

NOTES

ABBREVIATIONS USED

- AN.** Archives Nationales, Paris
AS. Archives de l'Académie des sciences, Paris
CRAS. *Comptes rendus de l'Académie des Sciences*
NAB. National Archives Building, Washington, D.C.
Oeuvres. Henri de Sénarmont, Émile Verdet, and Léonor Fresnel, eds., *Oeuvres complètes d'Augustin Fresnel* (Paris: Imprimerie Impériale, 1866–1870), 3 vols.
Report. *Report of the Officers Constituting the Light-House Board* (Washington, D.C.: A. Boyd Hamilton, 1852)
RG. Record Group

INTRODUCTION: DARK AND DEADLY SHORES

11 *Méduse*: Accounts of the ill-fated *Méduse* include Jonathan Miles, *The Wreck of the Medusa: The Most Famous Sea Disaster of the Nineteenth Century* (New York: Atlantic Monthly Press, 2007); Alexander McKee, *Wreck of the Medusa: Mutiny, Murder, and Survival on the High Seas* (New York: Skyhorse, 2007); Albert Alhadef, *The Raft of the Medusa* (Munich: Prestel, 2002). For a broader discussion of early nineteenth-century shipwrecks, see Jean Louis Deperthes, *Histoire des naufrages* (Paris: Ledoux et Tenré, 1815); Cyrus Redding, *A History of Shipwrecks and Disasters*

at Sea (London: Whittaker, Treacher, 1833); John Graham, *Shipwrecks and Disasters at Sea* (London: Routledge, 1866); Terence Grocott, *Shipwrecks of the Revolutionary and Napoleonic Era* (London: Caxton Editions, 2002); E. Chevalier, *Histoire de la Marine Française de 1815–1870* (Paris: Hachette, 1900).

11 “We abandon them!” Alexandre Corréard and J. B. Henry Savigny, *Nauffrage de la fregate la Méduse* (Paris: Hocquet, 1817), 55.

14 Lloyd’s of London reported: *Journal of the House of Commons* 91 (1836), 811.

14 In France, two naturalists counted: Jean Audouin and Henri Milne Edwards, *Recherches pour servir à l’histoire naturelle du littoral de la France* (Paris: Crochard, 1832).

16 one of the most ancient technologies: Some general overviews of lighthouse history are Ray Jones, *The Lighthouse Encyclopedia* (Guilford, Conn.: Globe Pequot Press, 2004); Samuel Willard Compton and Michael J. Rhein, *The Ultimate Book of Lighthouses* (San Diego: Thunder Bay Press, 2000).

18 “The painter has assembled”: Quoted in McKee, *Wreck of the Medusa*, 247.

CHAPTER ONE: DREAMS OF GLORY

21 Augustin Fresnel: For biographical information, see Charles Fabry, “La vie et l’oeuvre scientifique d’Augustin Fresnel,” in *Oeuvres choisies* (Paris: Gauthier-Villars, 1938), 633–53; François Arago, “Augustin Fresnel,” in *Oeuvres complètes de François Arago*, t. 1 (Paris: Gide et J. Baudry, 1855); “Centenaire d’Augustin Fresnel,” *Revue d’Optique théorique et instrumentale*, no. 6 (1927), 493–570. More recent is Claude Brezinski, *Ampère, Arago, et Fresnel: trois hommes, trois savants, trois amis, 1775–1853* (Paris: Hermann, 2008). Fresnel’s collected works, compiled largely under the care of his brother Léonor, are exceptionally well annotated and include an overview of his life and work by Émile

Verdet: Henri de Sénarmont, Émile Verdet, and Léonor Fresnel, eds., *Oeuvres complètes d'Augustin Fresnel* [hereafter *Oeuvres*] (Paris: Imprimerie Impériale, 1866–1870), 3 vols.

24 Jansenism: William Doyle, *Jansenism* (New York: St. Martin's Press, 2000); Dale Van Kley, *The Religious Origins of the French Revolution: From Calvin to the Civil Constitution, 1560–1791* (New Haven: Yale University Press, 1996).

25 “His memory seemed”: Fabry, “La vie,” 640.

