

- July 1798]. Mme Méchain met her husband in Rodez on 7 July, and left him on 18 August in Rieupeyroux, during which interval he conducted his observations at those two stations. Méchain was also accompanied by Agouste for these stations. See Méchain's logbook in AOP E2-10.
30. Méchain to Rolland, 5 jour comp. VI [21 September 1798], in Dougados, 'Lettres de Méchain', p. 85.
31. For Delambre's promise to bring Méchain back to Paris, see Delambre, 'Méchain', *Astronomie au dix-huitième*, p. 761.
32. Méchain to Rolland, 19 fructidor VI [5 September 1798], in Dougados, 'Lettres de Méchain', p. 82.
33. AOP E2-19, Méchain to Delambre, 19 fructidor VI [5 September 1798]. On the mistaking of a signal for a guillotine, see AOP E2-19, Fabre to Delambre, 15 frimaire VI [1 September 1798]. For the suspicions of local administrators about the signals, see AN F17 1135, Commissaire de Directoire de Lacauze to Admin. du dépt. du Tarn, 2 fructidor V [19 August 1797]; Commissaire de Directoire de Montredon to Admin. du dépt. du Tarn, 5 fructidor V [22 August 1797]. Méchain in Delambre, *Base*, 1, pp. 306-7.
34. Jeanne Bardou (p. 18), in Remy Cazals, *Autour de la Montagne Noire au temps de la Révolution, 1774-1799* (Carcassonne: CLEF 1989), pp. 11-20. Bardou was recounting what her two servants had told her about the surveyor Pierre de Lalande (no known relation to Jérôme Lalande).
35. Méchain to Rolland, 5 jour comp. VI [21 September 1798], in Dougados, 'Lettres de Méchain', p. 87. On the militia to guard at the Montalet site, see ADT L210, Commissaire de Lacauze, 29 thermidor VI [16 August 1798]; L266, idem, 11, 14, 17, fructidor 2 jour comp. VI [28, 31 August, 3, 18 September 1798].
36. AOP E2-19, Méchain to Delambre, 19 fructidor VI [5 September 1798].
37. On the Perpignan road, see ADPO L1105, Saussine, 'Dépt. de Pyrénées-Orientales, Ponts et Chaussées', 18 nivôse VI [7 January 1798]; Jacques Freixe, 'Tracé de la voie Domitienne de Narbonne à Gerona', *Revue d'histoire et d'archéologie du Roussillon* 2 (1901), pp. 387-405; 3 (1902), pp. 202-16, 285-317; Pierre Ponsich, 'Les voies antiques du Roussillon et de la Cerdagne', in *Les routes du sud de la France: De l'antiquité à l'époque contemporaine*, Colloque Montpellier, 1985 (Paris: CTHS, 1985), pp. 91-105.
38. Swindburne, *Travels*, 1, p. 2.
39. For the Perpignan baseline, see AOP E2-6, Delambre, 'Registre', pp. 255-318; AOP E2-4, Pommard, 'Base de Perpignan', thermidor-fructidor VI [August-September 1798]; AOP E2-5, Tranchot, 'Base de Perpignan', thermidor-fructidor VI [August-September 1798]. For the results, see ASPV 21 (21 brumaire VII [11 November 1798]), p. 492. The match of the two measurements was mostly due to compensating errors; see Levallois, *Mesurer la terre*, p. 64.
40. ENPC MS724, Delambre to Prony, 4 jour comp. VI [20 September 1798].

41. CUS, Lalande (Gotha) to Delambre, 19 August 1798.
42. AOP E2-19, Méchain to Delambre, 19 fructidor VI [5 September 1798].
43. For the mountain road to Saint-Pons, described as 'extremely difficult' in the eighteenth century, see J. Sahuc, *Saint-Pons: Dictionnaire topographique et historique* (Paris: Res Universis, 1993), pp. 12-13. But Méchain admitted he was located only a three-hour ride up from town; see AOP E2-19, Méchain to Delambre, 29 fructidor VI [15 September 1798].
44. AOP E2-19, Méchain to Delambre, 9 vendémiaire VII [30 September 1798].
45. While Delambre waited for Méchain's answer, he worked with Bellet and Tranchot to take geodetic measurements of the angle between Mont Alaric and Saint-Pons from Narbonne on 17-18 vendémiaire VI [8-9 October 1798]; see AOP E2-6, Delambre, 'Registre', p. 319.
46. AOP E2-19, Méchain to Delambre, 13 vendémiaire VII [4 October 1798].
47. For Méchain's procrastinations, see AOP E2-19, Méchain to Delambre, 19, 29 fructidor, 4 jour comp. VI, 9, 11, 13, 15, 22, 28 vendémiaire, 1, 7 brumaire VII [5, 15, 20, 30 September, 2, 4, 6, 13, 19, 22, 28 October 1798].
48. AOP E2-19, Méchain to Delambre, 19 fructidor VI [5 September 1798].
49. AOP E2-19, Fabre to Delambre, 15 fructidor VI [1 September 1798].
50. AOP E2-19, Méchain to Delambre, 29 fructidor VI [15 September 1798].
51. AOP E2-19, Méchain to Delambre, 4 jour comp. VI [20 September 1798].
52. AOP E2-19, Méchain to Delambre, 19 fructidor VI [5 September 1798].
53. Méchain to Rolland, 19 fructidor VI [5 September 1798], in Dougados, 'Lettres de Méchain', p. 83.
54. AOP E2-19, Méchain to Delambre, 4 jour comp. VI [20 September 1798].
55. AOP E2-19, Méchain to Delambre, 11 vendémiaire VII [2 October 1798].
56. For the offer of the directorship of the Observatory, see Delambre, 'Méchain', *Astronomie au dix-huitième*, p. 763.
57. Though Lalande expected their arrival on 15 November, they did not in fact arrive in Paris until 17 November; see BL, 'Procès-verbaux', 24 brumaire VI [14 November 1798].

