Scientific organizations greatly facilitate scientific progress. The different kinds of such organizations include: societies, which usually require annual dues, have annual meetings, publish journals, and sometimes have geographically located headquarters; professional journals, which may or may not be sponsored by societies, sometimes have academic homes, usually within colleges or universities (Vernon 2000), but sometimes at museums or society headquarters or in government agencies; botanic or zoological gardens; and field stations, usually for both teaching and research, but sometimes just for one purpose. Field stations have usually been affiliated with academic or other institutions that provided funding. Discussions of such organizations have appeared in previous parts of this history, notably in parts 48–51, on plant ecology, animal ecology, limnology, and marine ecology, 1870s–1920s (Egerton 2013, 2014a, b, c), and marine stations mentioned here are mainly ones previously omitted. Not previously mentioned is the Organization of Biological Field Stations online alphabetical list for North America. One can also consult Robert Kohler’s Landscapes and Labscapes: Exploring the Lab-Field Border in Biology (2002) for discussion of various stations. If one begins with an individual scientist, one can consult general sources to ascertain professional affiliation and memberships in scientific societies. One example is Allen G. Debus, editor, World Who’s Who in Science: a Biographical Dictionary of Notable Scientists from Antiquity to the Present (1968, xvi + 1855 pages); another is Charles C. Gillispie, editor, Dictionary of Scientific Biography (16 volumes, 1970–1978) and periodic additional volumes under other editors; American Men and Women of Science (edition 1, 1906, and frequent new editions), which includes Canada and USA; other nations have comparable reference works. The online Biodiversity Heritage Library has millions of pages of taxonomic literature, representing tens of thousands of titles in over 150,000 volumes—a useful reference service hosted by the Smithsonian Institution.

A useful critical bibliography is Arne Hessenbruch, Reader’s Guide to the History of Science (2000), which has articles relevant to history of ecology. Most relevant are “Ecology” (Egerton 2000),

When Edward Kormondy and Frank McCormick edited a Handbook of Contemporary Developments in World Ecology (1981), I wrote a jubilant review (Egerton 1983), welcoming publication of such comprehensive information. Of the 34 chapters on nations, 9 chapters began narratives before 1900: Austria, Egypt, Hungary, Iceland, Mauritius, New Zealand, Poland, South Africa, Switzerland; 13 chapters began narratives between 1900 and 1945: Australia, Belgium, Czechoslovakia, Greece, Italy, Japan, The Netherlands, Nigeria, Norway, Puerto Rico (USA possession), Sweden, United Kingdom, USSR; and 11 chapters began narratives in 1945 or later: Brazil, Costa Rica, Indonesia, Israel, Korea (South), Mexico, Pakistan, Singapore, Taiwan, United States, West Germany. These editors perhaps gave few guidelines to authors, as some nations’ articles are considerably more detailed than others. One might lament that four appendices listing major journals, professional organizations, research organizations, and abstracting services did not list starting dates (Kormondy and McCormick 1981:721–734, 741–746); “appendix II: Major Source Books in Ecology” does include publication dates. They edited the Handbook before the internet, and subsequently, beginning dates for journals were published by Graham and Dayton (2002:1485), drawing partly upon Brett, Brouwer, and Brett (1999).

When compiling their Handbook, Kormondy and McCormick were unable to find ecologists who would discuss development of ecology in Canada, Finland, France, India, Ireland, or Spain (Kormondy and McCormick 1981:xxii). Now, Canada has a historian of ecology, Professor Stephen Bocking, who has discussed recent history of Canadian ecology, mainly in connection with resource management (Bocking 1997:151–202, 2004), and Professor Emeritus Eric L. Mills writes on the history of Canadian oceanography. Finland has a history of botany which discussed Finnish ecological endeavors, 1828–1918 (Collander 1965). There are more general histories of ecology in French than in any other language (Deléage 1993, Drouin 1993, Acot 1994, 1998, Matagne 1999). A reason France was slow to establish an ecological society was that it already had many natural history societies that were receptive to publishing ecological studies (Matagne 1999:43–46, 273–284). The same was true for some other countries. Furthermore, merely publishing articles on the ecology of regions within a country could help organize its ecologists at a later date by providing a tradition around which to organize. An example is the Cambridge University Botanical Expedition to western Nigeria, January–May 1935, publications from which initiated studies and interest in Nigeria’s plant communities long before there were Nigerian ecologists to undertake similar studies (Egunjobi 1981:469–470).

Science began in some countries while they were colonies. Historian of science George Basalla wrote a brief, important article, “The Spread of Western Science” (1967), in which he explained that the level of science in European colonies depended upon the level of science in the mother country. During the
1600s and 1700s, Britain and France were leaders in European science, and they also had colonies where science was best developed. James McClellan (2000) compiled a critical bibliography on “Colonialism and Science” (2000), and Roy MacLeod (2001) edited a collection of articles on colonialism and science. Even though Spain lagged behind Britain and France, its desire to be competitive prodded it to follow their examples in its own colonies.

Ecology evolved out of natural history; the first institution to sponsor natural history research was Aristotle’s Lyceum in Athens before 300 BC (Egerton 2012a:4–7). Emphasis here is on the period when four ecological sciences were emerging from natural history, and on until 1945. We saw in earlier parts of this history that aquatic research stations were the earliest ecological institutions, beginning in Europe before 1870, but spreading mostly after 1870, and slightly later in the United States (Kofoid 1898, 1910, Juday 1910, Vaughan 1937, Jack 1945, Hiatt 1954, 1963, Egerton 2014a, b, c). Land-focused stations developed more slowly, because many ecologists at universities conducted research on lands near their university, without needing special organizations or facilities. This survey partly follows Kormondy and McCormick’s organization, but limited to years before 1946. Like theirs, my survey is incomplete, and ecologists everywhere can add to this story. Charles Gager compiled Botanic Gardens of the World: Materials for a History (1937).

A crucial aspect of the history of natural history studies was the history of scientific exploration. There is a vast literature on it, to which Juan Pimentel and Michael Bravo provided an introduction in their “Expeditions” critical essay (2000). To their list I add: Percy Sykes, A History of Exploration (1961), which began with antiquity, and John Parry, The Age of Reconnaissance (1963), which began with European explorations during the 1400s. Some expeditions deserved special notice, foremost being Captain James Cook’s three voyages, 1768–1779, of discovery in the Pacific Ocean (Villiers 1967, Beaglehole 1971, MacLean 1972, Hough 1995). John Beaglehole was the leading Cook scholar during his lifetime. Alan Villiers, in the Australian Navy during World War II, sailed a ship around the world and brought that perspective to his biography. Alistair MacLean’s biography is well illustrated. The National Geographic Society supported author William Gray and photographer Gordon Gahan, who retraced many of Cook’s routes (1981). Each Cook voyage had one or more capable naturalists who made important collections of biological specimens. France was inspired to do likewise, and sent out an expedition in 1788 that was lost at sea, and so France sent out another in 1791–1794 that was seized by the Dutch at Java, and finally a third expedition, 1800–1804, under Nicolas Baudin (1754–1804), which was very successful (Carr and Carr 1976, Farber 1982:40–41). Baudin’s exploration was extensively along the Australian coast that Cook had not explored, and modern Australia celebrated Baudin’s expedition findings with a lavish, very large volume that reproduced in color many drawings of animals collected, as well as landscapes and natives in black and white (Bonnemains et al. 1988). There were more relevant expeditions than can even be mentioned here, but Paul Farber’s summary of them (1982:32–46) is an introduction. Responding to many scientific voyages of exploration, one historian wrote of “The Ship as a Scientific Instrument in the Eighteenth Century” (Sorrenson 1996).

Some ecologists identify as much or more with another biological discipline as with ecology, and anyone who does, becomes organized by that discipline’s traditions if he/she wants to publish in that discipline’s journals. We should, therefore, itemize some histories of relevant disciplines.

Ornithology has at least six general histories, four detailed and two brief. The earliest detailed one is Erwin Stresemann, Die Entwicklung der Ornithologie von Aristotles bis zur Gegenwart (1951, English
Fig. 1. Captain James Cook’s three voyages. Sykes 1961:175.
1975), organized chronologically, with a few topical chapters at the end, and with a few illustrations. Next published was Peter Bircham, *A History of Ornithology* (2007), with numerous colored illustrations, a virtual history of British ornithology. Tim Birkhead is also British, but his *The Wisdom of Birds: an Illustrated History of Ornithology* (2008) is more of a general history, and also with numerous illustrations. Most detailed of all is Tim Birkhead, Jo Wimpenny, and Bob Montgomerie, *Ten Thousand Birds: Ornithology since Darwin* (2014), with many illustrations in both color and black-and-white, topically arranged, a large, impressive book. Both brief histories are chronologically organized; the earlier one is by British museum curator Michael Walters, *A Concise History of Ornithology* (2003), with numerous black-and-white illustrations; the second one is by French environmental scientist Valérie Chansigaud, *Histoire de l’Ornithologie* (2007, English, 2009), with numerous color illustrations. Peter Farber, unlike the above authors, is a historian of science, who wrote *Discovering Birds: The Emergence of Ornithology as a Scientific Discipline, 1760–1850* (1982). Daniel Lewis provided an American continuation of Farber’s subject in *The Feathery Tribe: Robert Ridgeway and the Modern Study of Birds* (2012). Ridgeway (1850–1929) was curator of birds at the Smithsonian National Museum, 1868–1919, and played a leadership role in professionalization of ornithology in America.

There are two recent histories of Entomology: Ray Smith, Thomas Mittler, and Carroll Smith edited *History of Ecology* (1973), which covers history of entomology since antiquity in 20 chapters by 25 authors, has a few illustrations, and all chapters having extensive bibliographies; Jacques Aquilar’s *Histoire de l’entomologie* (2006) is a brief, well-illustrated paperback, with many illustrations in color, and has an adequate brief bibliography. Historian of ecology Jean-Marc Drouin’s *Philosophie de l’Insecte* (2014) is a brief survey which is a cultural history of how entomologists and society, since about 1700, have viewed insects, with some illustrations and extensive documentation.

There is a very substantial literature on the history of BOTANY, yet only two general histories are cited here, since others on particular countries are cited below under those countries. British botanist A. G. Morton, *History of Botanical Science* (1981) is a detailed work, with some illustrations and a good bibliography. Joëlle Magnin-Gonze is a librarian in a Swiss botanical garden. Her brief *Histoire de la Botanique* (2004) covers from antiquity down to about 1900, with numerous illustrations, many in color, and an adequate brief bibliography. Historian of ecology Jean-Marc Drouin has also written *L’herbier des philosophes* (2008), which “is a history both of botanists’ philosophical ideas and of philosophers’ interests in botany” (Scharf 2009:399). It has illustrations and extensive documentation.

