Academia de Ingenieros. See Academy of Engineers Ferrol Académie de Marine. See Academy of Navy Brest Academies and societies, 57–59, 61–62, 302 Academy of Engineers Ferrol, 292 Academy of Navy Brest, 58, 98, 160, 301, 309 Academy of Science and Literature Berlin, 56, 58–59, 119, 147, 148, 149, 302 Academy of Sciences and Letters Denmark, 59 Academy of Sciences Paris and admeasurement study (1722), 5, 103, 194, 203–205, 238 closure of, 174, 301–302 and the Geodesic Missions, 8–9, 58, 307 history of, 57–58, 63 in the Louvre, 58, 286 and proximity to the Little Navy School, 286 publications of, 54, 56, 58 and support of naval architecture and technology, 6, 121, 286, 288 ties with the Academy of Navy Brest, 58, 301 Academy of Sciences Paris, Rouillé de Meslay	Academy of Sciences Saint Petersburg, 56, 59, 119, 145, 148, 219, 222, 251, 266, 269, 302  Academy of Sciences Sweden, 59, 246, 302  Admeasurement (volumetric tunnage), xix, 5, 43, 191–194. See also Academy of Sciences Paris, admeasurement study  Admiralty coefficient of resistance, 184  Anglo-French sailing trials (1832), 178–179  Archimedes, 312  and hydrostatics and stability of floating bodies, ix, 105, 194, 195, 207–209, 214–215, 232  and virtual displacement/lever laws, 114–115, 214  Aristotle, 103, 114–115, 195, 214, 261, 262, 298, 312  Arsenal of Venice. See Venice, Arsenal of Atwood, George, 256–257, 302–303, 312  Baker, Mathew, 43, 123–124, 127, 312  and Fragments of Ancient English Shipwrightry (1570), 41, 46–47, 193  Beaufoy, Mark, 114, 167, 183, 302
Academy of Sciences Paris, Rouillé de Meslay	Beaufoy, Mark, 114, 167, 183, 302
Prize, 58, 104, 121	Bélidor, Bernard Forest de, 206, 280
Prize on masting (1727), 5–6, 103–108, 119,	Benstrup, Knud, 199
214–217, 221, 266 (see also Masting of	Bentam, Charles, 39, 41
ships; Point vélique)	Berlin Academy of Science. See Academy of
Prizes on roll, pitch and lading (1755–1765),	Science and Literature Berlin
253–255	Bernoulli, Daniel, 312

and Hydrodynamica (1738), 144-146 and Euler, correspondence with, 309 and live forces, 117, 127, 145 and the Geodesic Mission to Peru, 10-18, and roll and pitch theory, 250-251, 253-255 20, 22, 116, 135, 146, 307, 308 Bernoulli, Jacob, 89, 91, 102, 118, 252, 312 and maneuvering theory, 96-98 Bernoulli, Johann, xvii, 119, 132-134, 312 and the metacenter, 7-8, 227-232 and debate with Renau over the derive and the quarrel with La Condamine, (1712–1714), 87, 88, 91, 92–94 307-308 and Essay d'une nouvelle Théorie de la and ratio of bow resistance, 137, 140, 173 Manoeuvre des Vaisseaux (1714), 60, 93, and relationship with Maurepas, 6, 7, 28-29, 95-96, 98, 102, 103, 108 93, 97, 102, 104, 191, 307-308 and "Hydraulica" (1743), 144-146 and roll and pitch theory, 251-253 and stability theory (1727), 106, 215, 216 Bernoulli laws (equations), 102, 144–145 Bignon, Jean-Paul, 5, 6, 10, 104, 203 and stability theory (1732-1746), 227-237 Bonjean, Antoine Nicolas François, vii-viii, and the trapezoidal method, 203-205, 228 312 on weight estimating, 206-207 Book publishing, 55-57, 61-62 wounded during Geodesic Mission to Peru, Borda, Jean Charles de, 313 16 Bourdé de Villehuet, Jacques-Pierre, 60, as head of French naval constructors, 289-290 99-100, 108, 255, 313 and hydrodynamics experiments, 150, Bourne, William, 194, 200 160-161, 163, 171, 176, 179-180, 244 Bows of least resistance, 134-137, 163. See and standardization of ship designs with also Solid of least resistance Sané, 35, 179, 239, 287 Britain, naval constructors of. See Naval Bossut, Charles, 55, 62, 163, 254, 280 constructors of Britain and hydrodynamics experiments, 163-168, Britain, survey of navy, 30-31 171, 176, 303, 313 British East India Company, 33, 191 British warships, speed compared with French Bouguer, Jean (father of Pierre), 3-5, 309 Bouguer, Pierre. See also Traité du navire warships, 176-178 (1746)Brunel, Isambard Kingdom, 183, 184, 302, 304-305 and the Academy of Sciences Paris, 5–6, 58, 203-204 Buffon, Georges-Louis Leclerc, count of, 284 and the Academy of Sciences Prize on Bureaucratic control of ship design masting (1727), 5-6, 51, 55, 103-108, 134, by ship models, 38, 40, 42, 65, 66 221 by ship plans, 38, 42 biography of, 1-7, 309-310, 313 by ship theory/naval architecture, x, 25, and bows of least resistance, 134-137 279, 286-287, 303-304 and use of calculus, 5, 98 Burgues de Missiessy-Quiès, Édouard Jacques, as central figure in the history of naval count of, 60, 255n155, 313 architecture, x Bushnell, Edmund, 197, 203 death of, 309-310 and De la Manoeuvre des Vaisseaux (1757), Calculus, 5, 114 98-102, 252, 309 and the priority dispute between Newton and Euler, comparison with, 135-138 and Leibniz, 132, 233, 237