Chapter 9 The Empire of Science

1. Louis-Sébastien Mercier, *Satires contre les astronomes* (Paris: Terrelongue, XI, 1803), pp. 16-17. 'On réserve sur-tout des cadeaux magnifiques / Pour ceux qui s'embrouillent dans les mathématiques, / Aux triangles liés avec d'énormes frais, / Qu'ils soient faux ou trompeurs, ne renoncent

- jamais . . . / Qu'ont fait les nouveaux poids, les nouvelles mesures? / A tous nos bons vieillards apporter des tortures. / Pour boire une chopine, auner un long ruban, / Ou réduire et changer les heures d'un cadran, / L'arc du méridien était-il nécessaire? / On peut très-bien auner sans mesurer la terre; / Et si ce haut calcul n'est point exempt d'erreur, / Briser longue habitude est mauvaise rigueur.
- Méchain to Rolland, 6 frimaire VII [26 November 1798], in Dougados, 'Lettres de Méchain', pp. 88, 90. The President of the Directory was the nation's chief executive.
 - Méchain to Rolland, 6 frimaire VII [26 November 1798], in Dougados, 'Lettres de Méchain', p. 90.
 - For the claim to be the first international scientific meeting, see Maurice Crosland, 'The Congress on Definitive Metric Standards, 1798-1799: The First International Scientific Conference?' *Isis* 60 (1969), pp. 226-31. The best account of the meeting is by Thomas Bugge, published in Danish and translated immediately into German under his direction as *Reise nach Paris in den Jahren 1798 und 1799*, trans. Johann Nicolaus Tilemann (Copenhagen: Brummer, 1801). An English version appeared soon after, with the sections on the metric system excised, as *Travels in the French Republic*, trans. John Jones (London: Phillips, 1801). A recent re-edition of this translation has been issued, with some of the metric material reinserted as *Science in France in the Revolutionary Era*, ed. Maurice Crosland (Cambridge: MIT Press, 1969).
 - CUS, Laplace to [Delambre], 5 pluviôse VI [24 January 1798].
 - Laplace to Delambre, 10 pluviôse VI [29 January 1798] in Yves Laissus, 'Deux lettres de Laplace', *Revue d'histoire des sciences* 14 (1961), pp. 285-96. For oblique references to the debate over the proposition of Laplace and the objections of Borda, see *ASVP* I (1, 5 pluviôse VI [20, 24 January 1798]), pp. 334-5.
 - Talleyrand to Cispaline Republic [Piedmont], 5 July 1798, in Kula, *Measures and Men*, p. 271.
 - For Napoleon's election to the Academy on 25 December 1797, see M. E. Maindron, 'Bonaparte, Membre de l'Institut Nationale', *Revue scientifique de la France* 1 (1881-2), pp. 321-38. For Napoleon and science, see the excellent study by Joachim Fischer, *Napoleon und die Naturwissenschaften* (Stuttgart: Steiner, 1988).
 - Clef du Cabinet*, 3 floréal VI [22 April 1798], in François-Alphonse Aulard, ed., *Paris pendant la réaction thermidorienne et sous le Directoire* (Paris: Cerf, 1898-1902), 4, p. 596.
 - Narrateur universel*, 24 frimaire IV [14 December 1797], in Aulard, *Thermidorienne*, 4, pp. 490-1.
 - For Jefferson's switch of latitude preference, see Jefferson to William Short, 26 July, 26 September 1790, in Jefferson, *Papers*, 17, pp. 281, 528. For the early French optimism regarding Jefferson and American participation, see *Loi relatif à l'établissement de nouvelles mesures pour les grains* (Paris: Imprimerie Nationale, 1790), p. 9. For Jefferson's views on the British-French coordination, see Jefferson to Rittenhouse, 20, 30 June 1790, in Jefferson, *Papers*, 16, pp. 542-3, 587-8. For the US

- Senate, see Committee on Weights and Measures, 5 April, 18 December 1792, in Joseph Gales, ed., *Debates and Proceedings in the Congress of the United States* (Washington, DC: Gales and Seaton, 1834-56), 3, pp. 117-18, 621-2. As time went on, Jefferson became even more convinced that the French had acted selfishly in choosing the meridian. See Jefferson to Doctor Patterson, 11 September, 10 November 1811, in Thomas Jefferson, *The Writings of Thomas Jefferson*, ed. H. A. Washington (New York: Derby and Jackson, 1859), 6, p. 11; 13, pp. 95-108.
- For Dombey's mission, see *PVCIP* 3 (11, 13, 21, 29 frimaire, 5 nivôse II [1, 3, 11, 19, 25 December 1793]), pp. 54, 64, 136, 197, 211. *RACSP* 9 (21, 26 frimaire II [11, 16 December 1793]), pp. 321, 436-7. Yves Laissus, 'Note sur le deuxième voyage et la mort de Joseph Dombey', *Comptes rendus du 94^e Congrès National des Sociétés Savantes, Histoire des sciences* (Paris: Bibliothèque Nationale, 1970), pp. 61-79.
 - [Joseph Fauchet], *Joseph Fauchet, Ministre Plenipotentiary of the French Republic near the United States of Mr. Randolph, Secretary of the United States, 15 Thermidor 2nd year of the French Republic (20 August 1794, Old Style)* (Philadelphia: Fennel [1794]). See also APS, Fauchet to Rittenhouse, 10 September 1794.
 - Fauchet to Randolph, 15 thermidor II [2 August 1794], in 3rd Congress, 2nd Session, 8 January 1795, no. 60, in Walter Lowrie and Walter S. Franklin, eds, *American State Papers: Documents* (Washington, DC: Gales and Seaton, 1834), 1, pp. 115-16. For public accounts in the US, see Anon., 'Foreign Literature, France', *American Monthly Review* (February 1795), pp. 195-8.
 - Fauchet to Commissaire du Dépt. des Relations Extérieures, 26 nivôse II [15 January 1795], in *Annual Report of the American Historical Association* 2 (1905), pp. 544-6. For Washington's addresses, see Washington to Congress, 8 January 1790 and 25 October 1791, in Gales, *Congress of the United States*, 1, pp. 968-72; 3, pp. 11-16. For Washington's actions in favour of Fauchet's proposals, see Washington to Congress, 8 January 1795, in Gales, *Congress of the United States*, 4, p. 809.
 - For the end of the Congressional debate, see Harrison, 'Weights and Measures', House of Representatives, 14, 19 May 1796, in Gales, *Congress of the United States*, 5, pp. 1376-83, 1405. For Fauchet's views, see 'Mémoire sur les Etats-Unis d'Amérique', 24 frimaire IV [15 December 1795], in *Annual Report of the American Historical Association* 1 (1956), pp. 85-131. John J. Reardon, *Edmund Randolph: A Biography* (New York: Macmillan, 1974), pp. 307-15.
 - On Jefferson's deference to Congress on this matter, see Jefferson to John Rutherford, 25 December 1792, in Jefferson, *Papers*, 2, p. 783.
 - Cuthbert Clarke, *A New Complete System of Weights and Measures* (Edinburgh: Author, 1789), p. 6. See the long list of British attempts at measurement standardization between 1200 and 1730 appended to Miller, *Speeches*, pp. 29-40. For one eighteenth-century attempt, see House of Commons, *A Report from the Committee Appointed to Enquire into the Original Standards of Weights and Measures in this Kingdom* (London:

