical Transactions*, 95, 1805, p. 186.

⁷⁴ See footnote 29.

⁷⁵ Flinders, Private Journal, 4 August 1807.

⁷⁶ Michael Barritt, ‘Matthew Flinders’s Survey Practices and Records’, p. 5; Matthew Flinders, ‘Concerning the Differences in the Magnetic Needle, on Board the Investigator, Arising from an Alteration in the Direction of the Ship's Head’, *Philosophical Transactions*, 95, 1805, p. 194.

⁷⁷ TNA ADM 55/76/36–88.

This Memoir will be included in the edition of the journals kept on HMS *Investigator* in 1801–03 that will be published by the Hakluyt Society in 2014.

⁷⁸ TNA ADM 55/76/64.

⁷⁹ TNA ADM 55/76/61.

⁸⁰ TNA ADM 55/76/60, 66–67.

⁸¹ TNA ADM 55/76/59.

the order in which the bearings were taken', thereby implicitly acknowledging his failure to provide sufficiently precise information to answer the question. In this instance, the fact that the order in which the bearings were taken had not been recorded prevented Flinders from comparing the different situations. He developed some theories to explain compass deviation,⁸² and from 1807, after some discussion with his Mauritian friends, Flinders began a search for 'the laws by which the compass and dipping needle are regulated'.⁸³

Flinders was aware that his scientific investigation was 'just the commencement of the inquiry, in which, indeed, conjectures are offered and some facts brought forward, but by which nothing is fully established'.⁸⁴ He argued in his memoir that his knowledge was restricted to the documentation he had on board, and that it could not be updated because of his imprisonment, 'which debars me [Flinders] from gaining information upon several points in the theory of magnetism', and that he had to resign himself 'to make out as much from the observations already allocated, as a very superficial knowledge on the subject of magnetism will enable me [Flinders]'.⁸⁵

Flinders was frustrated by not having access to the observations of Cook's second voyage, and not being able to procure a dipping needle. After 1804 this complaint became excessive as he shared his observations with French physicians and officers, invigorating his contemplation on the subject and providing him with more food for thought. In 1805, while on parole in a nice country estate, Flinders discussed with Murat 'especially the subject of how the variation changed with the ships head'.⁸⁶ Furthermore, the exchange he had with a physician named Joss boosted Flinders's search for the physical laws behind compass deviation, even though Joss's theory hardly seemed convincing and left Flinders in doubt.⁸⁷ Flinders discussed Joss's theory and the variation of the compass with French friends such as Cap-Martin and Charles DesBassayns⁸⁸ who provided him with relevant information on the subject. For example, as Flinders was in need of 'correct observations in certain places', Cap-Martin⁸⁹ supplied him with observations made on board the *Recherche* during D'Entrecasteaux's expedition in search of La Pérouse and on board the *Régénérée* in Sercey's squadron, tasked to prey on British merchantmen in the Indian Ocean.

Tuesday 1 May 1808. Went after breakfast to Tamarinds. Stopped on the way at Palma where I breakfasted a second time, and conversed with Mr. Cap-martin upon the variation of the compass: he furnished me with some observations from La Recherche and La Régénérée.

Flinders also discussed the subject with Desbassayns during their long conversations and walks, or through their correspondance:

Thursday 6 August 1807. Fine weather. Find my health considerably better this morning.

⁸² Flinders, Matthew, 'Concerning the Differences in the Magnetic Needle, on Board the Investigator, Arising from an Alteration in the Direction of the Ship's Head', pp. 191–3. TNA ADM 55/76/62–63.

⁸³ Private Journal, Monday 23 & Tuesday 24 May 1808.

⁸⁴ TNA Adm55/76/66.

⁸⁵ TNA Adm55/76/62.

⁸⁶ Flinders, Private Journal, 13 September 1805, p.90.

⁸⁷ Joss formed a system 'respecting an universal fluid which he [Joss] conceives to be the causes of magnetism...'. Private Journal, p. 166.