Calculus, differential Charnock, John, and A History of Marine in maneuvering theory, 98 Architecture (1800), xii, 139-140 in sails as curved surfaces, 101-102 Chauchot, 253 in the solid of resistance, 129-131 China, and standardization of ships, 38 Calculus, integral Choiseul, Étienne-François, duke of, 29, 110, 143, 239, 243, 245, 286-287, 293, 314. See in stability theory, 221-222 numerical approximation by the method of also 1765 Shipbuilding Ordinance trapezoids, 203-205, 228, 265 Clairaut, Alexis-Claude, 12, 144, 146-149, numerical approximation by Simpson's Rule, 253, 263, 314 246-247, 257, 277 Clairin-Deslauriers, François Guillame, 110, Calculus, partial differential 242, 243, 284, 314 in a vector field, 146, 147 Cod's head and mackerel's tail, 123-124 in fluid continuity and dynamics equations, Colbert, Jean Baptiste 149-150 and the Academy of Sciences Paris, 57, 58, Camus, Charles Étienne Louis, 12, 104–105, 63 215-217, 280, 284, 313 biography of, 62-63, 314 Cannon, naval, and effect on ship design, and the Construction Conferences (1681), 34 - 3574-79 Carpenters, as ship constructors, xvii, 23, rebuilding the French navy, 28, 62-64, 287-288 280-281 Cassini, Giovanni Domenico, 8-9, 13, 58, and Renau, 28, 51, 68-70, 81 126 and the search for a theory of ships, 37, Castries, Charles Eugène Gabriel de La Croix, 65-68, 74, 75-80, 82, 120-121 marquis of, 179, 287, 313 shipbuilding regulations of, 39, 48, 65, 66, Catamarans, of William Petty, 57, 126, 138, 71, 79, 194, 286 and standardization of ship designs, 35, Center of gravity, calculation of, 242-243. See 37-38, 49 also Inclining experiment and the Versailles Grand Canal, 67-68, Center of oscillation, 98, 99, 117-118 75-78, 151 Center of rotation experiment, 99, 100, 101 Compagnie des Indes. See French East Indies Chapman, Fredrik Henrik af, 59, 294, 314. See Company also Tractat om Skepps-Byggeriet (1775) Condorcet, Marie-Jean-Antoine-Nicholas and Architectura Navalis Mercatoria (1768), Caritat, marquis of, 121, 164-167, 269n15, 49, 246, 277, 278 308, 314 as chief constructor of Swedish navy, 30, Cono-cuneus, of John Wallis, 123, 126, 127, 246 and the creation of the Fleets Constructor used as hull form for design of Royal Corps, 295 Katherine, 138 and model experiments, 153-158, 173, 176 Construction Conferences (1681), 74–80 parabola method of, 158, 278 Constructor, definition of, xvii relaxation method of, 154-158, 303 Constructors. See Naval constructors and Simpson's rule, 246-247, 257, 277 Copper sheathing, 37 study abroad, 153-154, 246 Coriolis, Gustave Gaspard, 136, 145, 167

Corps des Ingénieurs-Constructeurs de la Marine. See Naval constructors, France Corps des Ingénieurs des Ponts et Chausées. See Corps of Engineers of Bridges and Roadways Corps du Génie Maritime. See Naval constructors, France Corps du Génie Militaire. See Corps of Military Engineers, France Corps of Engineer-constructors of the Navy, France. See Naval constructors, France Corps of Engineers of Bridges and Roadways, France, 280 Corps of Engineers, Spain, 245, 290 Corps of Maritime Engineering, France, Special School of. See Little Navy School Corps of Maritime Engineering, France. See Naval constructors, France Corps of Military Engineers, France, 56, 81, 92, 160, 167, 279-280, 288 Corps of Navy Engineers, Spain. See Naval constructors, Spain Coulomb, Charles Augustin de (scientist), 150, 182 Coulomb, François (constructor 1600s), 75 Coulomb, François (constructor 1700s), 217 Coulomb, Laurent (constructor 1600s), 75, 77 Coulomb, Pierre (constructor 1700s), 33 Cuerpo de Ingenieros de Marina. See Naval constructors, Spain Cuerpo de Ingenieros. See Corps of Engineers, Spain Currency conversion. See money conversion D'Alembert, Jean-Louis Le Rond, 314 and hydrodynamic experiments 164-167 hydrodynamic theories of, 144, 146-148, 252-253