26 “young man of the greatest”: registre de l'École centrale de Caen, An XI, Archives départementales du Calvados, Caen, France, reproduced in François Dutour, Nicole Poirier, and Rémi Poirier, *Augustin Fresnel, 1788–1827* (Caen: Conseil Général du Calvados, 2000), 17.

26 École polytechnique: Bruno Belhoste, Amy Dahan, and Antoine Picon, *La formation polytechnicienne* (Paris: Dunod, 1994); Bruno Belhoste, Amy Dahan Dalmedico, Dominique Pestre, and Antoine Picon, eds., *La France des X: Deux siècles d'histoire*. (Paris: Economica, 1995); Janis Langins, *La République avait besoin de savants: les débuts de l'École polytechnique—l'École centrale des travaux publics et les cours révolutionnaires de l'an III* (Paris: Berlin, 1987).

26 five feet three inches tall: Fiche d'immatriculation de Augustin Fresnel, 1804, Archives de l'École polytechnique, Palaiseau, France.

27 “He does not appear”: comte de Montalivet, November 18, 1808, Archives Nationales, Paris [hereafter AN] f/14/2228/2, n. 136.

28 “I find nothing more tiresome”: Augustin Fresnel to Léonor Mérimée, December 29, 1816, in *Oeuvres*, 1:xxviii.

28 “tormented by the worries”: Augustin Fresnel to François Arago, December 14, 1816, in *Oeuvres*, 1:xxviii.

29 diffraction: For Fresnel's optical work, see Jed Buchwald, *The Rise of the Wave Theory of Light* (Chicago: University of Chicago Press, 1989); Jean Rosmorduc, Vinca Rosmorduc, and Françoise Dutour, *Les révolutions de l'optique et l'oeuvre de Fresnel* (Paris:

Vuibert, 2004); Kenneth Schaffner, *Nineteenth-Century Aether Theories* (Oxford: Pergamon Press, 1972).

32 François Arago: Maurice Daumas, *Arago. La jeunesse de la Science* (Paris: Belin, 1987); James Lequeux, *François Arago* (Paris: EDP-Sciences, 2008); François Sarda, *Les Arago: François et les autres* (Paris: Tallandier, 2002).

34 “not a single”: Charles Coulston Gillispie, *Pierre-Simon Laplace, 1749–1827: A Life in Exact Science* (Princeton: Princeton University Press, 2000), 67. See also Roger Hahn, *Pierre Simon Laplace, 1749–1827: A Determined Scientist* (Cambridge: Harvard University Press, 2005). For a general discussion of scientific culture in the revolutionary and Napoleonic eras, see Charles Coulston Gillispie, *Science and Polity at the End of the Old Regime* (Princeton: Princeton University Press, 1980); Maurice Crosland, *The Society of Arcueil: A View of French Science at the Time of Napoleon I* (Cambridge: Harvard University Press, 1967); Lorraine Daston, “Nationalism and Scientific Neutrality under Napoleon,” in Tore Frängsmyr, ed., *Solomon’s House Revisited: The Organization and Institutionalization of Science* (Canton, Mass.: Science History Publications, 1990), 95–119; Jean Dhombres and Nicole Dhombres, *Naissance d’un pouvoir: Sciences et savants en France (1793–1824)* (Paris: Payot, 1989); Robert Fox, *The Culture of Science in France, 1700–1900* (Aldershot: Variorum, 1992); Ken Alder, *Engineering the Revolution: Arms and Enlightenment in France, 1763–1815* (Princeton: Princeton University Press, 1997).

34 “in short carried the spirit”: *Correspondance de Napoléon Ier*, 30 (1870), 330.

35 “Sire, I have no need”: The words are probably apocryphal, but the spirit of the exchange was recorded in William Herschel, *The Scientific Papers of Sir William Herschel* (London: Royal Society and Royal Astronomical Society, 1912), 1:1xii.

35 “but what was my disenchantment”: François Arago, *Histoire de ma jeunesse* (Brussels: Kiessling, Schnée, 1854), 55.