The first organization relating to an ecological science, and not a research station, seems to have been the International Council for the Exploration of the Sea (ICES), organized in 1902 among west European nations, motivated by stresses on commercial fisheries in European Atlantic and adjacent waters. ICES encompassed several oceanographic sciences and was important for advancing marine ecology (Rozwadowski 2002:42–76, Egerton 2014c:396–399). At first, it included only a few countries in northwest Europe, but later it expanded on both sides of the Atlantic Ocean and continues to flourish. The development of marine stations was discussed in part 51 (Egerton 2014c:348–374), and stations mentioned here are mostly ones omitted in part 51.

In 1908, an International Congress of Geography met at Geneva, and plant ecologist Carl Schrötter organized a tour of Swiss types of vegetation (Fischedick and Shinn 1993). It inspired Arthur Tansley
to organize a similar international plant ecology tour of Great Britain in 1911, which, in turn, inspired American plant ecologists Henry Cowles and Frederic Clements to organize a U.S. tour in 1913 (Golley 1993:14–15, Egerton 2013d:357). A third tour was planned, but had to be postponed due to World War I.

The first national ecological organizations were in Great Britain (1913) and North America (1915). These were extremely important beginnings, which merit our close attention. With Britain and America setting examples of founding ecological societies, when did other countries follow? Not very soon, because existing national scientific organizations more or less met the needs of new ecologists in many countries.

The second international ecological organization was possibly the Internationalen Vereinigung für theoretische und angewandte Limnologie (1922), initiated by Einar Naumann and August Thienemann (see below).

**AMERICAS**

The Spanish began natural history explorations in the New World during the 1500s, yet it remained a minor aspect of their colonial efforts. The English and the French began natural history explorations during the 1600s, and those efforts expanded with their expanding presence.

**North America (minus Mexico)**

Elsa Allen’s 206-page “History of American Ornithology before Audubon” (1951) covers European encyclopedists of 1500s, Spanish and French explorers, and British settlers and visitors down to the 1810s. The Centre National de la Recherche Scientifique sponsored an International Colloquium in 1956 on *Les Botanistes Français en Amérique du Nord avant 1850*, with the papers published under that title (Leroy 1957), an essential resource on French natural history explorations. My own surveys of North American biological explorations (Egerton 2006, 2009a, c, 2011a, b), are international in scope.

For the UNITED STATES, Marc Rothenberg (2000) provided a critical bibliography on the general history of science. Smithsonian Institution was established in Washington in 1846, and became important to natural historians, especially before the founding of ESA in 1915 (Rivinus and Youssef 1992, Fedunkiw 2000). The Botanical Society of America (BSA) was founded in 1893, but celebrated its Golden Jubilee in 1956, as it wanted to celebrate a new beginning in 1906, when it merged with Society for Plant Morphology and Physiology (founded 1896) and American Mycological Society (founded 1903) (Tippo 1958:1). A good number of the 40 chapters in BSA’s jubilee volume (Steere 1958) are either by plant ecologists or are relevant to plant ecology, and a good number of plant ecologists are among the 50 botanists honored by BSA at its 1956 meeting. ESA was founded in 1915, and a centennial history appeared in time for its centennial meeting (Egerton 2015).

There is a vast literature on the history of natural history explorations in America, and previously I provided a guide to much of it (Egerton 2006, 2007a, 2009c, 2011a, b, 2012a, b, c). However, I covered neither post-Civil War western explorations, which Richard Bartlett does cover in *Great Surveys of the American West* (1962), nor Alaska, on which some assistance is provided by Douglas Brinkley’s *The

There are useful regional histories of natural history. California is larger than many nation-states, and there are three important surveys of its biological explorations. Botany professor Richard Beidleman drew upon a lifetime of historical research in writing *California’s Frontier Naturalists* (2006), which has the broadest chronological coverage and is the longest of the three works, extending from the French La Pérouse Expedition at Monterey in 1786 to the U.S. Death Valley expedition in 1891. In celebration of the centennial of the California Academy of Sciences in 1953, botany professor Joseph Ewan wrote a 63-page survey of “San Francisco as a Mecca for Nineteenth Century Naturalists” (1955). Ewan devoted much of his career to the history of natural history studies in America, and so he also wrote from a deep knowledge. Historian of science Michael Smith, writing after Ewan and before Beidleman, covered geology as well as natural history of plants and animals in *Pacific Visions: California Scientists and the Environment, 1851–1915* (1987). Barbara Stein wrote a biography of the founding patron of the Museum of Vertebrate Zoology, University of California, Berkeley: *Annie Montague Alexander and the Rise of Science in the American West* (2001). Joseph Grinnell (1877–1939) was director of that museum, and his career (he first used the term “niche”), along with Alexander’s assistance are discussed by Susan Star and James Grieserner (1989).


In the United States, paying jobs in ecology were more plentiful than in Britain, because American higher education and government were still growing, and new ecologists could find jobs both in academia and government. Occasionally, a “school” of ecologists emerged at a particular university. The University of Chicago developed such schools in botany and zoology departments, beginning around 1900. The origin of Chicago’s plant ecology school under Henry Cowles is described in Victor M. Cassidy, *Henry Chandler Cowles: Pioneer Ecologist* (2007) and more briefly in Ronald Tobey, *Saving the Prairies* (1981:106–109), though Tobey’s book emphasized a contemporary rival plant ecology school at the University of Nebraska that educated Frederic E. Clements. The Chicago animal ecology school’s history is discussed by Gregg Mitman (1992). Ronald Engel’s *Sacred Sands* (1983) provides
information on both of Chicago’s ecology schools.

Not all ecologists found specific ecological positions; some wore two hats. Some ecologists were also ornithologists. The Nuttall Ornithological Club was organized in Cambridge, Massachusetts in 1873, and a decade later some of its members decided to found the American Ornithologists’ Union (Palmer 1933:7), following the example of the British Ornithologists’ Union. A fifty-year celebration volume (Chapman and Palmer 1933) included 50-year reviews of progress in studies on migration, banding, territorialism, life histories, and more. Much later, two collections of studies on the history of ecology appeared as Memoirs 12 and 13 of the Nuttall Ornithological Club (Davis and Jackson 1995, 2000). In the same time period, Mark Barrow published a synthesis of American ornithological history (1998).

In 1879, a Young Naturalists’ Society arose in Seattle, Washington, and it had a museum by 1885 (Benson 1994:214). The University of Washington was also in Seattle, since 1861, though its first natural historian, Orson B. Johnson, only arrived in 1882 (Benson 1994:220). Johnson and the Young Naturalists were mutually supportive. P. Brooks Randolph (b. 1860) was one of the three founders of the Young Naturalists’ Society, and by the 1890s he was the Society’s conchologist (Benson 1994:221). Collecting shells was how conchologists got started, and Randolph traded shells with other naturalists in the Northwest and beyond. The *Nautilus* was the journal of American conchologists, which helped Randolph meet, via mail, other conchologists, whose leadership was located in eastern USA.

In 1899, the universities of New Mexico and Montana established land research stations. Frederic E. Clements began preparing to open a private station on the side of Pike’s Peak, Colorado, which lasted for years of fruitful research by him and others (Hagen 1992:31–46, Vetter 2010, 2012, Egerton 2013:360). The Carnegie Institution earlier supported two other ecological stations, on a tropical island, and in a desert. Alfred Mayer recommended the tropical station, on Loggerhead Key, Florida, and he became its head in 1904 (Stephens and Calder 2006:15–44, Egerton 2014c:365–367). That station continued until 1942. For the desert station, Carnegie accepted advice from Frederick Coville and Daniel MacDougal in 1903, who recommended opening one near Tucson, Arizona (Burgess 1996:31, 70, Egerton 2013:363–364). MacDougal became its first head (Kingsland 1991, 1993). In 1917 Carnegie began funding Clements’ Pike’s Peak station (Tobey 1981:79). In 1928, the Rocky Mountain Biological Laboratory (RMBL) was founded in the Elk Mountains, west-central Colorado (Billick 2010). After 75 years of research at RMBL, its administrators realized that its researchers had provided a rich heritage of ecological understanding, and that this was also true of other such institutions. Consequently, RMBL organized an international symposium of ecologists from comparable institutions, and edited their reports into *The Ecology of Place* (Billick and Price 2010). Some of these stations around the world were founded before 1946 and continue functioning at high levels.

On 27 March 1914, entomologist Robert Henry Wolcott (1868–1934), at the University of Nebraska (Burgess 1996:115), wrote to animal ecologist Victor Shelford (1877–1968), then at the University of Chicago, suggesting formation of a Midwestern society of plant and animal ecologists (Shelford 1938, Burgess 1977:2, Croker 1991:120–121, Egerton 2015). Shelford discussed it with the university plant ecologist Henry Cowles (1869–1939), who was enthusiastic, but suggested a national society, that could be organized at the next AAAS meeting (Cassidy 2007:77–80). Word was passed around, and a preliminary organizational meeting was held on 30 December 1914, with at least 23 potential members
Fig. 2. ESA membership to 1976. Burgess 1977:3.
present. They agreed to form an Ecological Society of America at the next AAAS meeting, with John Harshberger (1869–1929) being asked to form an organizing committee. All known American ecologists were notified about the formal organizational meeting, which occurred on 28 December 1915, with about 50 ecologists present and supported by another 50 letters from ecologists not present (McIntosh 1976:355–356, Burgess 1977:7, 1985:66–67, Croker 1991:64–66, 2001:125, 169–170). There were 286 charter members; however, ESA membership grew slowly until about 1950. Its first annual meeting was held in 1916, with the annual meeting of AAAS (along with 59 other organizations), with Shelford the first president, William Morton Wheeler, vice-president, and Forrest Shreve, secretary-treasurer, with 125 members attending. World War I, 1914–18, was very disruptive of ecological progress in Europe, but less so in the United States, which only joined the war in 1917, and fought none of it on American soil (but did experience naval conflict in the Atlantic). ESA began publishing its Bulletin in 1917 (Taylor 1938), and in 1918 Daniel MacDougall, at Carnegie Institute’s Desert Laboratory, offered to turn over Plant World to ESA (Moore 1938). ESA accepted the offer and renamed it Ecology; the first issue appeared in January 1920 (Burgess 1977:16–18). Ecological Monographs began in January 1931.