paradox of, 147

Danish Academy of Sciences, 59

De la Théorie de la manoeuvre des vaisseaux

(1689) by Renau, 46, 60, 62, 81-87

Dassié, Charles, xiv, 48, 71

Deadweight (cargo tonnage), calculation of, 199-205 Deane, Anthony, 31, 41, 48, 68-69, 151, 314 and calculating displacement, 196-199, 248 Denmark, naval officer-constructors of. See Naval constructors, Denmark Denmark, survey of navy, 30 Dérive debate between Renau and Huygens (1691-1696), 88-91, 93 debate between Renau and Johann Bernoulli (1712-1714), 87, 88, 92-94 Pardies' analysis in La Statique (1673), 69-70 Renau's analysis in "Mémoire sur les constructions des vaisseaux" (1679), 71-73 Renau's analysis in De la Théorie de la manoeuvre des vaisseaux (1689), 81-87 Descartes, René, 8, 69, 73-74, 115-117 Descriptive geometry, 43 Digges, Thomas, xiv, 47 Displacement, calculations of, 196-202 due to gun ports, 35, 43 due to shallow Drogden Straits, 199 faulty ideas about, 195-196 reconciled with weights, 205-207 Doctrine. See also Naval tactics balance of power, 27 effect on ship design, 37–38 Double tangent rule of sail, 98, 99, 100-101 Du Buat, Pierre-Louis-Georges, 60, 121, 164, 168-171, 174, 176, 181, 182, 280, 315 Ducrest, Charles-Louis, marquis of 60, 182 Duhamel du Monceau, Henri Louis, 315. See also Élémens de l'Architecture Navale (1752); Little Navy School as chief constructor of French navy, 284 and his relationship with Bouguer, 266, 270, 309 and his relationship with Maurepas, 29, 269, 283-284

as first published work of naval architecture,

386-387 Duguesne, Abraham, 66, 74-80, 315 East Indies companies, survey of, 32–33 École de Paris. See Little Navy School École des Élève Ingénieurs-Constructeurs de la Marine. See Little Navy School École du Louvre. See Little Navy School École Polytechnique, 289 Élémens de l'Architecture Navale (1752) by Duhamel du Monceau, xi, 49, 57, 60, 61, 62, 100, 110, 140, 238, 245, 248, 286 description of, 269-272 Ellipse theory of ships, by Renau, 46, 71–74, 78, 79, 80, 88, 133 Elvius, Pehr, 99, 109, 315 Encyclopédie by Diderot and D'Alembert (1751-1772), 55, 61 Encyclopédie méthodique Marine (1783–1787), 61, 181, 182–183, 275 Engineer-constructors of the Navy, France. See Naval constructors, France Engineer-constructors of the Navy, France, School of. See Little Navy School Engineering definition of, xiv-xv, 279 as a tool for optimization, 301, 304 Ensenada, Zenón de Somodevilla y Bengoechea, marquis of, 29, 272, 274 Espionage, as a means of technology transfer, 64, 80, 139, 176, 272, 274, 291, 294

Euler, Johann Albrecht, 254-255

Scientia navalis (1749)

182

masting (1727), 104-105

biography of, 119-120, 315

Euler, Leonhard, 53, 56, 59, 177. See also

and the Academy of Sciences Prize on

and Bouguer, comparison with, 135-138

and Bouguer, correspondence with, 309 and bows of least resistance, 135–137

hydrodynamic theories of, 144, 149-150,

and the 1765 Shipbuilding Ordinance,

and roll and pitch theory, 250, 252, 254 and stability theory (1727), 105, 214-215 and stability theory (1735-1749), 219, 222-227, 233-237 Europe, survey of navies, 26-32 Examen Marítimo (1771) by Juan y Santacilia, xi, 19, 23, 60, 98, 102, 180-181, 244-245, 292 description of, 272-275 Experimentation, assessment of hull forms in Britain (1670-1750s), 139, 151-153 by Chapman (1770s-1797), 153-158, 173, 176 by the Society for the Encouragement of Arts (1758-1763), 153 by Tourville and Hoste (1686), 77, 259-260, 262 in the Versailles Grand Canal (1681), 68, 74-77, 151 by Zwijndregt (1750s), 153–154, 173 Experimentation, in hydrodynamics by Beaufoy (1793-1798), 167, 183, 302 by Borda (1767), 160-161, 163, 170, 171, 173, 174, 179-180, 182, 244, 287 by Bossut, Condorcet and D'Alembert (1775), 163-168, 171, 173, 176, 182, 303 by Du Buat (1779), 164, 167-170, 171, 174, 176, 181, 182 by Huygens (1668), 126-127, 129, 158 by Mariotte (1681), 126-127, 129 by Romme (1783), 164, 170-174, 176, 181, 182 by Thévenard (1768), 161–164, 173, 176, 182 use of Pitot's tube in, 168-171 Extended operations at sea, effect on ship design and technology, 36-37 Fatio de Duillier, Nicolas, 88, 91, 131-132,