- Whiston, 1758). For Scotland, see Lord John Swinton, *A Proposal for Uniformity of Weights and Measures in Scotland* (Edinburgh: Elliot, 1779). For other complaints about fraud, see Hubert Hall and Freida Nichols, *Select Tracts and Tables: Books Relating to English Weights and Measures, 1100-1742* (London: Offices of the Society, 1929), pp. 47-51. For an overview of the history of English weights and measures, see R. D. Connor, *The Weights and Measures of England* (London: Her Majesty's Stationery Office, 1987).
19. Miller, 6 February 1790, *Speeches*, pp. 17-18.
 20. For the pendulum 'yard', see John Whitehurst, 'An Attempt Toward Obtaining Invariable Measures', n.d., in *The Works of John Whitehurst* (London: Dent, 1792), p. iv. For an economist, see James Stueart, 'A Plan for Introducing an Uniformity of Measures over the World' [written c. 1760, first printed in 1790], in Stueart, *Works* (London: Cadell, 1805), 5, pp. 379-415.
 21. Renerus Budelius, *De Monetis* (1591), quoted in Miller, *Speeches*, p. 52. At Miller's request, Talleyrand inserted language allowing for 'a location to be determined' into the law passed by the National Assembly; see Miller, *Speeches*, pp. xiv-xv.
 22. John Rotheram, *Observations on the Proposed Plan for an Universal Standard of Weights and Measures in a Letter to Sir John Sinclair, M.P.* (Edinburgh: Creech, 1791), p. 10. In the same fashion, the British expected the Americans to follow their lead in measurement standards; see Rotheram, *Observations*, pp. 35-6. George Skene Keith, *Tracts on Weights, Measures, and Coins* (London: Murray, 1791).
 23. For Blagden, see BLL Add MS33272, ff. 97-8, Charles Blagden to Joseph Banks, 8 September 1791. For British mockery, see 'New System of Weights and Measures', *The Times* (London), 1 October 1798. For the parliamentary debate, see T. C. Hansard, ed., *The Parliamentary History of England from the Earliest Period to the Year 1803*, vol. 28 (1789-91), cols 297, 315-23, 874-5, 876-9.
 24. For a German sceptical of the reform, see Frederick Johann Lorenz Meyer, *Fragments aus Paris* (Hamburg: Bohn, 1798), 2, pp. 265-83. The CPM sent sample metre sticks to German commercial cities like Hamburg so that they might draw up conversion tables, see p. 279. On the German savants' objections to the meridian project, see pp. 268-9.
 25. For Delambre's recommendation of Tranchot for the German map project, see CUS, Delambre to [Prony?], 7 fructidor IX [25 August 1801]. Within days, Tranchot had the job and was on his way; SHAT 3M401, Tranchot to Gen. Andoessy (Dépôt de la Guerre), 8 fructidor IX [15 September 1801].
 26. Delambre, *Rapport historique*, p. pp. 77-8.
 27. For Jérôme-Isaac Méchain's role as aide to Nicolas-Auguste Nouet, the former monk who had served as Cassini IV's assistant under the ancien régime, see Jean-Joseph Marcel et al., *Histoire scientifique et militaire de l'expédition française en Égypte* (Paris: Denain, 1830-6), 4, p. 57. For P.-F.-A. Méchain's connection to Nouet, see KBD NKS1304, Méchain to Bugge, 1 vendémiaire X [23 September 1801]. For the geographic