- 36 “was active and incessant”: *Ibid.*, 146.
- 36 “tall commanding form”: *Penny Cyclopaedia* (London: Knight, 1858), 33.
- 37 “*ardeurs méridionales*”: François Arago to Mme Pelletier, Dossier Arago, Archives de l’Académie des Sciences, Paris [hereafter AS].
- 38 “show[ing] himself constantly”: *Extrait de l’arrêté pris à Valence le 9 mai 1815 par M. le Baron Bourdon Vatry*, AN f/14/2228/2, n. 56.
- 38 “When one knows Mr. Fresnel”: Pierre Charles Le Sage to comte de Molé, May 30, 1815, AN f/14/2228/2, n. 53.
- 39 “the residence in which”: Pierre Charles le Sage to comte de Molé, July 24, 1815, AN f/14/2228/2, n. 50.
- 39 “the poor state of my health”: Augustin Fresnel to comte de Molé, July 27, 1815, AN f/14/2228/2, n. 47.
- 41 “leaving no doubt”: Augustin Fresnel, in *Oeuvres*, 1:20
- 41 “My health has been weakened”: Augustin Fresnel to comte de Molé, September 15, 1815, AN f/14/2228/2, n. 20.
- 42 “very remarkable for their novelty”: François Arago to Gaspard de Prony, December 19, 1815, AS.
- 42 “will be profitable”: Gaspard de Prony to comte de Molé, December 20, 1815 AN f/14/2228/2, n. 60.
- 42 “very remarkable experiments”: comte de Molé to Augustin Fresnel, October 27, 1815, AN f/14/2228/2.
- 42 “attached the greatest importance”: Augustin Fresnel to Léonor Fresnel, February 18, 1816, Document LIX/15, in *Oeuvres*, 2:833.
- 42 “You could not give”: comte de Molé to Augustin Fresnel, June 7, 1816, AN f/14/2228/2, n. 31.
- 43 “I have decided to remain”: Augustin Fresnel to Léonor Fresnel, September 25, 1816, Document LIX/18, in *Oeuvres*, 2:837.
- 43 “all pale with hunger”: Émile Souvestre, *Les Derniers Bretons* (Paris: Charpentier, 1836), 190.

- 43 “I am a third of the time”: Augustin Fresnel to comte de Molé, April 24, 1817, AN f/14/2228/2, n. 34.
- 43 “I burn to leave Rennes”: Augustin Fresnel to François Arago, February 9, 1817, Dossier Fresnel, AS.
- 44 “impatient”: Augustin Fresnel to comte de Molé, April 24, 1817, AN f/14/2228/2, n. 34.
- 44 “on every occasion treated Fresnel”: Arago, “Fresnel,” in *Biographies of Distinguished Scientific Men*, W. H. Smyth, trans. (Boston: Ticknor and Field, 1859), 181.
- 45 “the motions of the rays”: Announcement in *Oeuvres*, 1:xxxvi.
- 45 “enemy attack”: Léonor Mérimée to Augustin Fresnel, March 6, 1817, Document LIX/23, in *Oeuvres*, 2:842.
- 47 “just as illuminated”: *Oeuvres*, 2:365.

CHAPTER TWO: THE FLASH OF BRILLIANCE

- 49 “on the universality of the coasts”: *Oeuvres*, 3:xxii.
- 52 Argand: John J. Wolfe, *Brandy, Balloons, and Lamps: Aimé Argand, 1750–1803* (Carbondale: Southern Illinois University Press, 1999).
- 53 up to eight mirrors: Jean-Baptiste Biot and François Arago, *Recueil d’observations géodesiques astronomiques et physiques* (Paris: Courcier, 1821), 158.
- 53 “Sirs, I have the honor”: Louis Becquey to Commission, July 21, 1819, in *Oeuvres*, 3:xxiv.
- 56 “the hassle of these little details”: Augustin Fresnel to Léonor Fresnel, 45 2, 1819, in *Oeuvres*, 3:386.
- 56 “perceived at first glance”: François Arago, “Fresnel,” in *Biographies of Distinguished Scientific Men*, W. H. Smyth, trans. (Boston: Ticknor and Field, 1859), 269.
- 58 dioptric: For the invention of the lens, see Augustin Fresnel, “Phares et appareils d’éclairage,” in *Oeuvres*, vol. 3, 1–474. For the technical development of the lens, see the series of articles by Thomas Tag titled “Producers of the Fresnel Lens” in *The Keeper’s*

Log: “Part I,” 21, no. 3 (Spring 2005); “Part II,” 21, no. 4 (Summer 2005); “Part III,” 22, no. 1 (Fall 2005); “Part IV,” 22, no. 2 (Winter 2005); “Part V,” 22, no. 3 (Spring 2006); “Part VI,” 23, no. 1 (Fall 2006); also Julia Elton, “A Light to Lighten Our Darkness: Lighthouse Optics and the Later Development of Fresnel’s Revolutionary Refracting Lens, 1780–1900,” *International Journal for the History of Engineering and Technology* 79, no. 2 (July 2009), 183–244.