315

Fausto, Vettor, 47, 298

and maneuvering theory, 97-98

Fernández de Landa, José Romero, 25, 30, Gaztañeta e Iturribalzaga, Antonio de, 29, 41 180, 244, 293, 315 Génie Maritime. See Naval constructors, France Génie Militaire. See Corps of Military Fincham, John and A History of Naval Architecture (1851), xii, 23, 78, 179 Engineers, France Finite elements, early examples in fluid Geodesic Mission to Peru resistance calculations, 134, 136, 141-143 Bouguer wounded during, 16 Fleets Constructors Corps, of Sweden. See and Bouguer's writing of Traité du navire Naval constructors, Sweden during, 18-20, 135, 263 Fluid resistance. See Resistance of fluids controversy over results, 17, 233, 307, 308 Forfait, Pierre, 24, 110, 299 and the debate over Earth's shape, 8-10, Fournier, Georges and Hydrographie (1643), 116, 191 48, 195-196, 280-281 measuring the baseline, 13–15 preparations for, 10-13, 29 France, naval constructors of. See Naval constructors of France return to Europe from, 17-18, 20-22 France, survey of navy, 27-29 and triangulation, 14-16 Franklin, Benjamin, 164–165 Gerner, Henrik, 30, 294, 316 Geslain, Blaise, 139 Freeboard, early rules for, 195 French Academy of Sciences. See Academy of Gobert, 139 Sciences Paris Godin, Louis, 9-17, 19, 20-21, 291, 307, 316 French East Indies Company, 33, 35 Grand Canal of Versailles. See Versailles and support of naval architecture, 33, Grand Canal 161-163 Grandjean de Fouchy, Jean-Paul, 4, 10, 263, French hydrodynamics 309, 315 British perceptions of, 176-179 Gravity, theories of, 8-10, 115-117 skepticism of, 179-180 Griffiths, John W., 158 Groignard, Antoine, 33, 239, 253-255, 316 French Revolution, marking the end of the Scientific Revolution, ix, 174, 301-302 Guardiamarinas. See Navy Guards, Spain French warships, speed compared with British Gun ports, effect on ship design, 34-35, 43, warships, 176-178 196 Friction, in fluid resistance, 150, 163, 167, GZ curve, as a measure of stability, 256–257 168, 170, 175-176 Froude number, 175-176 Harriot, Thomas, 123 Froude, William, vii, 114, 150, 158, 161, 163, Hennert, Johann Friedrich, 60, 61n24 170, 174, 175, 184, 255, 305 Hermann, Jacob, 95, 133 Histoire et Mémoire de l'Académie Royale des Furttenbach, Joseph and Architectura navalis (1629), xiii, 48 Sciences de Paris. See Academy of Sciences Paris, publications of Galileo Galilei, 159, 195, 262, 298-299 Hocquart, Jean-Hyacinthe, 203-205, 228, Gardes de la marine. See Navy Guards, France 316 Gautier, Jean-François, 29, 36, 180, 245, 255, Hohlenburg, Frantz, 245, 294 290, 292-293, 315 Hoste, Paul, 52, 281, 316. See also Théorie de Gay, Pierre de, 182-183, 315 la construction des vaisseaux (1697) Gazelle (18-gun), experiments by Bouguer on, and "Architecture navalle" (1714), 262