An interesting aside is the impact of World War I upon the orientation of the Scripps Institution, on the southern California coast (Walsh 2004:71):

_As a member of the NRC [National Research Council], [William] Ritter began to think the core program at the Scripps Institution needed to be reoriented. Like the Kiel school [Germany], the Port Erin station [England], and ICES, the research program integrated physical and chemical observations to provide a picture of an ecological whole. The primary focus was biological, and focus was on plankton, copepods, and other organisms. During and after the war, Ritter began to change his view of what the Scripps Institution should do._

In limnology, there was important activity at U.S. and Canadian universities before 1945. Two informal U.S. schools developed, at the University of Wisconsin (Frey 1963a, Hasler 1963) and at Yale University (Slack 2010:115–151) and two informal ones at the Canadian universities in Toronto and Saskatoon (discussed below). Edward Birge (1851–1950), who began teaching at the Wisconsin university in 1875, before he had completed his Ph.D. in 1878, initiated the Wisconsin school in 1878 (Frey 1963b:15–34, Egerton 1987:86–94, 1999a, 2014:138–140, Burgess 1996:16). In 1900, he hired Chancey Juday (1871–1944) as an assistant, and they were very productive researchers and authors (Juday and Hasler 1946, Burgess 1996:59–60, Egerton 1999b, 2014b:138–139). Birge became president of the university, which did not end his research, but training graduate students was left to Juday. One of Juday’s students was Arthur Hasler (1908–2001), who would succeed him (Egerton 2008a). Englishman Evelyn Hutchinson (1903–1991) initiated the Yale school, gradually, after he joined Yale’s faculty in 1928 (Burgess 1996:56–57, Slack 2010:89–99). He trained graduate students, who were attracted by his brilliant teaching and publications and by Yale’s reputation as one of U.S.’s leading universities.

The Limnological Society of American was organized in 1936, with Juday being one of the organizers (Lauff 1963:668–671). The source of this organization was a Committee on Aquaculture organized in 1925, meeting in Washington. At a AAAS meeting in 1926 in Philadelphia, the scope of the Committee was broadened to encompass hydrobiology, and the group continued meeting alongside AAAS. In January 1935, Professor Paul Welch (1882–1959), University of Michigan, distributed a circular
announcing the founding of the Limnological Society of American in January 1936, when there were 221 charter members. It still met with AAAS.

The title of a history of the Georgia Institute of Ecology (Barrett and Barrett 2001) indicates it was founded in 1940, but 1940 was only the year in which Eugene P. Odum (1913–2001) joined the University of Georgia faculty (Craige 2001:31). That institute developed with post-war funding from the Atomic Energy Commission. Gene Likens, Founding Director and Distinguished Senior Scientist Emeritus, is writing a history of the Cary Institute of Ecosystem Studies, which came into existence after 1946 (personal communication, 4 December 2014).

Part 51 (Egerton 2014c) did not mention the Woods Hole Oceanographic Institution (WHOI), because it was founded in 1930 and part 51 ended with the 1920s. It was founded at Woods Hole because the Federal Fisheries Laboratory and the Marine Biological Laboratory were there, and it was not primarily oriented toward marine biology. However, its first director, 1930–1940, was Harvard marine biologist Henry Bigelow (1879–1967), and oceanography does include marine biology (Bigelow 1964, Shor 1988, Lewandowski 1999). The Third International Congress on the History of Oceanography was held in 1980, which was also the 50th anniversary of the founding of the WHOI, and six participants in the International Congress took the occasion to write on WHOI history (Burstyn 1980, Deacon 1980, Fye 1980, Haedrich and Emery 1980, Revelle 1980). WHOI has since sponsored its own history (Cullen 2005).

Part 51 also omitted mention of the Hancock Institute for Marine Studies for the same reason: businessman–philanthropist G. Allan Hancock (1875–1965) founded it in the 1930s, and served as its director, 1938–1955 (Aleem 2002). Hancock had funded a scientific expedition to the Galapagos Islands in 1927 by the California Academy of Sciences, and he used his ship Velero III for 10 scientific expeditions, 1931–1941, each lasting two or three months. Hancock gave his Institute to the University of Southern California, Los Angeles, which still runs it.

Canada’s ecologists were ESA members from the start in 1915. Some Canadian contributions have been discussed in previous parts of this history (Egerton 2013d:362–363, 2014b, 2014c:371–374). In Canada, limnology developed more slowly than in USA. In the 1890s, commercial fisheries were declining in the Great Lakes, and the University of Toronto, assisted by Ontario provincial government funds, opened a Georgian Bay Biological Station at Go Home Bay, where research was conducted until it closed in 1911 (Fry and Legendre 1963:488–489). Why did it close? The site seemed inconvenient, but no one chose an alternative site. Since the Ontario government maintained a few research stations, the university perhaps felt no immediate pressure to continue. It awaited a faculty member who would push for another. There are two histories of government fisheries research (Johnstone 1977, Hubbard 2006). As part of the British Empire, Canada went to war against Germany in 1914, when Britain declared war, disrupting ecology studies and activities until 1918. Donald Rawson (1905–1961), from Ontario, earned three degrees from the University of Toronto (1926–1929). In 1929, he joined the faculty of the University of Saskatchewan, in Saskatoon, where he remained (Hammer 2005). “Rawson was not only a productive scientist; he was the central figure in a changing group of graduate students and co-workers whose many contributions mirror his enthusiasm and sustaining interest in freshwater biology” (Northcote and Larkin 1963:460). He served as president of the Limnological Society of America, 1946–
1947. Danish botanist Alf Porsild (1901–1977) followed in his father’s footsteps by studying the boreal flora of Greenland (Dathan 2012). The chief botanist at the National Herbarium of Canada, Oscar Malte, recruited him and his brother, Robert, to come to Canada to manage introduction of reindeer herds into Canada’s tundra to boost tundra economy. Although Porsild had the requisite botanical knowledge, the project failed for other reasons, but the Porsild brothers remained in Canada, and Alf Porsild eventually replaced Malte as chief botanist at the National Herbarium.

Latin America

There are a number of rather broad works on the history of Latin American science; Juan Pimentel wrote a useful critical bibliography, “Latin America” (2000) in less than two encyclopedia pages. His sources go back to 1954, but not to earlier works by Verdoorn, von Hagen, and Chardon. Frans Verdoorn edited (and compiled) *Plants and Plant Science in Latin America* (1945), which is an extensive compendium of whatever historical material he could find on the subject. It included illustrations, maps, “Special Supplement (Plant Science Institutions and Societies)” arranged according to nations (Verdoorn 1945:337–349), with addresses for some organizations, and a bibliography on general natural history (Verdoorn 1945:xxiii–xxxv). Also in 1945, Victor von Hagen published *South America Called Them: Explorations of the Great Naturalists, La Condamine, Humboldt, Darwin, Spruce*, followed by his anthology, *The Green World of the Naturalists: A Treasury of Five Centuries of Natural History in South America* (1948). Carlos Chardon, of the Dominican Republic, published *Los Naturalistas en la America Latina* (1949), extending from 1500s to 1900s, emphasizing Caribbean islands. Edward Goodman wrote a survey limited geographically to *The Explorers of South America* (1972). Robert Miller’s introductory chapter to his history of the Spanish expedition to America, 1862–1866 (1968:3–11), covers from 1500s to mid-1800s and includes a helpful bibliography.

Two English naturalists affiliated with the British Museum (Natural History), Frederick Ducane Godman (1834–1919) and Osbert Salvin (1835–1898), became friends while attending Cambridge University, took several trips together to Central America to study nature, and finally agreed to edit *Biologia Centrali-Americana: Zoology, Botany, and Archaeology* (63 volumes, 1879–1915), which described 50,263 species, of which 19,263 were new to science (Bircham 2006:192–193). It was a very expensive set, and consequently rare, and printed on now brittle acid paper. Fortunately, the Smithsonian Institution is putting the 57 biological volumes on the Internet. One can supplement this online resource with the online Biodiversity Heritage Library, also hosted by the Smithsonian.

studies, see Maguire (1958:222–223). Sarukhán cited (1981:43) three institutions founded before 1945 as ecologically significant: Sociedad Mexicana de Historie Natural, founded in 1868 and revived in 1936 by Enrique Beltrán (1903–1994), who had studied under Herrera, and who was a long-time director of Instituto Mexicano de Recursos Naturales Renovables, and thirdly, Sociedad Botanica de Mexico, which Maximino Martinez and colleagues founded in 1941. Richard Schwartzlose and Saúl Alvarez-Borrego have discussed “The History of Oceanography along the Mexican Pacific Coast” (2002).

PUERTO RICO is a Caribbean island of 3435 square miles, which Ponce de León conquered during 1508–1511 and founded San Juan. Chardon (1949:309–371) surveyed natural history studies conducted there from 1700 into 1800s. Puerto Rico became a possession of the United States after the Spanish-American War of 1898. The New York Botanical Garden sent a collector there in 1899, who was assisted by U.S. armed forces (Kingsland 2005:79–80). In 1914 the New York Garden’s Director, Nathaniel Britton, helped organize a scientific directed by the New York Academy of Sciences, which lasted until the mid-1940s. Floras and plant ecology studies published between 1911 and 1943 are listed by Herminio Lugo (1981:54), as well as a study on its economic entomology (1924). The University of Puerto Rico’s Mayaguez campus has maintained an agricultural research station at Rio Piedras since 1916, and the U.S. Forest Service maintains an Institute of Tropical Forestry also at Rio Piedras. Puerto Ricans eventually gained access to education in the United States, if desired, and also had contact with Americans who taught and researched in Puerto Rico. Ismael Vélez taught the first course in ecology in 1935, at the Polytechnic Institute (now Inter-American University). Professor Hermino Lugo, who wrote the Handbook’s chapter on Puerto Rico (1981), received his B.A. degree at the Institute (1939), but earned his M.S. and Ph.D. degrees from Cornell University (1948, 1954).

Columbus discovered JAMAICA in 1494 and Spanish settlers arrived in 1509, but not finding gold, few colonized it. Jamaica is 90 miles (145 km) south of Cuba and has 4244 square miles (10,991 km²). An English expedition seized and settled Jamaica in 1655. In 1687, Hans Sloane (1660–1773) became physician to its governor and remained there until 1688, when that governor died (Chardon 1949:55–56, Allen 1951:passim, de Beer 1975, Desmond 1977:563–564, MacGregor 2004). Sloane eventually published his valuable discoveries: Catalogus plantarum quae in Jamaica sponte proveniunt (1696) and Voyage to Madeira, Barbadoes, and Jamaica, with the Natural History of Jamaica (two volumes 1707–1725). Later, Patrick Browne (1720?–1790), another English physician–botanist, explored Jamaica (Chardon 1949:56–58, Desmond 1977:98, Nelson 2004). He published a new map of Jamaica (1755), and in 1756 his Civil and Natural History of Jamaica, which contained the map and 49 engravings.