59 “broken through an open door”: *Oeuvres*, 2:832.

62 François Soleil: Paolo Brenni, “Soleil, Duboscq, and Their Successors,” *Bulletin of the Scientific Instrument Society*, no. 51 (1996), 7–16; Allen Simpson, “François Soleil, Andrew Ross and William Cookson: The Fresnel Lens Applied,” *Bulletin of the Scientific Instrument Society*, no. 41 (1994), 16–19.

64 “dazzled by the spectacle”: Augustin Fresnel to Léonor Fresnel, June 19, 1820, in *Oeuvres*, 3:387.

65 “It must have been a hardy soul”: Augustin Fresnel to Léonor Fresnel, April 15, 1821, in *Oeuvres*, 3:388.

66 “enchanted”: *Ibid.*

66 “partial and little representative”: Vincent Guigueno, *Au Service des phares: La signalisation maritime en France XIXe–XXe siècle* (Rennes: Presses universitaires de Rennes, 2001), 57.

66 “not hesitate to recognize”: Isaac Bordiet-Marcet to Louis Becquey, AN F14.

66 “I don’t know”: Augustin Fresnel, to Léonor Fresnel, April 15, 1820, in *Oeuvres*, 3:389.

71 Jacques Tabouret: Although Tabouret’s first name is absent from all French documents, it appears in his contract with Chance Brothers. “An Agreement made the 1st day of January 1850,” BS6/3/3/3/36, Sandwell Community History and Archives, Smethwick, England.

72 “like the slats on a Venetian blind” “Mémoire sur un Nouveau Système de Phares,” in *Oeuvres*, 3:125.

72 “a good number of honest Parisians”: Augustin Fresnel to Léonor Fresnel, July 25, 1822, in *Oeuvres*, 3:391.

75 six months' worth of food and supplies: Thomas Adolphus Trollope, *A Summer in Western France* (London: Henry Colburn, 1841), 2:243.

76 "Having almost only bad workers": Augustin Fresnel to Thomas Young, September 16, 1823, in *Oeuvres*, 2:764.

77 "It's only by following the experimental method": Augustin Fresnel to Robert Stevenson, June 3, 1825, in *Oeuvres*, 3:423.

CHAPTER THREE: THE DREAM OF TOTAL REFRACTION

82 Carte des phares: Augustin Fresnel and Admiral Rossel, "Rapport contenant l'exposition du système adopté par la commission des phares pour éclairer les côtes de France," in *Oeuvres*, 3:241. For the history of the French lighthouse service, see Léonce Reynaud, *Mémoire sur l'éclairage et le balisage de côtes de France* (Paris: Imprimerie imperial, 1865); Vincent Guigueno, *Au Service des phares: La signalisation maritime en France XIXe-XXe siècle* (Rennes: Presses Universitaires de Rennes, 2001); Francis Dreyer and Jean-Christophe Fichou, *L'histoire de tous les phares de France* (Rennes: Éditions Ouest-France, 2005); Jean-Christophe Fichou, Noël Le Hénaff, and Xavier Méval, *Phares: histoire du balisage et de l'éclairage des côtes de France* (Douarnenez, France: Chasse-Marée, 1999); Fichou, *Gardiens de phares: 1798-1939* (Rennes: Presses Universitaires de Rennes, 2002); Xavier Méval, *Phares de France* (Douarnenez, France: Chasse-Marée, 2006); Émile Allard, *Les phares* (Paris: Rothschild, 1889); Guy Prigent, *Phares et balises* (Rennes: Éditions Apogée, 2002); Olivier Chapuis, *A la mer comme au ciel. Beautemps-Beaupré et la naissance de l'hydrographie moderne* (Paris: Presses Universitaires de la Sorbonne, 2000).