- aspect of the expedition, see Anne Godlewski, 'The Napoleonic Survey of Egypt: A Masterpiece of Cartographic Compilation and Early Nineteenth-Century Fieldwork', *Cartographia* 25 (1988), pp. i-xiii, 1-171, especially pp. 17-22; Anne Godlewski, 'Map, Text and Image: The Mentality of Enlightened Conquerors. A New Look at the Description of l'Égypte', *Transactions of the Institute of British Geographers* 20 (1995), pp. 5-28; Ghislain Alleaume, 'Entre l'inventaire du territoire et la construction de la mémoire: L'oeuvre cartographique de l'expédition d'Égypte', in *L'expédition d'Égypte, Une entreprise des lumières, 1798-1801*, ed. Patrice Bret (Paris: Hachette, 1998), pp. 279-94; Antoine Tramoni, 'Du plan terrier de la Corse à la carte de l'Égypte: La géographie des militaires', in *Benaparte et les îles méditerranéennes et l'appel de l'Orient*, Actes du Colloque d'Ajaccio, 29-30 May 1998, *Cahiers de la Méditerranée* 57 (1998), pp. 87-99; Yves Laisius, *L'Égypte, Une aventure savante* (Paris: Fayard, 1998); Muséum National d'Histoire Naturelle, *Il y a 200 ans, Les savants en Égypte* (Paris: NATHAN, 1998).
28. Fourier, in E. F. Jomard, 'Description de Syène et de ses cataractes', *Description de l'Égypte* 1 (Paris, 1821), p. 121. See also Nouet, 'Observations ... haute Égypte', *Décade égyptienne* 3 (IX [1800-1]), pp. 15-16.
 29. Marcel, *Expédition française en Égypte*, 5, p. 53. For Nouet's reports, see 'Rapport ... Alexandrie', 'Mémoire ... du Kaire, 11 messidor VII [29 June 1799]', 'Rapport ... styles, 21 messidor VII [9 July 1799]', 'Position ... points de l'Égypte', 'Observations ... haute Égypte', 'Position ... des pyramides', *Décade égyptienne* 1 (VII [1798-9]), pp. 165-82; 2 (VIII [1799-1800]), pp. 129-58, 226-51, 267-71; 3 (IX [1800-1]), pp. 7-27, 101-10.
 30. For the Nilometre, see Girard to Le Père, 30 thermidor VII [17 August 1799], in *Courier de l'Égypte* 37 (29 fructidor VII [15 September 1799]), p. 3; Pierre-Simon Girard, 'Résumé des deux mémoires sur le nilomètre de l'île d'Éléphantine et l'ancien coude des égyptiens', *Mémoires de l'Institut des Sciences Morales et Politiques*, 7 vendémiaire X [29 September 1801], pp. 63-74. Marcel, *Expédition française en Égypte*, 4, pp. 494-7. For the ancien régime suppositions about a connection between the pyramids and measures, see Jean-Sylvain Bailly, *Histoire de l'astronomie ancienne* (Paris: De Bure, 1781), pp. 77-85, 167-76. Also Pauton, *Métrologie*, pp. 6-7; and Pauton, *Explication de l'hieroglyphe du grand principe de la nature consacré dans les pyramides d'Égypte* (Paris: Desaint, 1781), pp. 345-7. Laplace himself had endorsed the idea; see Laplace, 'Mathématiques', *Écoles Normales*, 5, p. 203. For new speculations about the connection based on data gathered 1798-1801, see E. Jomard, *Mémoire sur le système métrique des anciens égyptiens* (Paris: Imprimerie Royale, 1817).
 31. AN Colonies C8A 59, Thomassin de Farret, 'Projet pour le commerce des colonies', 1752. See also, AN Colonies A23, Conseil Supérieur de Louisiane, 1 April 1715; Arrêté du Conseil Supérieur, 19 July 1725; Arrêté du Conseil d'État de Roy, 1 March 1744. AN Colonies C88 12, Jean-François Pierre, 'Mémoires pour l'établissement d'un poids public', 1767.

32. For La Pérouse, see La Pérouse, *Voyage de La Pérouse*, pp. 286-7. Fleurieu, ed., *Voyage autour du monde*, 4, pp. iii-viii, 1-130. For the Borda circle on the Entrecasteaux expedition, see Elisabeth-Paul-Edouard Rossel, ed., *Voyage d'Entrecasteaux* (Paris: Imprimerie Impériale, 1808), 1, pp. 33, 594-9; and volume 2.
33. Méchain to Rolland, 6 frimaire VII [26 November 1798], in Dougados, 'Lettres de Méchain', p. 90.
34. On the Pantheon at this moment, see [W. F. Blagdon], *Paris as It Was and as It Is* (London: Baldwin, 1803), 2, p. 140; see also Meyer, *Fragmente aus Paris*, 1, pp. 166-82.
35. Warmé, *Delambre*, p. 29.
36. AOP E2-8, Delambre, 'Mériidienne, Partie du nord, Observations', [1798-9]. Delambre tried (and failed) to hire young Pomar [sic] as an assistant at the Observatory on 23 April 1798; see Bigourdan, 'Bureau des Longitudes' (1928), pp. A17-18. Delambre to Humboldt, 22 January 1801, in Humboldt, *Briefe aus Amerika*, p. 120.
37. AOP E2-19, Méchain to Delambre, 6 nivôse VII [26 December 1798]. Méchain believed that the Paris latitude measurements should belong to him alone, to compensate him for Delambre's greater contributions elsewhere. But Delambre quietly insisted on conducting observations in parallel; see Delambre, *Grandeur*, p. 222.
38. AOP E2-19, Méchain to Borda, 7 nivôse VII [27 December 1798].
39. AOP E2-19, Méchain to Borda, 7 nivôse VII [27 December 1798].
40. On Méchain's avoidance of his colleagues, see Delambre, 'Méchain', *Astronomie au dix-huitième*, p. 762.
41. Danish State Archives F6 1087, Bugge to Danish Secretary of State, 17 November 1798, translation from the Danish by Arne Hessenbruch. This letter was written the day before Delambre and Méchain returned to Paris. Bugge also considered Lalande the greatest egotist and charlatan in all astronomy; see BLL Add MS8099, Bugge to Banks, 19 November 1798. Bugge was a long-time correspondent of Méchain, and respected him. He was also impressed by the precision of the repeating circle, when Méchain finally demonstrated its use to him. Bugge, *Science in France*, pp. 205-6. The Academy noted the arrival of the foreign savants, but did not meet with them in formal session until 28 November 1798, two weeks after Delambre and Méchain returned; *ASPV* 1 (16 vendémiaire, 6 frimaire VII [7 October, 26 November 1798]), pp. 476, 496-7. For the Academy's ban on publication, see *ASPV* 1 (16 prairial VI [4 June 1798]), p. 403.
42. Zach to Lalande, 28 May 1799, in Bigourdan, *Système métrique*, pp. 240-1.
43. Zach to Lalande, 3 December 1798, in Bigourdan, *Système métrique*, p. 240.
44. AAS Dossier Delambre, Margelay (Montheçon, dépt. de l'Allier) to Delambre, 18 floréal VII [7 May 1799].
45. *Décade philosophique* 15 (30 pluviôse VII [18 February 1799]), p. 372.
46. For Delambre's presentation, see ENPC MS726, Tralles, Van Swinden, Laplace, Legendre and Delambre, 'Observations relatives à la mesure