Aristotelian mechanics of, 103, 115, 214

7-8, 227, 232

and L'Art des Armées Navales (1697), 87, 100, Jombert (book publishers), 55, 56-57, 260-261 263-264, 307 Journals, scientific, 54-55, 61 and maneuvering theory, 87 model experiments of, 77, 259–260, 262 Juan y Santacilia, Jorge, xi, xvii, 316. See also and naval tactics, 87, 100, 260-261 Examen Marítimo (1771) and stability theory (1697), 103, 189, 191, as chief constructor of Spanish navy, 29, 211-215, 232 244, 291-292 Tourville's influence on, 77, 259-261 and criticism of naval architecture, 23, 25, Hudde, Johann van Waveren, 203-204, 248, 180, 244-245, 275, 292 316 and espionage in Britain, 29, 272, 273, 291 Hull model tests. See Experimentation, hydrodynamic theories of, 180-181 assessment of hull forms; Experimentation, and maneuvering theory, 98, 275 in hydrodynamics and participation in the Geodesic Mission to Huygens, Christiaan, 58, 73, 101-102, 117, Peru, 11, 12, 15, 17, 19-22, 29, 244, 272 316 and stability, roll and pitch theory, 255-256, and center of oscillations, 116-117 and the debate with Renau over the dérive Judichær, Olaus, 199, 294, 316 (1691–1696), 88–91, 93 and hydrodynamic experiments (1668), Knowles, Charles, 220, 226n89, 269 126-127, 129, 158 Krabbe, Frederick Michael, 245, 294 and stability theory (1650), 211 Kronan (124-gun), sinking of, 190 Hydrodynamics experimentation in, 158-173. See also L'Hôpital, Guillame-François-Antoine, Experimentation, in hydrodynamics marquis of, 88, 89, 91, 92, 102, 132-134, in modern ship resistance theory, 138-139 174-176 La Caille, Nicolas-Louis de, 309–310 theoretical development of, 144-150 La Condamine, Charles Marie de, 316 Hydrography schools. See Schools of and the Geodesic Mission to Peru, 2, 9-17, hydrography 20 - 22Hydrostatics. See Stability; Displacement and the quarrel with Bouguer, 17, 233, 307-309 Hyponatremia, first recorded instance (in Renau), 94 La Croix, César-Marie de, 317 on the need for weight estimates, 206 Inclining experiment, 99, 213-214, 232, and stability theory (1732-1735), 60, 242-244, 248, 303 219–222, 233–237, 266 Industrial Age, ix, xi, 26, 279, 303-305 La Hire, Philippe de, 89, 91, 127 Ingénieurs-Constructeurs de la Marine. See Naval Lagrange, Joseph-Louis, 149-150 constructors, France Lavanha, João Baptista, xiii, 47 Le Croisic, 3-6, 106, 204, 307 Jefferson, Thomas, 185 Le Monnier, Pierre Charles, 12, 243, 253, 310, **Jesuits** 317 correspondence as a model for scientific Learned societies. See Academies and societies journals, 53, 54 Least resistance. See Bows of least resistance; Solid of least resistance

history of, 51-54

Leibniz, Gottfried, 53, 55, 89, 91, 102, 117, Mary Rose (37-gun), sinking of, 189-190, 196 131-132, 233, 237 Masting of ships, 102-112. See also Point Lévêque, Pierre, 23, 181, 275 vélique; Academy of Sciences Paris, Rouillé Line of battle, effect on standardization of de Meslay Prize, Prize on masting (1727) ship design, 35-36 Maupertuis, Pierre Louis Moreau de, 9, 12, Little Navy School, 61, 80, 105, 110, 140, 59, 97, 146, 288, 307, 317 238, 239, 266, 269-270, 276, 282-286, Maurepas, Jean-Frédéric Philippe Phélypeaux, 289-290, 305, 309 count of in the Louvre, 285-286, 307 and the Academy of Sciences, 8-9, 58 Live forces (vis viva), 117, 135-136, 145, 146, biography of, 217-219, 317 161, 167 and his support of Bouguer, 6, 7, 28-29, 93, 97, 102, 104, 219, 237, 263, 307–308 Livre tournois. See Money conversion Longitude, as major scientific problem, 8, 25, and his support of Duhamel du Monceau, 190 29, 269, 283-285 Louis XIV, 51, 67-69, 77, 89 and his support of Geodesic Mission to Peru, Louvre 8-12, 217as the home of the Academy of Sciences and his support of La Croix, 219, 222, 237 Paris, 58, 286, 307 rebuilding the French navy, 28-29, 139, as the home of the Little Navy School, 217 285-286, 307 "Mémoire sur les constructions des vaisseaux" (1679) by Renau, 69-74, 81, 82 Lune (54-gun), sinking of, 187–188, 213 as first known work of naval architecture, MacLaurin, Colin, 95 70 - 71Maffioletti, Gianmaria, 32, 299, 317 Merchant fleets, survey of, 32-33 Mairan, Jean Jacques d'Ortous de, 5, 103, Metacenter 104, 194, 203-205, 317 as a science "multiple," 232-237 Maitz de Goimpy, François Louis Edme as icon, 187, 295 Gabriel, count of, 60, 61n23, 317 calculated in practice, 238-249 Maneuvering theory. See also Dérive derivation by Bouguer, 7-8, 221, 227-232, of Bouguer (1746–1757), 96, 98–100 265 continuation into 19th century, 100-101, lack of impact on ship design, 249-250, 296 109-110 longitudinal, 256 of Euler (1749), 97 used today, x, 7, 187 of Hoste (1691), 87 Method of trapezoids. See Trapezoids, method of Juan y Santacilia (1771), 98, 275 of and naval tactics, 96-101 Michael of Rhodes, 46 of Pitot (1727), 95-96 Model tests. See Experimentation, assessment of Renau, Huygens and Johann Bernoulli of hull forms; Experimentation, in (1689-1714), 82-94hydrodynamics of Savérien (1746), 96 Models. See Ship models Marguerie, Jean-Jacques de, 164n129, 317 Moivre, Abraham de, 131-132 Mariotte, Edmé, 78, 81-82, 126-127, 129, Money conversion, xx-xxi 133, 262, 317 Monge, Gaspard, 43

Morineau, Pierre, 272 Moseley, Henry, 255 "Multiple" in science definition, 233 the metacenter as, 232–237 Murray, Mungo, 60, 151–153, 179, 248