⁸⁸ Charles DesBassayns was from an influential family of Ile Bourbon (Réunion), where he started to develop the sugar industry after 1815.

⁸⁹ Cap-Martin died in 1809 to the sorrow of Flinders who noted with sadness on 1 October 1809 that he could not 'attend the religious ceremony for the repose of the soul of my poor deceased friend Cap-martin; but which the circumstances of my situation render it impossible for me to accept'.

Had some conversation with Mr. DesBassayns upon my discovery of the changes that the variation of the compass undergoes on altering the direction of the ship's head, which seemed to interest him: Our visitors left us this afternoon.

Wednesday 12 and Thursday 13 August 1807. Communicated my observations upon the ~~variation~~ changes in the variation of the compass which take place on changing the direction of the ship's head to Mr. Charles DesBassayns, and also some circumstances relating to my situation here; in all of which he seemed to take much interest. He had studied some years at Paris, the different branches of natural philosophy, and found my observations and remarks accordant with philosophical experiment.

Friday 14 August 1807 Took a walk to the Bay of Tamarinds with Mr. Charles Desbassyns during which we had much conversation upon science and scientific men.

Desbassayns informed Flinders that Alexandre Humboldt and Jean Baptiste Biot were conducting research on the earth's magnetism. It was important information for Flinders, as their works were 'similar', and Humboldt and Biot suggested like Flinders that 'the points of attraction were near and equally distant from the center of the earth.'

Friday 27 May 1808. ...Received a long letter from M. Charles Desbassayns, from which I learn that Humbolt and Biott had made researches into the magnetism of the earth similar to those which occupy me at present. They also found that the points of attraction were near, and equally distant from the center of the earth.

Indeed, although Humboldt and Biot's observations 'Sur les variations du magnétisme terrestre à différentes latitudes',⁹⁰ did not focus specifically on magnetism caused by the structure of ships, it did bring Flinders's wider knowledge of the subject up to date. The aim of Humboldt's magnetic observations during his voyage from 1799 to 1803 was to search for the law 'd'après laquelle l'intensité des forces magnétiques varie à différentes latitudes de l'équateur aux pôles magnétiques' that demonstrated the regular increase in the intensity of the earth's magnetic field from the equator to the poles.⁹¹ Like Humboldt, Flinders was occupied 'in searching the positions of the points of attraction of the magnetic needle', and he explained in a letter to Desbassyns that he had 'imagined an experiment by which the sum and difference of the attractions and repulsions of the poles may be readily obtained'.

Monday 30 May 1808 Fine weather. Occupied still in searching the positions of the points of attraction of the magnetic needle, which appear to be about, 17 of the earths semidiameter on each side the center: this agrees with the great dips, but not with the smaller ones.

Desbassayns also introduced Flinders to the treatise by the French physician René Just Haüy,⁹² in which Haüy proposed a law similar to the Newtonian law of universal gravitational

⁹⁰ Alexandre de Humboldt and Jean-Baptiste Biot, 'Sur les variations du magnétisme terrestre à différentes latitudes', *Journal de physique*, 59, 1804, pp. 429–50.

⁹¹ Alexandre de Humboldt and Aimé Bonpland, *Voyage de Humboldt et Bonpland*, Première Partie: Relation Historique, Vol. 3, Paris, J. Smith, 1825, p. 615. As a matter of fact, this issue had been previously investigated by Rossel during the D'Entrecasteaux expedition, Rossel concluded like Humboldt that the magnetic forces varied with latitude.