- de la méridienne ... du Citoyen Delambre', 14 pluviôse VII [2 February 1799].
47. On Laplace's deal with Méchain, see AOP E2-19, Méchain to Delambre, 18 pluviôse VII [6 February 1799].
48. For Méchain's Paris results, see AOP E2-19, Méchain to Delambre, 17 pluviôse VII [15 February 1799]; see also, Delambre, 'Méchain', *Astronomie au dix-huitième*, p. 762.
49. Méchain to Rolland, 6 germinal VII [26 March 1799], in Dougados, 'Lettres de Méchain', p. 93. For Méchain's presentation, see ENPC MS726, Legendre, Van Swinden, Prony, Méchain, Ciscar, Laplace and Tralles, 'Tableau des observations pour le calcul de la méridien ... du citoyen Méchain', 21 ventôse VII [11 March 1799]. The International Commission did reject a few of Méchain's observations; see KM, *Delambre, Base*, 1, p. 501.
50. For the setting aside of Méchain's latitude data for the Fontana de Oro, see Delambre's note [c. 1805-10] at the end of AOP E2-9, Méchain, 'Registre des observations astronomiques fait au Mont-Jouy et Barcelone en 1792 et 1793'.
51. For the criticism of Delambre's results, see Delambre, *Grandeur*, p. 223. The Commissioner was Bugge, so the comment may have come earlier.
52. For Delambre's new calculation methods, see Delambre, *Méthodes analytiques pour la détermination d'un arc du méridien*, 11 germinal VII [31 March 1799]; with Legendre, *Méthode pour déterminer la longueur exacte du quart du méridien*, 9 nivôse VII [29 December 1798] (Paris: Crapelet, VII [1799]).
53. On Borda's funeral, see Bougainville, 'Borda', *Décade philosophique* 16 (10 ventôse VII [28 February 1799]), pp. 434-8.
54. Méchain to Rolland, 22 floréal VII [11 May 1799], in Dougados, 'Lettres de Méchain', p. 101.
55. Méchain to Rolland, 22 floréal VII [11 May 1799], in Dougados, 'Lettres de Méchain', p. 101.
56. [Blagdon], *Paris as It Was*, 2, p. 141. This comment almost certainly comes from Lalande. For Laplace's suppositions about the figure of the earth, see Laplace, 'Mémoire sur la figure de la terre' (1783, pub. 1786), in *Œuvres complètes de Laplace* (Paris: Gauthier-Villars, 1878-1912); 11, pp. 3-32. Laplace, 'Mathématiques', *Écoles Normales*, 5, p. 213. For the tentative justification for taking the intermediate latitudes, see the subtle change between the draft and final version of the letter sent by Lavoisier in AAS Lavoisier 1228(36), Lavoisier to Méchain, 6 October 1793. In this letter Lavoisier first claims that the intermediate latitudes will be 'more useful' for identifying 'irregularities in the figure of the world' than for 'establishing the new measures', and then amends this to note simply that they will 'serve to identify' the irregularities. Lavoisier also censored a reference to the fact that it was Laplace who had insisted on the intermediate latitude measurements. On Bosovich's expedition, see John L. Heilbron, *Weighing Imponderables and Other Quantitative Science around 1800* (Berkeley: University of California Press, 1993), pp. 226-9.

57. For the eccentricity data, see Laplace, *Traité de mécanique céleste* (Paris: Crapet, VII [1799]), 2, pp. 138-45; Laplace in BL, 'Procès-verbaux', 19 frimaire VIII [10 December 1799].
58. The French first learned of this precious metal through Lalande; see Lalande, 'Lettre sur un métal appelé platine', *Journal des sçavans* (January 1758), pp. 46-59. Donald McDonald and Leslie B. Hunt, *History of Platinum and Its Allied Metals* (London: Johnson Matthey, 1982), pp. 179-93. W. A. Smeaton, 'Platinum Sales Problems in the French Revolution: Janety Writes to Sir Joseph Banks', and 'Bertrand Pelletier, Master Pharmacist: His Report on Janety's Preparation of Malleable Platinum', *Platinum Metals Review* 12 (1968), pp. 64-6; 41 (1997), pp. 86-8. On the budget for platinum, see AAS Lav. 167, Lavoisier, 'Etat des ouvriers', [1793]. For discovery of the short-weighting - the shipment was 78 *marcs* short of the contracted 500 *marcs* - see Guyton, 'Rapport', ASPV 1 (21 thermidor VII [8 August 1799]), pp. 610-13. For the secret scramble for platinum in the final days before the conference, see Danish State Archives F6 1087, Bugge to Danish Secretary of State, 17 November 1798.
59. Méchain to Rolland, 22 floréal VII [11 May 1799], in Dougados, 'Lettres de Méchain', p. 103. This was Lenoir's second, more accurate, comparator; see Delambre, 'Mètre définitif', *Base*, 3, pp. 691-8; Taylor, *Pleasure to Profit*. For the physical standards, see C. Wolf, 'Recherches historiques sur les étalons de l'Observatoire', *Annales de chimie et de physique*, 5th series, 25 (1882), pp. 5-112. The other three platinum bars were given to the Academy of Sciences, the Conservatoire des Arts et Métiers and the cadastre survey. Copper bars of the same length were distributed to all the different *départements* and the major ministries. Iron bars were distributed to the visiting savants.
60. [Laplace], 'Discours', 4 messidor VII [22 June 1799], in Delambre, *Base*, 3, pp. 581-9.
61. Van Swinden, in Delambre, *Base*, 3, p. 648. The members of the International Commission had been assured that the leading role at the ceremony would be given to the foreign savants. Méchain, as senior expedition leader, had expected to enjoy the honour of presenting results, but he bowed to political exigencies. Besides, he had never been one for public speeches. KBD NKS1304, Méchain to Bugge, 10 brumaire VIII [1 November 1799]. Méchain to Rolland, 22 floréal VII [11 May 1799], in Dougados, 'Lettres de Méchain', p. 103.
62. On the delay in returning the finished bar, see ASPV 2 (16 nivôse, 6 germinal VIII [6 January, 27 March 1800]), pp. 76, 128.
63. Baudin, 'Réponse', 4 messidor VII [22 June 1799], in Delambre, *Base*, 3, p. 651, quotation taken from J.-J. Rousseau.
64. Coquebert de Montbret to Alexandre Brongniart, 1794, in Isabelle Laboulais-Lesage, *Lectures et pratiques de l'espace: L'itinéraire de Coquebert de Montbret, savant et grand commis d'Etat, 1755-1831* (Paris: Champion, 1999), p. 299.
65. For a list of government pamphlets, see AN F12 1237, ATPM, 'Etat des différens ouvrages', 10 vendémiaire IV [2 October 1795]. For graphs,