Naval architects. See Naval constructors Naval architecture. See also Ship theory definition of, xiii-xvi, 25, 47-48 dissemination of knowledge of, 59-62 as a force multiplier, 28, 66, 120-121 histories of, xi-xiii as a means of bureaucratic control of ship design, x, 25, 279, 286-287, 303-304 role in doctrine and technology, 37-38 Naval constructors of Britain, 249, 296-298 of Denmark, 245, 293-295 of France, 29, 285-290 of the Netherlands, 248-249, 298 of Spain, 245, 290-293 of Sweden, 187, 246, 295 of Venice, 298-299 Naval tactics, 96-97 and maneuvering theory, 96–101 Navy Board models. See Ship models Navy Guards, France, 52, 161, 170, 259, 281 Navy Guards, Spain, 11, 21, 49, 244, 290-291 Netherlands VOC (East Indies Company), 32-33, 35 Netherlands, naval constructors of. See Naval constructors, Netherlands Netherlands, survey of navy, 31 Newton, Isaac, 318 and gravity theories, 8-10, 115-117 precursors to, 123-127, 138 Principia (1687) and rational mechanics, 113, 114, 117, 119 priority dispute with Leibniz on the

calculus, 132, 233, 237

and resistance of fluids, 128-129, 135-136,

148-149, 160, 163, 167, 168, 174, 184

and the solid of least resistance, 129–131, 138–139, 154

Nystrom, John W., 158

Ollivier, Blaise, 139, 205–206, 217, 238, 284, 318
Oscillations of ships. *See* Roll and pitch theory

Panfilli, Odorico, 140, 303 Pangalo, Biaggio (Blaise), 74-75, 77, 81 Parabola method, of Chapman, 158, 278 Pardies, Ignace Gaston, 69-71, 73, 81-82, 91, 101-102, 318 Parent, Antoine, 91, 95, 211, 234, 318 Pascal, Blaise, ix, 114, 210 Pendulum, as model of roll for ships, 118, 251-252, 255, 257 Pendulums, multiple. See Center of oscillation Pepys, Samuel, 48, 87, 151, 158, 196-197 Peru. See Geodesic Mission to Peru Petit École de Marine. See Little Navy School Pett, Peter, 31, 28, 123, 126, 138, 196 Pett, Phineas, 196 Petty, William, 57, 123, 126, 138, 151, 197, Philosophical Transactions of the Royal Society. See Royal Society Picardy Underground Canal, 164-165, 303 Pitot, Henri de, 318 and maneuvering theory, 60, 95-96 and the Pitot tube, 168, 169, 171 Plans. See Ship plans Point vélique. See also Masting of ships; Academy of Sciences Paris, Rouillé de Meslay Prize, Prize on masting (1727) Bouguer's definition of, 104, 106, 216, 265 controversy over, 108-109 modern use of term, 109 practical application of, 108, 110-112, Poleni, Giovanni, 41, 99, 121, 151, 249,

318

Polhem (Polhammer), Christopher, 49, 214, Republic of Letters, 53, 54, 89 318 Resistance of fluids Ponts et Chausées. See Corps of Engineers of pressure theory of, 146-148, 173 Bridges and Roadways shock theory of, 102, 113, 128-129, 173 Principles of Naval Architecture (1988), vii, xvi, Resistance of ships. See also Experimentation, xix, 49, 264 assessment of hull forms; Experimentation, Professionalization, of naval constructors. See in hydrodynamics; Resistance of fluids Naval constructors experimentation on, 151–173 Publishing books. See Book publishing new ideas in, 180-184 Pursuit curves, 97, 99 separation into components, 168-170, 174-175, 183 Rankine, William, 163 using shock theory, 133-143 Ratio of bow resistance, 137, 140-143, 173, Resistance tests. See Experimentation, 176, 179-180 assessment of hull forms; Experimentation, Rational fluid mechanics, ship theory in, in hydrodynamics 120-123. See also Hydrodynamics; Retamosa, Julián Martín de, 30, 293 Experimentation, assessment of hull forms; Reuss's Repetorium (1801–1821), 121–122 Experimentation in hydrodynamics Reyneau, Charles René, 5, 106, 133-134, Rational mechanics, ix, 113-120, 127 203 Relaxation method of Chapman, 154-158 Richelieu, Armand-Jean du Plessis, duke of, 28, 64, 188, 319 Renau d'Elizagaray, Bernard. See also "Mémoire sur les constructions des Robins, Benjamin, 158–160, 179, 319 vaisseaux" (1679); De la Théorie de la Roll and pitch theory, 22, 250-256, 275 manoeuvre des vaisseaux (1689) Rømer, Ole, 58, 199 in the Battle of Vigo Bay (1702), 92 Romme, Nicolas Charles, 60, 164, 170-174, biography, 68-69, 94, 318 176, 181–182, 242, 319 captures Berkeley Castle (1694), 89 Roquefeuil-Kerlouet, Aymar-Joseph, count of, and Colbert, 28, 51, 68-70 160, 243-244, 287, 319 and the Construction Conferences (1681), Rouillé de Meslay Prize. See Academy of 74 - 78Sciences Paris, Rouillé de Meslay Prize death by hyponatremia, 94 Royal Corps of Naval Constructors (Britain), and the dérive, debate with Bernoulli 207-208 (1712–1714), 87, 88, 91, 92–94, 119 Royal Katherine (84-gun), with cono-cuneus and the dérive, debate with Huygens hull form, 138 (1691-1696), 88-91, 93 Royal Louis (110-gun), inclining experiment and the dérive, initial ideas of, 71-73 on, 239, 303, 310 ellipse theory of ships, 46, 71-74, 78, 79, 80, Royal Society, 57, 58, 132, 138, 291, 302 88, 133 Russell, John Scott, 183-184, 302, 305 as member of Corps of Military Engineers, Russian Academy of Sciences. See Academy of Sciences Saint Petersburg 81, 92 mortar-ships of, 78 and Seignelay, 81-82 Sail, double tangent rule of, 98, 99, 100-101 and Vauban, 78, 81, 94 Sails, as curved surfaces, 101-102