The earliest Spanish settlement was on the island of Hispaniola, and the earliest report on its natural history was by Gonzalo de Oviedo (1478–1557), a summary version of which appeared in Toledo (1526), with part of a longer version published in Seville (1535), and a complete edition appeared in 1851–1855 (von Hagen 1948a:16–30, Chardon 1949:169–170, Allen 1951:427, Cook 1996). After a French invasion (1665), Spain’s colony lost a third of the island, and the remaining Spanish possession is now known as SANTO DOMINGO, and is the subject of a 62-page chapter in Chardon, Los Naturalistas en la America Latina (1949:169–231).

France, in 1665, established a slave colony on its western third of Hispaniola, named Saint Domingue. By the 1780s, it “had become the single richest and most productive colony in the world” (McClellan
Fig. 3. (a) Charles Plumier. Virville 1954:45. (b) *Clematis indica latifolia.* Plumier 1693:plate 82. From Virville 1954:59.

The Netherlands has a colony on the Caribbean island, CURAÇAO, where The Netherlands would establish a marine laboratory in 1955, but before that, P. Wagenaar Hummelinck edited a collective volume, Studies on the Fauna of Curaçao and Other Caribbean Islands (1940), which was ecologically significant, concerning marine animals in shallow water (Vass 1981:234).

COSTA RICA’s ecology began with the Swiss immigrant Henri François Pittier (1857–1950), son of a carpenter and forest inspector (Yacher 2004:1–7.) His family’s landlord was interested in botany, and since young Henri became friends with his landlord’s son, Henri also acquired that interest and gained access to the landlord’s library. He graduated from the Académie de Lausanne in 1877, where he had studied science and physical geography. Pittier was much influenced by the writings of geographers Alexander von Humboldt (1769–1859) and Carl Ritter (1779–1859), and biologists Darwin, Wallace, and Haeckel (Yacher 2004:10–23). In 1877, he obtained a position teaching science at a school for women in Switzerland, where he remained until 1887. However, in 1880, he traveled to America and attended classes at Stevens Institute of Technology, in New Jersey. In 1887, the Swiss economy was in crisis and Pittier’s colleagues at the women’s school disapproved of his radical science (evolution), and the Americas seemed to hold more promise. He accepted an invitation to go teach in Costa Rica. By then he had published 24 articles and monographs, he belonged to several scientific organizations, and he spoke French, German, English, Italian, and Greek. While in Costa Rica, he founded a National Meteorological Observatory, a Physical Geography Institute, and a herbarium, before permanently moving to Venezuela in 1917 (Fournier-Origgi 1981:29, Yacher 2004:27–133). American botanist Paul C. Standley (1884–1963) published Flora of Costa Rica (Field Museum of Natural History, 4 parts, 1937–1938). In 1927, the government established its School of Agriculture, and in 1940 its University
Fig. 4. Map of Panama Canal Zone, Gatun Lake, and Barro Colorado Island. Chapman 1929:3.
of Costa Rica. In 1943, the Organization of American States founded at Turrialba the Institute of Agricultural Sciences for teaching and research in tropical agriculture and forestry. It offered a graduate program leading to a master’s degree. It emphasized ecology for solving agricultural problems.

PANAMA broke free from Colombia in 1903, and the United States acquired the right to build the Panama Canal, beginning in 1907 (McCullough 1977). A land of 28,575 square miles, its canal was completed in 1914, a year before founding of ESA (Egerton 2015). Creation of the canal required damming the Chagras River, creating the Gatun Lake (1910). The lake made islands out of former hilltops; a large example is Barro Colorado Island (15.6 km², 6 square miles), which has 300 species of trees. In 1923, American entomologist Dr. James Zetek (1886–1959), who had been fighting mosquitoes in Panama since 1911 (but not discussed by Sutter 2007), and Harvard zoologists William Morton Wheeler (1865–1937) and Thomas Barbour (1884–1946) urged Panama Canal Zone Governor Jay Morrow to declare the island a nature reserve, which he did on 17 April, but with no funds to maintain it (Barbour 1943:193–196, Evans and Evans 1970:277–281, Angehr 1989, Royte 2001:8–9). Barbour and others provided enough funds to establish a biological station, with Zetek’s director. He laid out 25 miles of trails and hired natives to cut vegetation for them. Zetek’s own research was on termites, and with 30 species at Barro Colorado Island (BCI), he obtained research funds from both the American Wood-Preservers Association and the USDA’s Bureau of Entomology (Royte 2001:32). An ecologist who conducted research at this station was University of Chicago professor Warder Clyde Allee (1885–1955), who traveled there with his wife, Marjorie, who wrote children’s books (Dugatkin 2006:40). They co–authored a children’s book, Jungle Island (1925), based upon their experiences there (Dugatkin 2006:40). American botanist Standley published Flora of the Panama Canal Zone (1928). American Museum of Natural History ornithologist Frank Chapman (1864–1929) spent 12 dry seasons at BCI, and two of his 22 books discussed his researches there: My Tropical Air Castle (1929) and Life in an Air Castle: Nature Studies in the Tropics (1938). Chapman was a popular author and an outstanding museum leader (von Hagen1948:345–355, Vuilleumier 2005). By 1940, over 400 scientific publications had been published on studies at BCI, and Barbour asked Congress for $10,000 to improve facilities, hire a permanent director, and buy equipment (Royte 2001:36). Funding was postponed because of war. Strandley (1958:223–224) summarized history of Panama floral studies.

Two very young Spanish naval engineers, Jorge Juan (1713–1773) and Antonio de Ulloa (1716–1795), accompanied a French scientific expedition to the equator in Peru (now in Ecuador) in 1735 (Chardon 1949:61–63, Leonard 1964, Goodman 1972:184–194, López de Azcona 1973, Vernet 1976, Tepaske 1996a, b). The goal of the expedition was to measure the arc of a meridian; it was headed by three scientists, and the account later published was by Charles-Marie de La Condamine (1701–1774), mathematician and naturalist, who canoed down the Amazon River in 1743, taking over three months (La Condamine 1745 (English 1745, 1751), von Hagen 1945:3–85, 299–301, 1948:124–130, Goodman 1972:183–200, Laissus 1978). Juan and Ulloa returned to Spain in 1744 on separate ships. Ulloa’s ship was captured by the British, and he was taken to London, where the Royal Society of London made him a member and returned him to Spain. On authorship of Ulloa and Juan’s Relación histórica del Viaje a la América Meridional (Madrid, 1748, English, 1758), Irving Leonard wrote (1967:4): “Of the five volumes of the original edition…four came from the hand of Antonio de Ulloa, the fifth being a kind of technical appendix prepared by Jorge Juan.” Ulloa remained in Spain’s government service and made additional trips to America, followed by books of his observations.
Fig. 5. Spanish Scientific Expedition to America, 1862–1866, itinerary. Miller 1968:5.
In 1862–1866, Spain sponsored its own scientific expedition to South America (Miller 1968:12–21, Goodman 1972:321–324). It occurred because Spanish naturalists and government independently wanted in 1860 to undertake such an expedition, and by joining forces, they were able to plan and fund it. The scientific members of the expedition included five biologists: Patricio María Paz y Membaliela (1808–1874), who was a retired naval captain who studied mollusks and had a collection of 40,000 shells of 12,000 species; Fernando Amor y Mayor (1820–1863), who taught physics, chemistry, and natural history, and had collections of minerals, beetles, and flowers; Francisco de Paula Martínez y Sáez (1835–1908), professor at the University of Madrid, who collected 30,000 fish, aquatic mammals, and reptiles and kept a diary; Marcos Jiménez de la Espanda (1831–1898), professor at the University of Madrid, who supervised collection of land mammals, birds, and reptiles and who later founded natural history and geographical societies; and botanist Juan Isern y Batlló (1821–1866), whose herbarium of 8000 specimens and descriptions and letters home are at the Botanical Garden in Madrid. The scientists also included an anthropologist, a taxidermist, and an artist–photographer. The expedition left Cadiz in August 1862 and returned to Spain in January 1866.

Paz complained continually, and so alienated the officers that the Triunfo’s captain confined the scientists below deck. On 24 July 1863 Paz resigned and returned to Spain. Amor did brilliant work, but died after a year. Martínez did good work, but back in Spain he focused upon pre-Columbian Peruvian civilizations. Isern was a diligent worker, who died from a tropical liver infection shortly after returning to Spain. The expedition’s return coincided with a financial crisis in Spain, which dampened its homecoming (Miller 1968:167–175). Robert Miller concluded that this rather successful expedition was forgotten because of the crisis and the deaths of two important naturalists and the resignation of its leader. Eventually, this mostly land expedition would be overshadowed by the spectacular Challenger ocean expedition, 1872–1876 (Egerton 2014c).

Alexander von Humboldt and Aimé Bonpland began their Spanish American explorations in VENEZUELA in July 1799 (von Hagen 1945:86–168, 1948:145–166, Chardon 1949:117–140, Egerton 2009a:258–263), yet his presence and subsequent publications were too early to spark a Venezuelan scientific tradition. Venezuela was slow to develop its science (Arnal 2002:603).

...from 1908 to 1935, when Venezuela was under the repressive rule of General Juan Vicente Gómez, organized scientific activities were non-existent. The few who made scientific contributions worked in isolation and their resources were scarce; the impact of their work was at best marginal. The backward state of academic institutions, the lack of scientific organizations and of a favorable cultural framework contributed to the society’s inability to take advantage of the scientific knowledge that foreign specialists had gathered from the country’s flora and fauna.

One of those isolated scientists was Henri Pittier, who arrived from Costa Rica in 1917 (Jahn 1950, Arnal 1991:91–115, Yacher 2004:145–170); in 1929 he published his Manual de las Plantas de Venezuela. Arnal admitted that a few years before 1935, “the Venezuelan Society of Natural Sciences had begun to hold sessions and to publish articles and the minutes of its meetings in its official journal.” Its members “stressed the need for the Society to contribute to the protection of the flora and fauna and the importance of starting scientific collections.” In 1936, with a new government under Eleazar López Contreras, Pittier was appointed head of the Botany Department in the Ministry of Agriculture and

Arnal’s “The Beginnings of Modern Ornithology in Venezuela” (2002) credited two Americans, Chapman (discussed above under Panama) and William H. Phelps (1875–1965) with having provided early momentum for Venezuelian ornithology. Chapman’s role was indirect, as head of ornithology at the American Museum of Natural History; he sponsored explorers. Phelps was a son of a prosperous New York lawyer; he studied zoology at Harvard, and after his junior year, 1896, he traveled to Venezuela to study its birds for his senior thesis. There he met his future wife, Alicia Elvira Tucker (Murphy 1970). After graduating from Harvard in 1897 and publishing his thesis (Phelps 1897), he returned, married her, and they settled in San Antonio de Maturin, where he became a prosperous businessman and funded an ornithological expedition to Venezuela by the American Museum of Natural History.