- see [Prieur], *Echelles graphiques pour la comparaison de l'aune de Paris avec le mètre* (Paris: Imprimerie de la République, thermidor III [July-August 1795]). Scores of privately printed guides helped citizens learn the new measures; see Cit. Bonnin, *Vocabulaire étymologique des poids et mesures de la République française* (Paris: Fournier, VII [1799]); Pierre Periaux, *Tableaux comparatifs des mesures républicaines avec les anciennes* ([Rouen]: n.p., VII [1799]); C. F. Martin, *Le régulateur universel des poids et mesures* (Paris: Guyot, 1807). For a quasi-official national almanac, see *Le manuel républicain* (Paris: Didot, VII [1799]), pp. 76-82. For a paper dial-up calculator, see BNR Estampes IA mat 3a. Leblond, 'Cadrons logarithmiques adaptés aux poids et mesures', 16 pluviôse VII [4 February 1799]. For playing cards, see BNR Estampes Kh383 no. 227, Bézu, 'Jeu de 52 cartes historiques' ([Égalité-sur-Marne]: n.p. [1792]). For the marble metre, see Fernand Gerbaux, 'Le mètre de marbre de la rue Vaugirard', *Bulletin de la Société Historique du VI^e Arrondissement de Paris* (1904), pp. 1-72. For the blind instructor, see AN F17 1237, ATPM, 'Tableaux', III-IV [1794-6].
66. François Gattey, *Table des rapports des anciennes mesures agraires avec les nouvelles*, 2nd edn (Paris: Michaud, 1810), p. 6. For a conversion table for Paris, see Min. Int., *Table de comparaison entre les mesures* (Paris: Imprimerie de la République, IX [1800-1]). For the frustrations of local administrators translating local measures, see ADSM L259, 'Rapport au département par la CPM', 26 ventôse VI [16 March 1798]; ADSM L260, Seine-et-Marne, 'Registre des séances du Commission Temporaire des Poids et Mesures', 30 pluviôse VI-25 pluviôse VII [18 February 1798-13 February 1799]; ADSM, François de Neufchâteau (Min. Int.), *Instruction sur les nouvelles mesures pour les terrains* (Paris: Imprimerie de la République, fructidor VI [August-September 1798]).
67. ATPM, *Avis instructif sur la fabrication des mesures de longueur à l'usage des ouvriers* (Paris: Imprimerie de la République, III [1795]). For the shortage of rulers, see AN F12 7637, 'Rapport sur le nombre de mètres à envoyer dans chaque des sections de Paris' [1795]; AN F17 1237, ATPM, 'Etat des mesures linéaires entrées en magasin', 14 brumaire IV [5 November 1795]. Ultimately, the cost of making enough rulers for all France was expected to come to 11 million francs. The government budgeted less than 2 per cent of that; see BEP Prieur 4.4.6.2, [Prieur], 'Aperçu des dépenses de l'établissement des nouvelles mesures' [1794-5]. The difference was supposed to be made up through the sale of the rulers by private sub-contractors. For attempts to spur production, see AN F12 1289, CPM to Paré (Min. Int.), 18 ventôse II [8 March 1794]; see also AN F12 1237, ATPM, 'Tableau sommaire des engagements contractés', 12 thermidor IV [30 July 1796]. For a request to use an abbé's home to manufacture metre sticks, see BEP Prieur [no number], Feras et Cornu to Prieur, 21 pluviôse II [9 February 1794].
68. For attempts to mass produce metre sticks, see AN F12 1310, 'Extrait des Registres du Comité de Salut Public', 27 floréal III [16 May 1795]; AN F12 1311, ATPM to [Atelier de Perfectionnement], 8 floréal IV [26