⁹² Private Journal, 19 February 1808. It was Napoléon who ordered The *traité élémentaire de physique* to Haüy, to serve as the basic study tool in physics in French public high schools/lycées, as part of the French institutionalisation of scientific education. Haüy is also famous for his *Traité de minéralogie* and is considered one of the fathers of modern crystallography.

attraction having analysed the changes in deviation and dip of the compass needle in relation to time, place and the presence of iron. Haüy made the connection between electricity and magnetism, and compared the various European theories of his time.⁹³

In contrast to these general works, which based their assumptions on the existence of fluidic particles circulating within a magnet, Flinders focused chiefly on magnetism aboard ships, with a more practical and applied perspective related to nautical sciences. After his return to London, he was able to complete his observations and finalize his deductions regarding the compass's deviation aboard ships, while the Admiralty⁹⁴ authorized him to orchestrate a series of experiments at Sheerness, Portsmouth and Plymouth to observe and compare the direction of the deviation from different ships and ports.⁹⁵

To conclude, Flinders benefited from the learned society of Île de France in constructing his theory on the deviation of the compass that, in turn, benefited the development of nautical sciences. This context of scientific interface where French knowledge complemented and, to a certain extent, stimulated Flinders's work can also be traced in Flinders's understanding of the geology of the island.

4. Flinders and his contribution to the history of geology in Mauritius

During his excursions to the Piton and the Rivière des Tamarins⁹⁶ with his friends, Flinders carefully observed the mineralogy and the geology of Île de France. In his description and identification of the rocks and minerals which he examined, he applied the practical method of British practitioners, based on methodical observation. His interpretation of the local geology indicates a familiarity with the ongoing European debates on the origins of rocks, which he discussed with his French companions. On 15 October 1805, during a visit to the Grand Bassin,⁹⁷ Flinders found rocks containing 'small holes' which made a sound when struck. He identified them as 'imperfect basalts'. The small cavities he noted were formed by the expansion of gas bubbles during the solidification of magma and are common in volcanic rocks. Flinders went on many other excursions with his friends. On 15–16 February 1808, applying the criteria used by practical geological surveyors, he described a rock brought to him by Desbassyns in terms of its colour ('brownish grey'), texture ('close grained' and 'homogenous') and composition ('of a calcareous nature'). He noted that this limestone did not appear to contain shells or other marine substances. When the conversation with his friends turned to the origin of the island, Flinders found that his personal opinion matched that of Desbassyns. Both believed in 'the former existence of volcanos in the island', and that most of its rocks were 'lava which has been more or less fused'.

Tuesday 15 October 1805 ... I observed a good deal of the stone to be ferruginous, and this part seemed to have once been in a liquid state. Most of the other stone was full of small holes something in the manner of a honey comb, and when struck was sonorous. I suppose it to be imperfect basaltes: its colour is an iron grey...

⁹³ René Just Haüy, *Traité élémentaire de physique*, 2 vols, Vol. 1, de l'Imprimerie de Huzard-Courcier, 1821, pp. xxiii–xxxviii.

⁹⁴ With Captain Hurd, who replaced Alexander Dalrymple in 1808.

⁹⁵ See Private Journal. Ingleton has detailed the experiments: Geoffrey Chapman Ingleton, *Matthew Flinders: Navigator and Chartmaker*, Guildford, Genesis Publications, 1986, pp. 407–09. See also Antony Edward Fanning, *Steady as She Goes: A History of the Compass Department of the Admiralty*, London, H.M.S.O., 1986, pp. xxvi–xxvii.

⁹⁶ The hilly south-western part of the Island, near Mme d'Arifat plantation. It is now part of Black River George National Park.

⁹⁷ East of the Rivière des Tamarins.

Monday 15. Tuesday 16 February 1808. Sent back the books and charts lent me for the construction of my chart of Madagascar. Ch. Desb. brought a specimen of the lime stone mine on M. Remi's habitation. It appears to have been formed by the deposition of calcareous matter from either the sea or a spring in the hollows left by the volcanic lava; some peices of the common stone are mixed with it, being probably rolled down by the torrent or sea. There are no certain marks of shells or other marine substances in the lime stone. Its colour is a brownish grey, close grained, and except small and sometimes rounded particles of the common stone here and there, is homogeneous: The lime stone was found at the surface, but the mine has not been sufficiently dug to know how far down it may extend. My friend Charles and Mr. Joss who came this morning being of opposite opinions as to the original formation of this island, I had the pleasure to hear it discussed, and was confirmed in my opinion as to the former existence of volcanos in the island, and that the stone is, with very rare exceptions, a lava which has been more or less fused.