Immigrant physician–botanist José Celestino Mutis (1732–1808) in Bogotá, COLOMBIA, led a

New Yorker William Beebe (1877–1962), at the New York Zoological Society (Bronx Zoo), wanted a research facility in the American tropics to study jungle life. Beebe aspired to establish one during a trip to South America in 1908, and by 1916 he arranged for his research team to use Kalacoon House, a “fine large house overlooking the confluence of the Mazaruni, Essequibo, and Cuyuni rivers, which [George] Withers had offered rent free,” near Georgetown, British Guiana (now GUYANA; von Hagen 1948a:300–311, Welker 1975:67–69, Gould 2004:190). He studied the fauna on a small plot and produced three articles on his findings (Beebe 1916a, b, c). Beebe’s station, which was not permanent, will be discussed further in part 58A (F. N. Egerton, unpublished manuscript).

In 1532, Francisco Pizzaro conquered PERU, which the Spanish highly valued for its silver and gold. Garcilaso de la Vega (1537?–1616?) was the son of a Spanish official and an Inca princess (Chardon 1949:29–30, Allen 1951:428–429). His father died in 1560, and he sailed to Spain in 1561, where he remained. He wrote his Commentarios Reales de los Incas (Lisbon, 1609, English 1869–1871) largely from memory. It includes discussions of domesticated plants, birds, mammals, reptiles, and fish. José de Acosta (1540–1600) was a Spanish Jesuit scholar who spent the years 1571–1583 in Peru, then left for Mexico (von Hagen 1948:56–75, Chardon 1949:10–14, Allen 1951:427–428, Kish 1970, Ross 1996). He spent 1586 in Mexico City and returned to Spain in 1587. He published his very detailed Historia Natural y Moral de las Indias (Seville, 1590, English 1604), which was an important source of information on the plants and animals that he observed. In autumn 1802, Alexander von Humboldt reached Lima, where he learned that Andean farmers used guano as a fertilizer (Botting 1973:161, Egerton 2009a:265). He sent a sample of it to Paris for chemical analysis, which led to establishment of guano fertilizer commerce from Peru (Zuta and Flores 1980:643–646). The Guano Company sponsored early 1900s studies on the Peruvian anchovy, and such studies led to the development by the 1950s of oceanography.

BRAZIL is about the size of the 48 contiguous US states. Silvia Figueirôa (2000) provided a critical bibliography of general studies on the history of science in Brazil. Two German naturalists were early explorers there: zoologist Johann Spix (1781–1826) and botanist Karl von Martius (1794–1868); they were members of a German expedition, 1817–1820 (Goodman 1972:296–299, Sanders 1974, 1975b). Spix and his assistants collected 85 mammal species, 350 bird species, and nearly 2700 insect species. He wrote volume 1 of their coauthored Reise in Brazil (three volumes, 1823–1831). Martius collected specimens of 6,500 plant species; they became part of the Munich herbarium, which also acquired living plants and seeds for its botanic garden. Martius became professor of botany in Munich’s Landshut University. He also began compiling a Flora Brasiliensis (15 volumes, Munich, 1840–1906), which others completed.
Fig. 7 (a) Karl F. P. von Martius. Verdoorn 1945:xi. (b) Map of Spix and von Martius’ travels in Brazil, 1817–1820. Wikipedia.

Fig. 8. The German colony, Blumenau, southern Brazil, on the Itají River near the coast, where Fritz Müller lived. From J. Tschudi, Reisen durch Südamerika (five volumes, 1868–1869). Copied from Verdoorn 1945:xxxvi.
By early 1900s, Brazil had capable native naturalists, especially at the Museu Nacional do Rio de Janeiro (MNRJ). Alberto José Sampaio (1881–1946) was a native of Rio de Janeiro who joined MNRJ’s Botany Section in 1905 (Franco and Drummond 2008:727–731). He became the leading Brazilian botanist of his time until he retired in 1941. In 1916 he published a flora of the sizeable and remote state, Mato Grosso; it initiated a phytogeographical survey of Brazil, and he published *Phytogeographica do Brasil* in 1934, with a phytogeographical map (reproduced in Franco and Drummond 2008:730). He also linked nature protection and nationalism, and he championed reforestation of logged areas and creation of nature reserves. Armando Magalhães Corrêa (1889–1944) was also a Rio de Janeiro native who became a sculptor and artist and amateur naturalist, which led to his becoming a curator in the Natural History Section of MNRJ (Franco and Drummond 2008:731–735). His *O Sertão Carioca* (1936) cautioned that poor rural people were degrading the environment on which they depended by wasteful extraction of resources, and that government needed to provide them with assistance and adequate laws to ensure resources for future inhabitants. He seconded Sampaio’s call for nature reserves where scientists could study and the people could learn nature appreciation.

Cândido de Mello Leitão (1886–1948) was from the state of Paraíba, but graduated from the Medical School of Rio de Janeiro (1909) and taught medicine until 1913, when he began teaching zoology, and later became professor and researcher at MNRJ (Franco and Drummond 2008:735–738). His research was on spiders and on ecology, especially cooperation among animals and the balance of nature. In the 1930s and 1940s, he presided over the National Hunting and Fishing Council. He also stated that the first three national parks, created in 1937–1939, were not receiving adequate support for management, infrastructure, and research. His *Zoogeografia do Brasil* (1937) complemented Sampaio’s work in phytogeography. He defined zoogeography very broadly: “study of animal life, concerning environmental influences, mutual relations between animal species and their distribution throughout the land, not only in the present time but also during the geological eras” (1937:7, translated by Franco and Drummond 2008:737).

Frederico Caarlos Hoehne (1882–1959) was from a small town near Juiz de Fora, in the Atlantic Forest biome (Franco and Drummond 2008:738–745). He was largely self-taught in botany, and at age 17 was supporting himself with orchid sales, and augmented his herbarium by exchanging specimens with other collectors. In 1907, at age 25, he became chief gardener at MNRJ and came under guidance from Sampaio. In 1908 he participated in a MNRJ expedition to Mato Grosso, the first of many which he undertook to expand MNRJ’s herbarium and botanic garden and knowledge of Brazil’s plants. In 1917, at the invitation of São Paulo state, he moved to the city São Paulo and helped run the Instituto de Botânica do Estado de São Paulo. In his extensive expeditions he and his associates collected over 10,000 specimens of over 4,000 different species, about 200 of which were new to science. Hoehne was also a very productive author, publishing over 600 scientific and popular articles. Protecting nature was a common theme in his writings. His influence was important for creation of Brazil’s first national parks, and he also advocated sustainable use of Brazil’s natural resources.

Sampaio was in charge of Brazil’s First Conference on Nature Protection (1934), and he had it meet at MNRJ (Franco and Drummond 2009:83–89). Other biologists also played prominent roles in the conference. It is especially interesting here because it brought together members of different scientific organizations for a common purpose. However, it did not arrange for an ongoing umbrella organization to
Fig. 9 (a) Alberto José Sampaio. web. (b) Cândido de Mello Leitão. web.
insure that plans for the future, which were discussed, would be implemented. The next such conference was not held until 1964.

In the mid-1920s German naturalist Konrad Guenther (1874–1955), whose specialty was ornithology, spent a year in Brazil studying plants and animals and wrote a natural history travel book in the tradition of Wallace and Bates, *Das Antlitz Brasiliens* (1927; English, 1931, 400 pages, 32 photo plates, 40 drawings); unlike those English naturalists, as an associate professor at the Albert-Ludwigs University in Friburg, he did not have to support himself by collecting specimens for European museums (von Hagen 1948:326–344, Gebhardt 1966). It seems odd that he apparently never contacted Brazilian naturalists who shared his interests. He did mention Hoehne’s *Flora of Brazil* as an authority (Guenther 1931:77), but gave no indication of having met him.

Southernmost South America is divided, north-to-south, into Argentina and Chile. Dutch zoologist Hendrik Weyenbergh (1842–1885) in 1872 went to teach at Universidad Nacional de Córdoba, ARGENTINA. He was a founding member of Sociedad Entomologica Argentina and served as president of the Academia Nacional de Ciencias, before returning to The Netherlands in 1881. Despite my brief account in part 51 (Egerton 2015a:374), it is helpful to mention here that oceanography in Argentina has been discussed in some detail (Ehrlich and Sánchez 1990, Sánchez 2002). In CHILE, zoologist Carlos E. Porter, Museo de Santiago, edited *Revista Chilena de Historia Natural* from its founding in 1897 until 1942 (Duarte 2013:84–85). Not mentioned in part 51 is “History of Marine Science in Chile,” which Tarsicio Antezana and Nibaldo Bahamonde discussed (2002).

**EUROPE**

In AUSTRIA, early studies in what is now ecology usually came from university faculty. For example, Franz Unger (1800–1870) studied medicine at the Graz, Vienna, and Prague universities, then taught botany at Graz and Vienna (Olby 1976). One of his students in Vienna was Gregor Mendel. In 1836 Unger correlated differences in alpine vegetation with whether it grew on limestone or siliceous soils (Kühnelt 1981:106). Ludwig K. Schmarda was the first professor of zoology in Austria, at Graz. His textbook, *Die geographische Verbeitung der Tiere* (1853) discussed the influence on animals of temperature, light, air, electricity, climate, seasons, food, seawater, fresh water, and dry land (Kühnelt 1981:105). Joseph R. Lorenz synthesized his marine ecology studies in *Physicalische Verhältnissse und Verteilung der Organismen im quamerischen Golf* (1863). Anton Kerner (1831–1898), like Unger, studied medicine at Vienna, then switched to botany. He also, like Unger, taught at two other universities—Budapest and Innsbruck—before returning to teach at Universität Wien (Vienna). While at Budapest he conducted studies on the Danube Basin, published in his *Pflanzenleben der Danaulaender* (1863, English 1951; Egerton 2013d:342–343).