84 Soleil for seven thousand francs: mémoire des fournitures et ouvrages faits pour le sr. Soleil (1824), AN F/14/19830.

87 found his prisms inexact: *Oeuvres*, 3:368.

87 "It is quite difficult to": Augustin Fresnel to Robert Stevenson,

1825, in Guigueno, *Au Service*, 56. From National Library of Scotland (NLS), Ace 10706 (Stevenson Papers), n. 80, Incoming letters (1824–1826).

88 “I waited some days”: Augustin Fresnel to M. Georges Bon-temps, director of the Choisy-le-Roi factory, August 4, 1826, reproduced in Thomas Tag, “Producers of the Fresnel Lens, Part I: The Early Development of the Fresnel Lens,” *Keeper’s Log* 21, no. 3 (Spring 2005).

88 “Monsieur Soleil complains”: Augustin Fresnel to M. Tassaert, Paris, June 26, 1825, quoted in *ibid.*

90 “neither the leisure nor the health”: Augustin Fresnel to M. Roard, Paris, December 30, 1826, in *Oeuvres*, 3:381.

91 “If one questions Arago”: Augustin Fresnel to Claude-Louis Mathieu, July 18, 1822, Dossier Mathieu, AS.

91 “the most glorious and Undividable”: “A Translation of the Charter of K.H. the 8th, Exemplified by His Most Excellent Majesty King George II,” in *The Royal Charter of Confirmation Granted by His Most Excellent King James II to the Trinity House of Deptford-Strond* (London: Trinity House, 1763), 104.

91 built under private contract: The English example was central to the argument that lighthouses do not always function as a public good, in R. H. Coase, “The Lighthouse in Economics,” *Journal of Law and Economics* 17, no. 2 (1974), 357–376; see also James Taylor, “Private Property, Public Interest, and the Role of the State in Nineteenth-Century Britain: The Case of the Lighthouses,” *Historical Journal* 44, no. 3 (September 2001), 749–771. The literature, however, does not take into consideration the impact of the Fresnel lens, which ended the era of privately owned lighthouses.

91 “the evil of having lights”: Quoted in Bella Bathurst, *The Lighthouse Stevensons: The Extraordinary Story of the Building of the Scottish Lighthouses by the Ancestors of Robert Louis Stevenson* (New York: HarperCollins, 1999), xxi.

92 “like a star of the first magnitude”: Captain Henry Kater (second

British officer assisting Colby), "An Account of the Trigonometrical Operations in the Years 1821, 1822, and 1823, for Determining the Difference of Longitude between the Royal Observatories of Paris and Greenwich," *Philosophical Transactions* 118 (January 1828), 154.

92 Northern Lighthouse Board: Bathurst, *Lighthouse Stevensons*; Alison Morrison-Low, *Northern Lights: The Age of Scottish Lighthouses* (Edinburgh: National Museums Scotland, 2010); Alan Stevenon, *A Rudimentary Treatise on the History, Construction, and Illumination of Lighthouses* (London: John Weale, 1850); Thomas Stevenson, *Lighthouse Illumination* (London: John Weale, 1859); David Stevenson, *Lighthouses* (Edinburgh: Adam and Charles Black, 1864).

93 "Monsieur Frenel": Cited in Guigueno, *Au Service*, 29.

94 "fractious to the extent": Henry Cockburn, *Circuit Journey* (Edinburgh, 1888), 234, cited in Alison Morrison-Low, "Brewster and Scientific Instruments," in A. D. Morrison-Low and J. D. Christie, eds., 'Martyr of Science': *Sir David Brewster, 1781-1868* (Edinburgh: Royal Scottish Museum, 1984).

94 "the Creed of the Society": David Brewster to H. Brougham, September 26, 1847, Brougham Papers, Ms. 26632, University College, London, cited in G. N. Cantor, *Optics after Newton: Theories of Light in Britain and Ireland, 1704-1840* (Manchester: Manchester University Press, 1983), 176.

94 Brewster's immediate response: Bathurst, *Lighthouse Stevensons*, 137.

94 "bizarre disposition of spirit": François Arago, "Sur le nouveau Système d'éclairage des phares adopté en France," *Annales de chimie et de physique*, t. 37 (Paris: Crochard, 1828), 399.