The differing views held by Flinders and Debassyns on the one hand, and by Joss on the other, with regard to the volcanic origin of the island and its rocks, were then the subject of major debate in Europe. Two opposing theories on the formation and classification of rocks had been proposed at the turn of the nineteenth century by the German geologist Abraham Gottlob Werner (1749–1817) and by the Scottish geologist James Hutton (1726–1797). Werner believed that crystalline rocks⁹⁸ such as granite originated from minerals that precipitated and crystallized beneath the warm waters of the ancient primordial ocean. When sea levels fell, the erosion of these primitive rocks⁹⁹ provided the material for the deposition of sediments. This theory was referred to as Neptunism, after the Greco-Roman god of the sea. Werner also proposed a new classification of rocks in which he did not recognise basalt as being of volcanic origin but instead included it among the primitive rocks. Werner's classification of rocks was well known in Great Britain, and particularly in Scotland where Robert Jameson (1774–1854), Werner's former student, defended his teacher's theory. The supplement to *Encyclopaedia Britannica*, published in 1801, which Flinders had on board, referred to Werner's theory, as well as to Haüy's classification of crystals, in an article on 'mineralogy'. In contrast to Werner's ideas, Hutton's theory, first published in detail in 1795, emphasised the immense 'continuance of time' necessary for the formation of the earth's geological features. Hutton thought that geological processes were 'extremely slow' and occurred in cycles: solid rocks being subjected to weathering and erosion to form sediments, which were then transported by rivers and deposited in the sea. Buried deep under the weight of thick deposits of more sediment, they solidified and were subjected to 'a sufficient intensity of subterraneous fire or heat, and a sufficient degree of compression upon those bodies'.¹⁰⁰ These sedimentary rocks began to melt to form magma, which then rose to higher levels in the crust where it gradually cooled and solidified to form plutonic rocks, or, in other cases, where it reached the surface and erupted as lava to form volcanic rocks. The whole cycle then started again. This theory was later referred to as uniformitarianism, as opposed to catastrophism. The latter theory assumed that the earth had been affected in the past by sudden, short-lived, violent events, a view which was held in France by Buffon and Georges Cuvier and in Great Britain by William Buckland. In Hutton's theory, basalts were the product of volcanic activity. Because Hutton invoked heat as a geological agent, his theory

⁹⁸ These are now known as igneous rocks.

⁹⁹ The term primitive was first applied by Lehman and was adopted by Werner.

¹⁰⁰ James Hutton, 'Theory of the Earth; or an Investigation of the Laws Observable in the Composition, Dissolution, and Restoration of Land Upon the Globe', *Transactions of the Royal Society of Edinburgh*, Vol. I, Part II, 1788, p. 237.

was referred to as ‘Plutonism’ after the god of the underworld. In France, geologists such as Déodat Gratet de Dolomieu taught Werner’s theory at the École des Mines, while also supporting Hutton’s view on the volcanic origin of basalts.¹⁰¹ Thus, the discussion between Desbassyns and Joss probably reflected the competing German and Scottish theories, to the delight of Flinders, who opted for the Plutonist view of Hutton.

On his other excursions in the Rivière des Tamarins, Flinders continued to note the volcanic origin of the island and recorded ‘many strata nearly perpendicular: the stone resembling the usual stone of the country’ in the rocky banks.¹⁰² Such strata were most likely outcrops of basalt showing vertical joints that form when lava flows cool. The French naturalist and artist from the expedition of Nicolas Baudin, Jacques-Gérard Milbert,¹⁰³ drew a picture of this river that depicted accurately part of the volcanic landscape of Île de France described by Flinders with ‘the great stones which cover the ground’. However, these stones had not ‘been thrown out from the volcanoes’, as Flinders thought, and the angular blocks of rock shown in Milbert’s drawing seem to have broken away and fallen off the basalt cliffs, at the foot of which they now rest.