- April 1796]. For more on the mass production of guns and metre sticks, see Ken Alder, *Engineering the Revolution: Arms and Enlightenment in France, 1763-1815* (Princeton: Princeton University Press, 1997), pp. 253-91. Etienne Lenoir was among those who received an award for the design for his machine; see AN F4 2556, ATPM, 'Comptes', IV [1796-6]. For the inaccuracy of the rulers, see Meyer, *Fragmente aus Paris*, 2, pp. 279-80.
69. For customer preferences, see Dupin, 'Rapport', in Aulard, *Thermidorienne*, 4 (25 February 1798), pp. 556-7; see also 5 (30 December 1798), pp. 98-9; also, 5, pp. 108-9, 287, 477-8, 576, 579, 632. For police frustration, see AN F12° 215, ATPM to Min. Police, 9 messidor IV [27 June 1796]; AN F17 1135, Min. de Police Générale to Min. Int., 21 vendémiaire VI [12 October 1797]; ADSe VD° 429, Bureau Central de Paris, *Avis mesures de capacité pour les liquides, 22 brumaire VIII* [13 November 1799] (Paris: Lottin, VIII [1799]). For the snafu over enforcement between the Min. Police and various administrative units, see ADSe VD° 2421, 2486, 2073, 2075, 4037, 4065, which date from the years IV through VI [1795-8].
70. Meyer, *Fragmente aus Paris*, 2, pp. 282-3, emphasis added.
71. For law expanding the use of the new measures, see Min. Int., *Proclamation du Directoire exécutif*, 28 messidor VII [16 July 1799]. For the frustrations of police inspectors, see François-Alphonse Aulard, ed., *Paris sous le Consulat* (Paris: Cerf, 1903), 1 (November-December 1799), p. 65; 2 (12 September 1801), p. 521. For the warnings about cheating in restaurants and fine grocers, see *Almanach des gourmands* 7 (1809), pp. 196-8.
72. ATPM, *Aux citoyens rédacteurs*, 5-6. See the original complaint in *Feuille du cultivateur* 38 (9 messidor III [27 June 1795]), pp. 227-8.
73. For the Ecole Normale, see Laplace, 'Mathématiques', in *Ecoles Normales*, 5, pp. 201-19. For the mixed reception of the metric system in Revolutionary public schools, see Y. Marec, 'L'arithmétique révolutionnaire à Rouen (1789-99)', *Etudes normandes* 3 (1980), pp. 69-83.
74. ATPM, *Aux citoyens rédacteurs*, 1, pp. 18-19.
75. François de Neufchâteau (Min. Int.), 'Emploi des nouvelles mesures', 12 fructidor V [29 August 1797], in Nicolas-Louis François de Neufchâteau, *Recueil des lettres circulaires, instructions, discours et autres actes publics émanés du Cen. François de Neufchâteau* (Paris: Imprimerie de la République, VII [1798-9]), 1, pp. xlii-xliv.
76. Emmanuel Pères, *Rapport... relative aux pesées publics*, 21 vendémiaire VIII [12 October 1799] (Paris: n.p. [1799]). For the law on the Bureaux des Poids et Mesures of 27 brumaire VII [17 November 1798], see Bigourdan, *Système métrique*, pp. 186-7. The law was amplified and extended to all major market towns on 7 brumaire IX [29 October 1800], and again on 16 June 1808; see Désiré Dailloz, ed., *Jurisprudence générale* (Paris: Bureau de la Jurisprudence Générale, 1845-70), 35, pp. 983-5. For the analogy to poison, see Monseigneur, *Opinion sur le projet... concernant l'établissement des pesées publics*, 23 fructidor VII [9 September 1799] (Paris: Imprimerie de la République, VII [1799]).

77. On the use of troops to police the market, see A.-B.-J. Guffroy, *Avie civique contre un projet libéraliste* (Paris: Everat, vendémiaire VII [September-October 1798]), p. 12. For a defence of the Paris Bureau, see Brillat, Binot and Pelletier, *Mémoire des citoyens nommés pour administrer les Bureaux de Poids Public du département de la Seine* (Paris: Bailleur [1799]). Also, Brillat, Binot and Pelletier, *Réponse des Administrateurs du poids public... aux colonnes de Joseph Guffroy* ([Paris]: n.p., fructidor VII [August-September 1799]). Brillat had been lobbying for the contract for several years; see also BEP Prieur 4.5.10, Chef de la 4e division du Min. Int. to Bureau des Poids et Mesures, 13 pluviôse V [1 February 1797]; Brillat to Min. Int., 16 frimaire VI [6 December 1797].
78. On physicians, see Vincent-Jean-Paul Biron, *Rapport fait à la Société de Médecine de Paris, 21 et 22 pluviôse X sur l'application des nouveaux poids et mesures* [10, 16 February 1802] (Paris: Brasdor et Pelletier, X [1801-2]). On notaries, surveyors and accountants, see Revellière-Lépeaux et al., 7 pluviôse IV [27 January 1796], in Antonin Deboudie, ed., *Recueil des actes du Directoire-Exécutif* (Paris: Imprimerie Nationale, 1910-17), 1, p. 492; Aulard, *Thermidorienne* 5 (August-September 1798), p. 99; Min. Int. to Admin. Centrales des Dépts., 21 brumaire VII [11 November 1798], in François de Neufchâteau, *Recueil des lettres*, 1, pp. 273-5. On the national legislators, see AN F12° 210, ATPM to Conseil des Anciens, 14 nivôse IV [4 January 1796]. For the package labelled in old units, see Louis Marquet, 'Anciens mesures, anciens poids', *Amis du vieux Saint-Etienne* 36 (1957), p. 9.
79. For the shifts within the artillery, see SHAT 4c32, F.-M. Aboville, 'Mémoire', 1 nivôse IV [21 December 1795]; Gen. Drouin, 'Mémoire', 3 vendémiaire V [24 September 1796]; Min. Guerre to Comité Central d'Artillerie, 19 vendémiaire X [10 October 1801]; Chief Inspector of Revenue to Gen. Songis, 26 fructidor XIII [11 September 1805]; Comité Central d'Artillerie, 'Observations', 29 March 1806. In 1822, the artillery had yet to take up metric conversion; see Anon., 'Mémoire', 1822.
80. On Napoleon's use of the old units, see BN Piece 8-D3 MON-36, Musée de l'Histoire de France (Paris), *Le mal de changer: Les français et la révolution métrique*, Exposition, Archives Nationales, 1 June-31 August 1995 (Paris: Presses Artistiques, 1995), p. 10.
81. APS, Lalande to [Fabroni], 16 December 1801. For the consultations with Delambre and Laplace, see *Moniteur* 41 (11 brumaire IX [2 November 1800]), p. 157; law of 13 brumaire IX [4 November 1800], in Bigourdan, *Système métrique*, pp. 190-1.
82. Sabatier et al., 5 brumaire VII [27 October 1799], in Maindron, 'Bonaparte', p. 326. See also, McDonald and Hunt, *Platinum*, pp. 181-2.
83. Lalande, in Claretie, *Empire*, p. 234. For Laplace's proclamation identifying the reform of weights and measures as proof of the republicanism of the new régime, see Laplace to Admin. Centrales et Municipales, 30 brumaire VIII [21 November 1799], in François de Neufchâteau, *Recueil des lettres*, 3, p. 103. For Laplace's willingness to abandon the

nomenclature, which he blamed on Prieur, see Laplace to Chaptal (Min. Int.), 3 February 1804, in Bigourdan, *Système métrique*, p. 192.