HUNGARY was part of the Austrian Empire from the 1700s to 1918, when it became independent. Gábor Palló has written a critical bibliography (2000) on the general history of Hungary’s science. Its earliest ecological study was Kerner’s monograph, which initiated plant ecology in Hungary. Botanist R. Soó compiled a *Bibliographia Synoecologica Scientifica Hungarica, 1900–1972* (1978). Zoologist Ottó Herman (1835–1914) wrote a *Magyarország. Pokfaunája* (three volumes, 1876–1879), and he “was probably the first in the world to develop a system of animal life forms in his study on the spider fauna of Hungary. He was also a pioneer of bromatological investigations in ornithology and the first in
Europe to organize an observatory system for bird migration” (Balogh and Jermy 1981:185–186). Since 1880, The Research Institute of Plant Protection in Budapest has investigated the ecology of insect pests and insect–plant relationships (Balogh and Jermy 1981:187). In 1906, an Experimental Station for Fish Physiology and Sewage-water Analysis (later, Research Institute for Fish Production) was founded, which R. Maucha headed, 1933–1952, and where he conducted production biology research. In 1946, he “summarized the results of the fundamental and experimental work carried out during a quarter of a century in limnology” (Balogh and Jermy 1981:188). In 1927, a Biological Research Institute was established in Tihany, focused on hydrobiological studies of Lake Balaton. G. Enta and O. Sebestyén (1946) “summarized the results of two decades’ investigation. Their work is regarded as a fundamental study in limnology of great shallow lakes.” In 1932 E. Dudich, University of Budapest, published on “the energy budget of cave communities, the first to emphasize the autarky or self-supporting nature of them” (Balogh and Jermy 1981:188). He founded an animal ecology center that “concentrated on food chains and energy turnover of terrestrial communities.” János Balogh was one of Dudich’s students, who in 1935 “published one of the first ecological monographs dealing with the quantitative analysis of a life form (the spiders) within a terrestrial community.” Hungarians also studied aquatic life in the Adriatic Sea (Stiller-Rüdiger and Zavodnik 1990).

The British are known for their numerous scientific organizations, and some of their histories are mentioned here. GREAT BRITAIN (now UK) has the oldest still-active scientific organization in the world, the Royal Society of London for the Improving of Natural Knowledge, begun in 1660 and received a Royal Charter in 1662 (Sorrenson 2000), which has been important for the history of ecology. Even more important for ecology is the Linnean Society of London, founded 1788 (Gage 1938, Gage and Stearn 1988). Much younger, but also important for ecology is the British Association for the Advancement of Science, founded in 1831 (James 2000). More specialized than these three societies was the Zoological Society that began having regular meetings and publishing its proceedings in 1830 (Bircham 2007:189). Other prominent biological examples are the Entomological Society of London, founded in 1833 (Neave and Griffin 1933), and the Botanical Society of the British Isles, founded in 1836 (Allen 1986). By 1858, ornithologists wanted an even more specialized organization, and they organized the British Ornithologists’ Union. Its first act was to establish its periodical, The Ibis, which still flourishes (Bircham 2007:188–197). A tendency to form natural history clubs or societies is illustrated in David Allen, The Naturalist in Britain: a Social History (1976), and specialized examples are illustrated in Michael Salmon’s “Appendix II: Entomological Societies, Publications and Significant Events” and in his “Journal Titles and Their Abbreviations” (Salmon 2000:397–408, 421–424).

Universities have also played an important role in nurturing ecologists both as students and as faculty, which can be seen in S. M. Walters’ The Shaping of Cambridge Botany (1981), which is where Professor of Botany John Stevens Henslow helped an unfocused undergraduate, Charles Darwin, find his way in science.

Fig. 10. London entomologists (a) John Obadiah Westwood. (b) Edward Bagnall Poulton. Neave and Griffin 1933: facing 131, frontispiece.
Galton (1908), with contemporary illustrations. Not surprisingly, Great Britain was the first country to organize its ecologists, in 1913, into the British Ecological Society (BES) (Tansley 1947, Pearsall 1964, Duff and Lowe 1981, Sheail 1987). Arthur Tansley (1871–1955) was the first leader in British plant ecology (Ayres 2012, Egerton 2013:355–358), and he established a journal, The New Phytologist (1902), which published ecological papers, among others. He also led in the formation of BES and its Journal of Ecology (1916), which became a de facto plant ecology journal. The questions ecologists asked and the methods they used tended to discourage amateurs, who founded natural history societies (Lowe 1976). Between the world wars, “plant ecologists were largely occupied with studies of the dynamics of vegetation, attempting to elucidate the causal relations between the plant community and its habitat” (Duff and Lowe 1981:143). Common interest, however, was insufficient for plant ecology to flourish; new plant ecologists could not find work in either universities or government, and so Tansley discouraged his botany students from specializing in plant ecology. This does not mean, however, that there was no progress between the wars. Tansley’s paper, “The use and abuse of vegetational concepts and terms” (1935) was one of the most important ecological publications between the wars. Surprisingly, although British animal ecology only arose after World War I, it fared better between the wars than did plant ecology. Two zoologists and an algologist organized the Fresh-water Biology Association which established the Lake Windermere Station in 1926 (Egerton 2014b:135).


FRANCE played a leading role in the history of early modern and of modern science. Davy de Virville edited and wrote the first half of Histoire de la Botanique en France (1954), which is illustrated with numerous portraits and plant illustrations, but has little documentation. King Louis XIV and his prime minister, Jean-Baptiste Colbert, responded to the establishment of the Royal Society of London in 1660 by establishing the Académie Royale des Sciences in 1666, which still flourishes, though “Royale” was dropped from its name during the French Revolution. James McClellan (2000) provided a critical bibliography on its history. The history of the Muséum National d’Histoire Naturelle was different: during the Revolution, in 1793, the Jardin du Roi was transformed into the Muséum. Claude Schnitter, Ann Masseran, and Philippe Chavot (2000) compiled a critical bibliography that offers guidance to that history. More narrowly focused on present concerns is Patrick Matagne’s Aux Origines de l’Écologie: les Naturalistes en France de 1800 à 1914 (Matagne 1999), which is a rich resource for understanding how French naturalists, botanists, and zoologists organized themselves during that period. Additional information for that period comes from collected articles on The Organization of Science and Technology in France, 1808–1914 (1980), edited by Robert Fox and George Weisz. Unlike in Great Britain and North America, all the numerous relevant French organizations did not lead to an ecological society before
World War I. Perhaps the reason is that there were numerous societies that already satisfied the needs of France’s ecologically oriented scientists, and then, of course, World War I intervened before any of the French entertained the idea of attempting to emulate British and North American ecological societies. The Zurich-Montpellier school of “phytosociologie,” under leadership of Swiss botanist Josias Braun-Blanquet (1884–1980), at the University of Montpellier, arose in 1912 and swept through France, yet between World Wats I and II, American pre-war plant ecology also exerted an influence in France (Acot and Drouin 1997). Braun-Blanquet did not publish his paradigm, *Pflanzensociologie*, until 1928 (English, 1932). Testimony to the persisting influence of at least some aspects of early American ecology was publication by Yves Grafmeyer and Isaac Joseph, editors, *L’Ecole de Chicago: Naissance de l’écologie urbaine* (1979), which included a 40-page introduction, three articles of commentary, and some American ecological articles translated into French. Paul Jovet (1896–1991), a charismatic ecologist, focused upon urban ecology and had a broad public influence (Drouin 1997). Jovet’s publications included a history of botany essay, “Flore et Phytogéographie de la France” (1954), beginning with Lamarck.

The NETHERLANDS, so close to Britain, often developed scientifically at about the same pace. F. Holkerna published a study on dunes and salt marshes in 1870 (Segal 1981:245), before Eugenius Warming published his famous study on the dunes and salt marshes of Denmark (1895). Botanist Melchior Treub (1851–1910) studied at Leiden University (doctorate 1873) and remained there for seven years at the botanical institute (Zeilstra 1959, Van Steenis 1976). In 1880 he became director of the botanical garden at Buitenzorg, Java (on which, see below, Indonesia). Hydrobiologist Karel Vass (d. 1980) thought that “The first investigations of ecological significance concerned fishery problems” (Vass 1981:229), in 1884. He praised a committee report from the Netherlands Zoological Society (NDV) on oysters and oyster culture as having ecological significance, but Vass failed to compare that report with Karl Möbius’ famous German report (1877) on the same subject (Egerton 2014a:61–62). NVD established a marine station near den Helder in 1890 that at first produced faunistic studies, but during the 1900s there was a gradual shift to ecological studies. The prominent microbiologist Martinus Beijerinck (1851–1931) in Delft in 1888 discovered the mutualistic relationship between nodule-forming bacteria and legumes (Woldendorp 1981:255), though this followed German mycologist Albert Frank’s discovery in 1885 of the symbiotic relationship between fungi and tree roots (Egerton 2012a:178).

In 1918, the Netherlands parliament decided to drain the Zuider Sea, a large brackish bay (3450 km²) in the center of the country. Before drainage, the NDV described the region’s biota, grouped according to degree of salinity in different parts of the bay (published 1922). In 1912, Gerrit Wolda (1869–1949) began a long-term monitoring of nesting success of tits in birdhouses he placed in woods near the Agricultural University at Wageningen (Bakker 1981:235, Birkhead et al. 2014:367). In 1924 a student, Huijbert N. Kluijver (Kluyver, 1902/3–77) became Wolda’s part-time assistant, and in 1934 he took over Wolda’s nesting study. In 1945, David Lack visited Kluijver and subsequently established a similar long-term study at Wytham Woods, near Oxford University. Explicit Dutch studies on plant ecology only began with J. Bijhouwer’s study on dune vegetation, with vegetation map, in 1926.

Plant ecology research began in BELGIUM and in Belgian Congo (Zaire) in the late 1930s, by adopting the Zurich–Montpellier focus on phytosociology. J. Louis and J. Lebrun published a “basic paper on the plant communities of Belgium (1942),” and soon afterwards established a Center for Ecological and Phytosociological Research (Bourdeau 1981:119). Belgium is adjacent to The Netherlands and about the same distance from Britain, but was not as productive as those countries in ecological publications.
Its ecology papers appeared either in Belgium’s botany and zoology journals or else in foreign ecology periodicals. Roger Charlier (2013) briefly surveyed Belgian marine biology since 1830.

For the Iberian peninsula, the sources known to me, 1870s to 1920s, are discussed in part 51 on marine ecology (Egerton 2014c:352–355); additionally, recognition is extended here to the first school of oceanography, in PORTUGAL, founded by Prince Henry the Navigator (1394–1460), at Sagres, where it was active from 1418 into the 1470s (Guill 1980). Its motivation was imperialistic, and it was not oriented toward marine biology, but it deserves recognition as a first step worldwide.