Saturday July 1. Fresh east^{ly}. winds. Breakfasted early, and went with the three brothers Labauve on an excursion to the valley of Tamarinds; but the difficulty of travelling along the great blocks of slippery rock in the bed of the river, or in the scrubby woods on the banks, prevented us from going further than to the two high precipices which form the entrance, and where I supposed to have been the original and sole cascade of the river. In the rocky banks, I saw many strata nearly perpendicular: the stone resembling the usual stone of the country in some measure, but is brittle and breaks in perpendicular lines On the surface, the great stones which cover the ground have for the most part sharp edges, having been broken, I think, by their fall after having been thrown out from the volcanos of which the island contains so many remains¹⁰⁴.

¹⁰¹ Wolf Mayer, ‘The Geological Work of the Baudin Expedition in Australia (1801-1803): The Mineralogists, the Discoveries and the Legacy’, *Earth Sciences History*, 28, no. 2, 2009, p. 300.

¹⁰² Flinders, *Private Journal*, Saturday 1 July 1809.

¹⁰³ As a matter of fact, Jacques-Gérard Milbert did not fulfill his mission, as he left the expedition in Île de France.

¹⁰⁴ *Ibid.*, Saturday 1 July 1809



Figure 3. Jacques-Gérard Milbert, *Illustrations de voyage pittoresque à l'Île de France*, 1812. Cascade des Tamarins, with 'the great stones which cover the ground', and their 'sharp edges'. Source: <http://gallica.bnf.fr/ark:/12148/btv1b2300673j>

Consequently, Flinders's interpretation of the geology of Île de France highlights how geological theories that divided scientists in both England and France had circulated among the European educated classes, and encouraged them to construct a geological history of the Earth through the observation and classification of its rocks.

Conclusion

Diligently, Flinders gathered important geographical information while on Île de France, making the best of his time, his limited yet valuable freedom of movement, and the friendly and helpful social network of the island.¹⁰⁵

His outstanding nautical, geographical and editorial work attests to the fact that French learned society played a helpful and supportive role in its progress, and that, despite the wars, the fate of British and French knowledge was European. If European borders were politically thick, they were scientifically and scholarly thin. The circulation of nautical and geographical knowledge was not really limited by European national boundaries and wars, and became increasingly linked with science to uncover the universal laws that regulate the earth, while in its practical aspects it also served national interests and politics.

Furthermore, Flinders's work on Île de France shows that progress in nautical and geographical sciences was run by a broadly based community of seamen, scholars, men, and women versed in sciences who exchanged their observations, experience, information, understanding and interests, where the sea, its islands and shores were common bonds. In this regard, Flinders's captivity isolated the British captain from the political and bellicose scenes

¹⁰⁵ Flinders remained much attached to his French companions, and faithfully, from London, continued to correspond with them.

of the Napoleonic wars, which dominate our general perception of the history of that period. In effect, the exchange of knowledge that Flinders had with his French friends was partly based on a different temporality that scientifically united what our chronological conception of history would separate. This alternative temporality was embodied idealistically in Europe by Joseph Banks and Laurent Jussieu with the concept of a 'Republic of letters'.¹⁰⁶ On Île de France in the Indian Ocean, this concept gained ground.¹⁰⁷

Ultimately, within the nineteenth century's ongoing colonial competition between Britain and France, Flinders's work evolved in the service of British national interest and was used by the Admiralty, the British Secretary of State for the colonies, and the New South Wales colonial administration to develop British overseas territories. But from the perspective of all humanity, on Île de France Flinders's geographical and scientific studies were rooted in the collective and cosmopolitan adventure that connected competent and informed people working concurrently to expand our knowledge of the world.

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¹⁰⁶ John Gascoigne, *Science in the Service of Empire: Joseph Banks, the British State and the Uses of Science in the Age of Revolution*, Cambridge University Press, 1998, pp. 165–6.

¹⁰⁷ This does not imply that the Indian Ocean was at peace: In actual fact, in this ocean, French and British privateers were reciprocally in frequent, if not constant, action against each other, and its islands were highly coveted by both France and Britain.