CHAPTER FOUR: RACE TO PERFECTION

97 "*les passions tristes*": David Barnes, *The Making of a Social Disease: Tuberculosis in Nineteenth-Century France* (Berkeley: University of California Press, 1995), 25.

98 Becquey quickly agreed to the request: Louis Becquey to Augustin Fresnel, March 12, 1827, in *Oeuvres*, 3:441 (“deplorable state” is editor’s phrase).

98 “the most beautiful crown”: François Arago, *Biographies of Distinguished Scientific Men*, W. H. Smyth, trans. (Boston: Ticknor and Field, 1859), 279.

99 “I could have wished to live longer”: *Ibid.*, 278.

99 “paternal kindness”: Léonor Fresnel to Louis Becquey, July 25, 1827, AN f/14/2228/2, n. 163.

100 Industrial Revolution: For the history of industrialization in France, see Jean-Pierre Daviet, *La Société industrielle en France (1814–1914)* (Paris: Seuil, 1997); Antoine Picon, *L’Invention de l’ingénieur moderne* (Paris: Presses de l’École nationale des ponts et chaussées, 1992); Jeff Horn, *The Path Not Taken: French Industrialization in the Age of Revolution, 1750–1830* (Cambridge: MIT Press, 2006); François Caron, *La dynamique de l’innovation: Changement technique et changement social (XIX–XXe siècle)* (Paris: Gallimard, 2010).

102 “a triumph”: Cited in François Sarda, *Les Arago: François et les autres* (Paris: Tallandier, 2002), 112.

102 “Modern lighthouses”: François Arago, “Les phares,” in *Oeuvres complètes de François Arago* (Paris: Gide et J. Baudry, 1855), 6:56.

102 “our most useful”: François Arago, June 6, 1833, in *Archives parlementaires de 1787 à 1860: recueil complet des débats* (Paris: Paul Dupont, 1892), 625.

103 “One day”: “Discours d M. Arago, dans la Chambre des députés, Séance du 25 mai 1842,” in *Annales maritimes et coloniales* (Ministère de la marine de des colonies, 1842), 1058.

104 “notable advantages”: Quoted in Bella Bathurst, *The Lighthouse Stevensons: The Extraordinary Story of the Building of the Scottish Lighthouses by the Ancestors of Robert Louis Stevenson* (New York: HarperCollins, 1999), 153.

104 Léonor petitioned the Ponts et chaussées: Léonor Fresnel to Louis Becquey, July 4, 1837, AN f/14/2228/2, n. 85.

105 his new bride: Eulalie Françoise Réal-Lacué was the daughter of revolutionary politician Pierre François Réal. A forty-six-year-old widow, she had received a marriage proposal from Stendhal in October of 1836, before marrying Léonor in December. Robert Alter, *A Lion for Love: A Critical Biography of Stendhal* (New York: Basic Books, 1979), 237.

105 singing parts of an opera: Léonce Reynaud to François Soleil, Paris, December 1, 1841, AN f/14/20813.

106 Léonor began pushing French manufacturers: *Commission des phares*, registre D, 5, cited in Vincent Guigueno, *Au Service des phares: La signalisation maritime en France XIXe-XXe siècle* (Rennes: Presses Universitaires de Rennes, 2001), 59.

106 Santander Lighthouse: According to his son, Lepaute first asked Soleil to provide the lenses. Soleil, however, refused, wanting “the market to be under his name alone.” Lepaute, stuck with the order from Spain, was forced to try his hand at making the optics himself. Henry-Lepaute, fils to Léonce Reynaud, Paris, March 6, 1874, AN f/14/20816.

106 “a happy concurrence”: Léonor Fresnel, “Note pour l’Exposition de 1844,” AN f/14/20816.

109 “grave and perilous”: “Note sur l’appareil catadioptrique excut par M. François jeune, pour le phare écossais de Scherivore,” read January 8, 1844, François Arago, rapporteur, *Comptes rendus de l’Académie des sciences* [hereafter CRAS] 18 (1844), 7.

110 “determined to put in practice”: Alan Stevenson, *Account of the Skerryvore Lighthouse* (Edinburgh: Adam and Charles Black, 1848), 177.

110 “heavily weight the consequences”: “Note sur l’appareil catadioptrique.”