Saint Petersburg Academy of Sciences. See 1765 Shipbuilding Ordinance, 29, 210, 239, Academy of Sciences Saint Petersburg 245, 286-287, 292, 310. See also Choiseul; Salvini, Andrea, 299 Duhamel du Monceau; Standardization of San Carlo Borromeo (64-gun), as standard for ships Venice warships, 41, 99, 101, 249, 299 Sewell, John, 176-177, 183, 302. See also Sané, Jacques-Noël, and standardization of Society for the Improvement of Naval ship designs with Borda, 35, 179, 287 Architecture Sauveur, Joseph, 81–82, 319 Sheldon, Charles, 245–246 Savérien, Alexandre, 96, 108-109, 264, 319 Sheldon, Francis (I), 39, 41, 293 School of Maritime Engineering, France. See Sheldon, Francis (II), 319 Little Navy School Sheldon, Gilbert, 59, 214, 246, 320 School of Naval Architecture, Venice, 32, 249, Ship 298-299 as compared with an army, 24 School of Naval Engineering, Netherlands, as a composite machine, 24 298 Shipbuilding methods, differences in French, School of Paris. See Little Navy School Dutch and British, 36, 64, 65, 66, 88, School of student Engineer-constructors of 291–294. See also Espionage the Navy. See Little Navy School Shipbuilding treatises, 40, 46-49 School of the Louvre. See Little Navy School Ship models, 38-40, 68, 299 Schools of hydrography, 3, 5, 6, 52, 54 as a means of bureaucratic control of ship Schools of Naval Architecture, Britain, 277, design, 38, 40, 42, 65, 66 297-298 Ship plans, 40-44, 74, 79 Scientia navalis (1749) by Euler, 56, 57, 59, as a means of bureaucratic control of ship 97-98, 102, 109, 119, 135-137, 143, 167, design, 38, 42 222, 252 mathematics and, 38, 43, 46 abridged versions of (Théorie complette de la Ship resistance. See Resistance of ships. See construction . . . and Théorie complète de la also Resistance of fluids; Experimentation, construction . . .), 57, 97, 143, 227, 269, assessment of hull forms; Experimentation, 288 in hydrodynamics description of, 266-269 Ship theory Scientific revolution as a force multiplier, 28, 66, 120-121 dating of, ix as a means of bureaucratic control of ship end of, xi, 26, 279, 301-303 design, x, 25, 279, 286-287, 303-304 structures of, 51-62 in rational fluid mechanics, 120-123 Seignelay, Jean-Baptiste Colbert, marquis of, role in doctrine and technology, 37–38 search by Colbert for, 37, 65-68, 74, 75-80, and the Construction Conferences (1681), 82, 120-121 74-79 Shock theory of fluid resistance, 102, 113, missions to Britain and Holland, 64 128-129, 173 and the search for a theory of ships, 65-68, Simpson's rule, 246-247, 257, 277 74, 79-80 Simultaneous discoveries. See "Multiple" in shipbuilding regulations of, 65, 66, 79-80 science Seppings, Robert, 254 Smeaton, John, 121, 151, 153, 160, 320