Carl Linnaeus, Uppsala University, SWEDEN, founded the idea of ecological science, which he called oeconomia naturae (Matagne 1999:111–115, Egerton 2007:81), yet Sweden did not become a leader in advancing his concept. A later Uppsala botanist, Göran Wahlenberg (1780–1851), followed instead Humboldt’s lead in developing phytogeography (Fries 1950:69 + portrait facing title page, Eriksson 1976, Egerton 2010c:295). However, throughout the 1800s, applied sciences—in agriculture, forestry, and fisheries—flourished while natural history sciences declined (Söderqvist 1986:27–30). From the early 1900s, Swedish botanists studied peat stratigraphy, vegetation history, forest ecology, and phytosociology, but there were no new positions for ecologists (Sjörs 1981:303). Plant ecology and animal ecology arose among young botanists and zoologists during the 1910s, and a rivalry between two different schools in plant ecology arose in the 1920s and lasted into the 1930s, in schools at Uppsala and at Stockholm (Söderqvist 1986:75–115, Egerton 2013:353–355). A climax came in 1933 when members of each school applied for a vacant chair of botany at Uppsala. The winner was Einar Du Reitz (1895–1967) of Uppsala University, which ended the rivalry. Finish immigrant zoologist Oscar Nordqvist (1858–1925) made a place for himself as head of a privately endowed freshwater fisheries laboratory at Aneboda, in southern Sweden, where he could also advance limnology (Söderqvist 1986:79–81, Egerton 2014b:134). Nordqvist hired as an assistant an undergraduate at the University of Lund, Einar Naumann (1891–1934), who became Sweden’s leading limnologist (Thienemann 1938), with a privately endowed chair in limnology at University of Lund in 1929 (Söderqvist 1986:86). Naumann and August Thienemann (see below, Germany) initiated the founding of Internationalen Vereinigung für theoretische und angewandte Limnologie in 1922 (Thienemann and Naumann 1922). Thomas Söderqvist wrote a detailed social history, *The Ecologists: from Merry Naturalists to Saviours of the Nation, a Sociologically Informed Narrative Survey of the Ecologization of Sweden, 1895–1975* (1986), which is well documented but does not focus on the substantive progress of ecology. Rob Fries edited and wrote half of *A Short History of Botany in Sweden* (1950), which has some portraits and photographs of buildings and landscapes and a fold-out map tracing the voyages abroad of Swedish explorers, but little documentation.

In NORWAY, Bergens Museum established a marine biological station at Bergen in 1892, oriented toward fisheries. Johan Hjort (1869–1948) at the University in Kristiania (now Oslo) was to become the national leader in both fisheries and marine ecology studies (Schwach 2002, 2013, 2014, Schwach and Hubbard 2009, Egerton 2014c:397, 399–401). He persuaded the university to establish a marine biological laboratory at Drøbak on the Kristianiafjord (now Oslofjord) in 1894. Teaching of plant ecology began at the University in the 1920s, but most other ecological sciences developed after 1945 (Wielgolaski et al. 1981).

Ecology in DENMARK is most remembered internationally for research by faculty at the University
Fig. 11. (a) Carl R. Sahlberg. (b) Johan P. Norrlin. Collander 1965: facing pages 32, 64.
of Copenhagen. Phytogeographer Joachim Schouw (1789–1852), explored the distributions of European plant species (Christensen 1924–1926, I:253–276, II:165–179, Sanders 1975). Zoologist Japetus Steenstrup (1813–1897) discovered alternation of generations in some invertebrate animals (1842), and he founded paleobotany (1842) with studies on past vegetation in peat bogs (Clements 1916:14–16, Egerton 2009b:49–52, 2013b:138). These achievements earned him a professorship in zoology at the University of Copenhagen. Botanist Eugenius Warming (1841–1924) published *Plantesamfund* (1895, German, 1896, English, 1909), which was the first detailed organization of plant ecology and exerted a strong influence internationally, helped by translations (Christensen 1924–1926, I:617–675, 776–806, Müller 1976, Egerton 2013b:346). Plant ecologist Christen C. Raunkiaer (1860–1938) succeeded Warming as professor of botany and pioneered quantification in the study of species in plant communities, using quadrats for sampling, as Clements was doing in America (Adsersen online:15–16). Raunkiaer published mainly in Danish, which limited foreign appreciation of his work. Therefore, a committee of five colleagues arranged to have 17 of his publications translated into English (1934), 16 of which ranged in dates between 1904 and 1928, with the 17th being published for the first time, in English, in the 1934 volume.

In FINLAND, the first university was in Åbo (Turku), and in 1746, its first Professor of Economy was botanist Pehr Kalm (1716–1779), who had studied under Linnaeus and spent September 1748–February 1751 exploring eastern North America (Egerton 2006:349–353). A later successor of Kalm’s as Professor of Natural History and Economy was Carl Reinhold Sahlberg (1799–1860), who in 1821 organized Finland’s first scientific society, Societas pro Fauna et Flora Fennica. In September 1827 a tragic fire destroyed much of Åbo, including the University Library and the university’s natural history collection (Collander 1965:14–17). The University then moved to Helsingfors (Helsinki) and reopened in autumn 1828. The Societas also moved. Sahlberg’s assistant was J. M. af Tengström (1793–1856), who was Custodian of the Museum and Instructor in Natural History. Zoology was pursued more actively than botany. The University of Helsinki and the Societas were the two institutions that supported natural history and ecology, the latter appearing first in the work of Johan Petter Norrlin (1842–1917), who had explored Finnish vegetation on his own before he entered the university in 1862 (Collander 1965:72–74). In 1863 and 1866, the Societas supported his summer explorations. His interest was in plant sociology, which he called plant topographical research. He began publishing his research in 1870, submitted his doctoral dissertation in 1871, and continued publishing through 1874. Thereafter, Norrlin made his mark as a professor who trained ecologists, just as Henry Cowles did at the University of Chicago. “In this way [Norrlin] gathered around him a considerable school, the only real school, in fact, to be originated by any botanist in the nineteenth century” (Collander 1965:74).

Ragnar Hult (1857–1899) was one of Norrlin’s earliest students. He had “a remarkable facility of expression both in speech and in writing” (Collander 1965:75), and he was an energetic field botanist. He also studied at Uppsala University in Sweden (Fries 1950:70). In summer 1877 he and botany student Hjalmar Hjelt traveled to northern Ostrobothnia and Kemi-Lappmark, and in his doctoral dissertation (1881) and later, he went beyond Norrlin’s topographical studies in his accounts of vegetation stratification. Hult distinguished seven vegetation layers: ground, lower, middle, and upper field layers, shrub, lower forest, and upper forest. Later, he and other Norrlin students studied the Finnish archipelago. A. K. Cajander (1879–1943) was another eminent Norrlin student, who surveyed vegetation along three rivers and their deltas and published *Beiträge zur Kenntnis der Vegetation der Alluvionen des nördlichen Eurasiens* (three volumes, 1903–1909). He was also responsible for bringing the School of Forestry.
from isolated Evo State Park into the University of Helsinki in 1908 (Ilvessalo 1965:119–122). Cajander also organized forestry research in Finland. Runar Collander was senior author, who wrote 116 pages of *The History of Botany in Finland, 1828–1918* (1965), which contain 16 portraits; Yrjö Ilvessalo wrote an appendix, pages 117–130, and there is a joint bibliography, pages 131–153. P. Mälkki (1990) discussed the early Finish members in the ICES.

ICELAND had a natural sciences society and a museum founded in 1887 (Fridriksson 1981:207). The museum evolved into an institute of natural sciences, emphasizing marine biology, botany, ornithology, geology, and geography. J. Jónsson (1990) briefly surveyed oceanography in Icelandic waters before 1900. An Icelandic Agricultural Society was founded in the 1890s, and three agricultural research stations were established, 1902–1906. An Icelandic Meteorological Society was founded in 1920, and an Icelandic Forestry Society in 1930. A law passed in 1935 established a University Research Institute, which opened in 1937, with three divisions: industry, agriculture, and fisheries. Iceland’s National Research Council was founded in 1939 and functioned as a coordinating and advisory body.


Milena Rychnovská edited and wrote an introduction to a multiple-authored chapter on CZECHOSLOVAKIA in Kormondy and McCormick’s *Handbook*. Only her introduction provided specific details on ecology before 1945, and only in two instances: Professor Vladimir Úlehla (1888–1947), University of Brno, initiated a course in ecology by inviting Swedish Professor Henrik Gunnar Lundegardh (1888–1969) to be a visiting professor to teach the course. Rychnovská (1981:128) stated that that experience inspired Lundegardh to write his textbook, *Klima und Boden in ihrer Wirkung auf das Pflanzenleben* (edition 5, 1957). Her other instance: M. Deyl, one of the young plant ecologists at Charles University in Prague, published “Plants, Soil and Climate of Pop Ivan: Synecological Study from Carpathian Ukraina,” *Opera Botanica Cechica* 2 (1940) 1–288, which also discussed microorganisms and animals.

SWITZERLAND has had a long tradition of natural history studies, with land studies often focused upon its mountains, beginning with Conrad Gessner (1516–1565), who first studied mountain vegetation and distinguished four altitudinal zones (1555, Gigon et al. 1981:313). He also listed environments of different kinds of plants and compiled a landmark record of the phenology of 1250 trees, shrubs, and herbaceous plants in the Zurich region (Greene 1983, II:792–794). Many subsequent worthy Swiss naturalists of the 1500s–1700s are omitted here in favor of important ecological contributors of the 1800s, beginning with Genevan professor of botany August-Pyramus de Candolle (1778–1841), who built upon Linnaeus’ ecological contributions, to which he added the concept of competition between species as a factor in determining geographical ranges (Pilet 1971b, Candolle 2004, Egerton 2010a:26–29). His son, Alphonse (1806–1893), followed in his footsteps and publishing a notable *Géographie botanique raisonnée* (two volumes, 1855) and other botanical works (Pilet 1971a). A younger Zurich contemporary of Alphonse de Candolle, Oswald Heer (1809–1883), had an early interest in both plants and insects and taught these subjects at the University of Zurich and at Zurch’s Technische Hochschule (Burga 2013). His doctoral dissertation, *Beiträge zur Pflanzengeographie* (1835), was “the first monograph on plant

GERMANY has an extensive history of contributions to the development of ecology before 1946, but I am unaware of any historical discussion of ecologically oriented institutions for this period. I examined
Contributions

Berichte zur Geschichte und Theorie der Ökologie, edited by Ekkehard Höxtermann, Joachim Kaasch, and Michael Kaasch (2001) with social history in mind, but it is oriented toward the history of ecological theory. Ludwig Trepl’s brief Geschichte der Ökologie (1987) was only slightly more helpful. However, I did obtain some assistance from Engelbert Schramm’s Ökologie-Lesebuch (1984), the scope of which is broader than only German ecology, but it does at least discuss German contributors.