110 Eddystone: Mike Palmer, *Eddystone: The Finger of Light* (Woodbridge: Seafarer, 2005); for English lighthouses more generally, see W. H. Davenport Adams, *Lighthouses and Lightships* (London: T. Nelson and Sons, 1870); Lynn F. Pearson, *Lighthouses* (Buckinghamshire: Shire, 2003).

- 110** “Went to Mr. H. Laponte”: Bence Jones, *Michael Faraday: The Life and Letters of Faraday* (Philadelphia: J. B. Lippincott, 1870), 223. For more on Faraday, see Geoffrey Cantor, *Michael Faraday, Sandemanian and Scientist* (New York: Macmillan, 1991); Frank A. J. L. James, *Michael Faraday: A Very Short Introduction* (Oxford: Oxford University Press, 2010).
- 111** “experimented with the greatest care”: Henry-Lepaute, fils to Léonce Reynaud, Paris, March 6, 1874, AN f/14/20816.
- 112** “sublime simplicity”: Jules Michelet, *The Sea* (New York: Rudd and Carleton, 1861), 99.
- 116** “the installation of a 1st order apparatus”: Léonce Reynaud à l’ingénieur ordinaire, June 23, 1852, AN f/14/19896, n. 45.
- 116** “For the sailor who steers by the stars”: Michelet, *Sea*, 97.
- 118** took center stage: Armand Audiganne, *L’Industrie contemporaine, ses caractères et ses progrès* (Paris: Capelle, 1856).
- 120** “eminently national industry”: *Visites et études de S.A.I le Prince Napoléon au Palais de l’industrie ou Guide pratique et complet à l’exposition universelle de 1855* (Paris: Perrotin, 1855).
- 120** “The invention of these devices”: *Ibid.*
- 121** introduced the idea in an 1849 talk: Stevenson’s presentation to the Royal Scottish Society of Arts is mentioned in its *Transactions of the Royal Scottish Society of Arts* (Edinburgh: Neill, 1851), 3:283; the first published account is Thomas Stevenson, *Holophotal System of Illuminating Lighthouses* (Edinburgh: Neill, 1851).
- 121** “the first lighthouse”: Thomas Stevenson, *Lighthouse Construction and Illumination* (London: E. and F. N. Spon, 1881), 89.
- 123** “The glory of the invention”: “Chronique,” *Annales des ponts et chaussées* (Paris: Victor Dalmont, 1855), 3e série, 2e semestre, 86.
- 123** Léonor Fresnel wrote an open letter to Arago: Léonor Fresnel to François Arago, August 31, 1852, *CRAS* 35 (1852), p.364; see also François Arago, “Sur le nouveau Système d’éclairage des phares adopté en France, Examen d’une Réclamation que le Dr. Brewster vient de faire à ce sujet” *Annales de chimie*, t. 37 (1853), 392–409.

123 Reynaud went even further: Léonce Reynaud, “Réponse de M. Reynaud à M. Stevenson,” *Annales des ponts et chaussées* (Paris: Victor Dalmont, 1855), 3e série, 2e semestre, 95.

123 “As for the catadioptric mirror”: *Ibid.*, 96.

124 “You have rendered”: Robert Louis Stevenson to Charles Baxter, February 2, 1873, in Ernest Mehew, ed., *Selected Letters of Robert Louis Stevenson* (Princeton: Princeton University Press, 2001), 29.

124 “whenever I smell salt water”: Robert Louis Stevenson, “Memoirs of Himself,” in *Memories and Portraits, Memoirs of Himself and Selections from his Notebook* (Whitefish, Mont.: Kessinger, 2003), 149.

124 “But there Eternal granite hewn”: Robert Louis Stevenson, “Skerryvore,” in *Underwoods* (London: Chatto and Windus, 1887), 69.

CHAPTER FIVE: THE AMERICAN EXCEPTION

127 tonnage American ships carried: In 1790, the merchant marine shipped 478,377 tons; in 1810, the tonnage was 1,424,783. No. 86, “Statement Showing the Amount of Registered, Enrolled, and Licensed Sail and Steam Tonnage,” *Congressional Edition* (Washington, D.C.: Government Printing Office, 1882), 2025:297.

127 “hardly anyone in the United States”: Alexis de Tocqueville, *Democracy in America*, Henry Reeve, trans. (New York: J. and H. G. Langley, 1840), 2:42.

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