Society for the Encouragment of Arts, model of Juan y Santacilia (1771), 256 experiments of, 153, 248 of La Croix (1732-1735), 60, 219-222, 233-237, 266 Society for the Improvement of Naval Architecture, 59, 61, 113-114, 176, 184, of Parent (1700), 211 248, 297, 302 of Stevin (1608), 209-211 sponsors Beaufoy's experiments, 114, 167, used by navies in design, 238-239 183, 302 Standardization of ships Solid of least resistance. See also Bows of least arguments against, 36 resistance; Shock theory of fluid resistance by Borda and Sané, 35, 179, 239, 287 as applied to ship design, 133-140, 153, in Britain (Establishments), 31, 35 163 in China, 38 by Colbert, 35, 37-38, 49 and the calculus priority dispute between effect on ship design, 25-26, 35-36 Newton and Leibniz, 132 early development, 106, 131-133 and the line of battle, 35-36 Newton's formulation of, 129-131 under the 1765 Shipbuilding Ordinance, persistence of, 184-185 286-287 ships built to the form of, 138–140 in Spain, 36 and Thomas Jefferson, 185 in Venice, 31-32, 41, 99 Spain, naval constructors of. See Naval Stevin, Simon, ix, 114, 115, 118, 195, constructors, Spain 209-211, 213 Spain, survey of navy, 29–30 Stibolt, Ernst Vilhelm, 59, 60, 320 Speed of French warships Stoot, William (Fred), xii comparison with British warships, 176-178 Strategy. See Doctrine contribution of ship theory to, 178-179 Stratik (Stratico), Šimun Filin (Simone), 299, Stability accidents, 187-191 320 Sutherland, William, 133 Stability experiments, 189, 242. See also Inclining experiment Sweden, Fleets Constructor Corps. See Naval constructors, Sweden Stability theory in the Academy Prize on masting (1727), Sweden, survey of navy, 30 Swedish Academy of Sciences. See Academy of 214-217 of Archimedes (220) BC, 207-209 Sciences Sweden of Atwood and Vial du Clairbois at large angles of heel (1796-1798), 256-257, Tactics. See Doctrine; Naval tactics 302-303 Technology, effect on ship design, 33-37 of Bouguer (1727), 106, 215, 216 Théorie de la construction des vaisseaux (1697) of Bouguer (1732-1746), 227-237 by Hoste, 48, 87, 91, 133, 189, 211, 213 of Camus (1727), 105, 215-216 description of, 259-262 of Euler (1727), 105, 214-215 Thévenard, Antoine-Jean Marie, 33, 110, of Euler (1735-1739), 219, 222-227, 163–164, 320 233-237 Thurah, Diderich Lauritsen de, 199, 300 of Hoste (1697), 103, 189, 191, 211-215, Tonello, Gasapard, 158, 299 232 Tourville, Anne-Hilarion de Cotentin, count of Huygens (1650), 211 of, 320

and the Construction Conferences (1681), School of Naval Architecture (see School of 74 - 78Naval Architecture, Venice) influence on Hoste, 77, 87, 96, 259-261 survey of navy, 31-32 influence on Renau, 74-75, 77 Verenigde Oostindische Compagnie (VOC). See Tractat om Skepps-Byggeriet (1775) by Netherlands VOC Chapman, 60, 154, 246, 295 Verne, Jules, 113 description of, 275-278 Versailles Grand Canal Simpson's rule in, 246-247 construction of, 67-68 Traité du navire (1746) by Bouguer, 48, 97, 98, fleet of, 68, 76 102, 108, 135-137, 222, 227, 251 model experiments in (1681), 74-77, 151 as central thread in the history of naval Vial du Clairbois, Honoré-Sébastien, 60, 256-257, 276, 290, 298, 302, 321 architecture, x, 1 "De la Mâture des vaisseaux" (1727) as Victory (104-gun), model experiments (1937), predecessor to, 108 175 description of, 262-266 Vinci, Leonardo da, 150 duplicate copy of manuscript, 19-20 Virtual displacements and virtual velocities, illustrations in, 42, 57 103, 114-115 price of, 55 Vis viva. See Live forces as principal text in the Little Navy School, VOC (Verenigde Oostindische Compagnie). See Netherlands VOC writing of, 1, 7, 18-20, 262-264, 307, 309 Voltaire (François Marie Arouet), 11, 12, 53, Trapezoids, method of, 203-205, 228, 265 91, 139, 308 Triton (60-gun), masting experiments on, Vortices or attraction, as theories of gravity, 108 8, 115-117 Triton (slave ship), Bouguer's return from Peru on, 22, 252, 307 Wallis, John, 75, 123, 126, 127, 136, 138, Tunnage rules. See Admeasurement 321. See also Cono-cuneus Turgot, Anne-Robert-Jacques, 164, 269, 320 Waveline principle, of John Scott Russell, 184 Wegersløff, Frederik, 222, 245, 294 Weight estimates Udemans Junior, Willem, 33, 49 Ulloa y de Torre-Guiral, Antonio de, xi, 11, development of, 205–207 12, 15, 17, 20-21, 29, 291, 321 faulty, 242 tabulation by group, 206, 239 Whole-moulding, 40 Varignon, Pierre, 119, 133, 203-205, 228, 321 Witsen, Nicolaes, 48, 203, 321 Vasa (64-gun) sinking of, 30, 189, 190 stability experiment on, 189, 242 Zwijndregt, Pieter Pauluszoon van, 33, Vauban, Sébastien Le Prestre, marshal of, 153-154, 173, 321 77-78, 92, 94, 279-280, 321 Vector composition of forces, 69-70, 93-94, 118-119 Venice

Arsenal of, 31-32, 67, 249, 298-299