Chapter 10 The Broken Arc

- George Sand, *Winter in Majorca*, trans. Robert Graves (Chicago: Cassandra [1956], 1978), p. 29. Graves's translation.
- For Méchain's astronomy, see Méchain to Chaptal, in *Moniteur* 98 (28 messidor IX [17 July 1801]), p. 1232. Also Méchain, *MC* (May 1800), pp. 290-311. For his mood, see Méchain to Rolland, 18 fructidor VII [4 September 1799], 16 messidor VIII [5 July 1800], in Dougados, 'Lettres de Méchain', pp. 105-9, 115-17.
- For the insults to Méchain behind his back, see Bugge, *Travels*, pp. 247-8; Delambre, 'Méchain', *Astronomie au dix-huitième*, p. 765.
- For Méchain's retreat, see Delambre, 'Méchain', *Astronomie au dix-huitième*, p. 763.
- For Delambre's expectation that the *Base* would be published in three volumes and finished within a year, see AAS Dossier Delambre, Delambre to Petit-Genest, 20 prairial VII [18 June 1799]. Méchain knew that his role in writing the *Base* would be minimal; see KBD NKS1304, Méchain to Bugge, 2 brumaire IX [24 October 1800], 1 vendémiaire X [23 September 1801].
- Delambre and Méchain cooperated on commissions to judge astronomical work, see *ASP* 2 (11 germinal VIII [1 April 1800]), 21 brumaire X [12 November 1801], pp. 129, 429-30. For Delambre and Napoleon, see Delambre, 'Lui-même'. For Méchain and Napoleon, see KBD NKS1304, Méchain to Bugge, 2 brumaire IX [24 October 1800].
- Méchain to Rolland, 18 floréal IX [8 May 1801], in Dougados, 'Lettres de Méchain', p. 120. At one point the bureaucrats of the Bureau of Longitudes would not even forward letters to Méchain which were addressed to him as 'Director'; see KBD NKS1304, Méchain to Bugge, 2 brumaire IX [24 October 1800]. In fact, Delambre was appointed 'administrator' of the Bureau, rather than its president, so his stay may have been legitimate. And he served for a little over a year, not two years as Méchain alleged.
- KBD NKS1304, Méchain to Bugge, 1 vendémiaire X [23 September 1801]. For squabbles over firewood and supplies, see BL, 'Procès-verbaux', 19 vendémiaire X [11 October 1800]. For Méchain's threat to resign, see Méchain to Rolland, 18 floréal IX [8 May 1801], in Dougados, 'Lettres de Méchain', p. 120.
- For Méchain's sense of being wronged, see KBD NKS1304, Méchain to Bugge, 10 brumaire VIII [1 November 1799]. Delambre discovered Méchain's knowledge of these events when he in turn became Méchain's scientific executor in 1805; see Delambre's marginal note (c. 1810) on AOP E2-19, Delambre to Borda, 4 frimaire VI [24 November 1797].
- For Delambre's initial election as (temporary) Secretary of the Academy on the same day that Napoleon was elected its President, see *ASP* 2 (1 germinal VIII [22 March 1800]), pp. 11, 25 pluviôse XI [14 February 1803]), pp. 126, 625, 629. The presidency of the Academy had always been (and remained) a rotating and largely honorific office, although Napoleon used it to reorganize the Academy into two branches – one for the mathematical sciences (maths, physics, astronomy, geography and the mechanical arts) and one for the physical sciences (chemistry, the life sciences and medicine). Delambre was made Permanent Secretary for the mathematical sciences, with Cuvier made Permanent Secretary for the physical sciences. Napoleon's new regulations provided that the Permanent Secretary be named by the branch itself, but with 'the approbation' of the First Consul, meaning in effect that the position was in Napoleon's gift. Delambre privately noted that this interference in the self-governing nature of the Academy was a novelty of which he himself did not entirely approve. Delambre, 'Lui-même'.
- For the proposal to revive the Balearic extension, see BL, 'Procès-verbaux', 19 fructidor X [6 September 1801]. For Méchain's report, see AN F17 3712, [Méchain], 'Rapport aux Consuls sur la continuation de la mesure de la méridienne de France depuis Barcelone jusqu'aux îles Baléares' [September-October 1802]. Antonio E. Ten, 'Le problème du 45^e parallèle et les origines du système métrique décimal', in *Scientifiques et sociétés pendant la Révolution et l'Empire*, 114e Congrès National des Sociétés Savantes, 1989 (Paris: CTHS, 1990), pp. 441-52.
- Méchain to Rolland, 10 floréal VIII [11 May 1799], in Dougados, 'Lettres de Méchain', p. 114. Méchain was 'alarmingly' ill in March-April 1801; see *ASP* 2 (6 germinal, 1 prairial VIII [27 March, 21 May 1800]), pp. 128, 169. The young savant whom Delambre had in mind was Lalande's pupil Henri, then triangulating his way through Bavaria; see Lalande, *Bibliographie astronomique*, pp. 701, 704, 791, 868; also Delambre, *Grandeur*, pp. 225-4.
- For Humboldt's pleasure at obtaining results approximating to those of Méchain, see CUS, Humboldt to Delambre, 23 floréal VII [12 May 1799]. Humboldt also compared his data to Méchain's in Humboldt to Zach, 12 May 1799, in Humboldt, *Die jugendbriefe Alexander von Humboldts*, 1787-1799, eds Ilse Jahn and Fritz G. Lange (Berlin: Akademie-Verlag, 1973), pp. 671-2. Humboldt's latitude result, taken on 8 January 1799, was 41°23'28" and 41°22'59", as compared with Méchain's result of 41°22'47", supplied in a private letter from Méchain, which Humboldt mentioned. This suggests that Méchain also knew that Humboldt planned to take a measurement at the Fontana de Oro. See Delambre's commentary on these values in SBB Autgr. J1792(3), Delambre to Humboldt, 10 November 1807. The results were published in 1810 in a two-volume work dedicated to Delambre; see Alexandre de Humboldt and Jabbo Oltmanns, *Recueil d'observations astronomiques, d'opérations trigonométriques et de mesures barométriques* (Paris: Schoell, 1810), 2, pp. 3-6.
- Méchain to Rolland, 6 frimaire VII [26 November 1798], in Dougados, 'Lettres de Méchain', p. 91.