There were German contributors to ecological sciences before 1800, and Gerhard Kortum (2002) began his survey of German oceanography in the Pacific in 1741. I start this survey with Alexander von Humboldt (1769–1859), who explored Spanish America in 1799–1804 and who played a major role in science until his death (Beck 1959–61, Rupke 2000, Egerton 2009a, 2012c:121–125 + cover). Not only were his scientific works important, he was also the most important contributor to advancing scientific organizations during his time. His mother was French, and he lived in Paris, 1805–1829, before returning to Berlin. Not being a university professor, his influence depended upon his publications, personal contacts, and public addresses.

Germany’s Gesellschaft Deutscher Naturforscher und Ärzté was founded in 1822, yet there is no unified history of it (Rauschenbach 2000). Germany was only unified in 1871, and disunity likely contributed to Germany lagging behind England and France in establishing Germany-wide scientific organizations.

In contrast to Humboldt, other influential German contributors to ecological sciences were either professors at universities or in biological institutions. Julius Ratzeburg (1801–71), who is the only German entomologist I included in my survey of entomologists during the 1800s (Egerton 2012:187, 2013a:44–45), was son of a professor and became one himself. Parasitologists and microbiologists, whose work led to a germ theory of disease, included Karl Rudolphi (born in Sweden, but education and career in Germany, 1771–1832), Gottlob Küchenmeister (1821–1890), Rudolf Virchow (1821–1902), Karl Leuckart (1822–1898), Julius Cohn (1828–1898), and Robert Koch (1843–1910) (Egerton 2012:193–196, 2013b).

August Grisebach (1814–1879) studied at, and later taught at, Göttingen University (Wagenitz 1972, Egerton 2013d:333–344). His landmark Die Vegetation der Erde und ihrer klimatischen Anordnung (1872) relied extensively upon taxonomy, but his publications in the 1830s and 1840s showed Humboldt’s strong influence (five are reprinted in Egerton 1977b). (Carl Georg) Oscar Drude (1852–1933) earned his doctorate at Göttingen under Grisebach (1873) and served as chairman of the Department of Botany, Dresden Technical University, 1879–1920 (Egerton 2013d:345–346). He published two substantial works: Handbuch der Pflanzengeographie (1890) and Deutschlands Pflanzengeographie (1896) and co-edited with Adolf Engler Die Vegetation der Erde (15 volumes, 1896–1923). Drude also wrote one of the earliest plant ecology textbooks, Die Öcologie der Pflanzen (1913).

Ernst Haeckel (1834–1919), namer of “öcologie,” as a boy had a hero, Humboldt, and as a young zoologist acquired another hero, Darwin (Uschmann 1972, Di Gregorio 2005, Richards 2008, Egerton 2012a:198–200, 2013c). He studied at Würtzburg, Vienna, and Berlin, and spent his career at the University of Jena. Haeckel reorganized zoology along evolutionary lines, in his Generelle Morphologie der Organisme (1866), and in it named and described a new science, “öecologie,” which he also publicized in later publications (see six reprints in Acot 1998, II:681–836). A hostile competitor,

A different German plant ecology tradition than Grisebach’s is the subject of Eugene Cittadino’s fine *Nature as the Laboratory: Darwinian Plant Ecology in the German Empire, 1880–1900* (1990). This tradition reflects Darwin’s influence upon some botanists who had trained in plant anatomy and physiology. Others in that tradition resisted Darwin’s influence, as Cittadino made clear, and my summary focuses upon pro-Darwinians. Alexander Tschirch (1856–1939) studied at the University of Berlin under Simon Schwendener, who had argued for the compound nature of lichens (Egerton 2015a:104). Schwendener suggested that Tschirch research the correlation of physiological anatomy of plant species with Grisebach’s vegetation zones (Cittadino 1990:59–61). Tschirch easily found differences in stomata of plants in arid versus wet regions, but that data did not correlate with Grisebach’s zones. Cittadino (1990:61) saw Tschirch’s stomata study as representing “a new trend in which laboratory-trained botanists applied their knowledge of plant anatomy and physiology to particular aspects of the study of plant distribution.”

Another Schwendener student in Berlin was Georg Volkens (1855–1917), who undertook a similar project, but conducted his research in the field, in Egypt, East Africa, Java, and smaller Pacific islands (Cittadino 1990:62–74). The product of Volkens’ initial research, in Egypt, was *Die Flora der ägyptisch-arabischen Wüste, auf Grundlage anatomisch-physiologischer Forschungen dargestellt* (1887). Volkens claimed that “This book was a success; it called forth an entire literature and thereby helped found and develop a special discipline of botany, plant ecology” (autobiographical sketch, 1917, translated in Cittadino 1990:66). His Egyptian trip also marked a transition from foreign botanical exploration to find new species to his conducting anatomical–physiological research (his findings are explained in Cittadino 1990:65–71). Volkens’ 1892 ascent of Mount Kilimanjaro did not yield the dramatic differences in vegetation at different elevations that Humboldt had found on Mount Chimborazo in Ecuador, because Kilimanjaro has only arid vegetation.

Andreas Schimper (1856–1901) was the son of a professor of geology and botany at the University of Strasbourg/Strassburg (name spelling changed after Franco-Prussian War) and the son also studied there, under Anton de Bary (Sanders 1975, Cittadino 1990:97–108, Egerton 2013d:346–347). After spending a school year, 1880–1881, at Johns Hopkins University in Baltimore, Schimper visited Florida and the West Indies before returning to Germany in January 1882, and the tropics captured his interest, as it had for Humboldt, Darwin, Bates, and Wallace. In August 1886, Schimper and fellow botanist (Johann) Heinrich (Rudolf) Schenck (1860–1927), who had received his doctorate from the University of Bonn (1884), traveled to Blumenau, where they were welcomed by Fritz Müller, who assigned each a research project that each successfully completed. Schimper studied mutualism between *Cecropia adenopis* trees and *Azteca instabilis* ants, which protect the trees from leaf-cutting ants, and in return, the *Azteca* receive both secure abodes and food (Cittadino 1990:106–108). Thomas Belt (1832–1878) had already published his observations on a similar situation which he observed in Nicaragua between *Gummiferae* acacia trees and *Pseudomyrma bicolor* ants (Belt 1888; Walker 1991). Schimper published his findings in 1888 and reprinted them in his *Pflanzengeographie* (Schimper 1898:154–168, English 1903:140–153). He commented: “Belt must be considered as the actual discoverer of myrmecophily, although [F.] Delphino [1868], on the basis of much less convincing material, nearly simultaneously
Fig. 13. *Cecropus adenopus*. (a) Portion of a young stem with septa perforated by ants and structure made by them. (b) Summit of young stem. On one internode $a$ is not yet bored; on another internode entrance $b$ is bored. Schimper 1903:142. 143.
and quite independently published the same idea” (Schimper 1903:140). Schenck studied the biology and anatomy of lianas, which took six years and resulted in a 500-page work in two volumes (1886; Cittadino 1990:108–110).

In 1927, plant ecologist Reinhold Tuexen and colleagues, who had mapped the flora of Hanover, met in Göttingen to found the Floristische-sociologische Arbeitsgemeinschaft, and it began publishing its Mitteilungen and continued to do so through 1939. Their organization disbanded during the war, but Tuexen revived it in 1946.

German contributions to limnology included independent scholar Otto Zacharias (1846–1916) founding of Biologische Station on the Grossen Plöner See in 1892, partly supported by royalties from his publications, including Die Tier-und Pflanzenwelt des Süßwassers (1891) (Thienemann 1917, Egerton 2014b:133). Kurt Lampert (1859–1918), Königlichen naturlentabinetts, Stuttgart, wrote an outstanding monograph, Das Leben der Binnengewässer (1899). In 1917, Zacharias’ station became affiliated with the Kaiser Wilhelm Gesellschaft under the capable direction of August Thienemann (1882–1960), who joined the faculty of the University of Kiel and became Europe’s leading limnologist (Thienemann 1959, Steleanu 1989:300–308, 385–404, Egerton 2008b). He remained at Plön for forty years and edited Archiv für Hydrobiologie for over forty years. In January 1922, he and Naumann initiated the Internationale Vereinigung für theoretische und angewandte Limnologie (later, Societas Internationalis Limnologiae), which held its founding meeting in August, with 188 members from 23 countries (Thienemann and Naumann 1922, Steleanu 1989:405–411). It published an annual Verhandlungen.

German studies on marine plants were one way in which German botanists became international collaborators with foreign botanists (Hoppe 1990).

Karl Möbius (1825–1909) worked his way up from teaching school in a small town to becoming a Professor of Zoology at Kiel University in 1868 (Querner 1974, Nyhart 2009:140–143, Egerton 2014a:60–62). In 1869, the Prussian government asked him to study French and English oyster culture in order to promote that practice in German waters. He had already studied Mollusca in Kiel Bay and had used the term “Biocönose” to designate species having something in common, but had not defined it precisely. However, he did so in Die Auster und die Austerwirtschaft (Möbius 1877, English, 1880:727)

Every oyster-bed is thus, to a certain degree, a community of living beings, a collection of species, and a massing of individuals, which find here everything necessary for their growth and continuance….

In 1887, he left Kiel to become director of a new natural history museum in Berlin.

Victor Hensen (1835–1924) studied medicine at Würzburg and Berlin before earning his medical degree at Kiel (1858) (Rothschuh 1972, Mills 1989:see index, Egerton 2012:199–200, 2013c:236, 2014c:390–392). He remained at the University of Kiel, and in 1868 became professor of physiology. He did much research and publishing on physiology, but in 1863 he also began research on marine biology, and in 1883 began quantitative studies on plankton and fish eggs. He served briefly in the Prussian Landtag (parliament) and established a Prussian Kommission zur wissenschaftlichen Untersuchung der

In 1887, (Andreas Heinrich) Karl Brandt (1854–1931) went to Kiel to replace Möbius as professor of zoology—likely recruited by Hensen (Mills 1989:43–76). He had studied marine sciences at Berlin before earning his doctorate at Halle (1877). In 1882–1885 he had conducted research at the Naples marine station. He was part of Hensen’s oceanic research team on plankton, and he attempted to explain—rather unsuccessfully—why plankton are more abundant in northern than in equatorial waters (based on the nitrogen cycle). In 1900, he was appointed to a new Deutsche wissenschaftliche Kommission für internationale Meerschung and also became Germany’s leading representative to the International Commission for the Exploration of the Sea (1902), which organization facilitated his own research. Hans Lohmann (1863–1934) “was the most energetic and original member of the Kiel school” (Mills 1989:133). He earned his doctorate at the University of Kiel (1889) and remained there until 1913, when he went to the Zoological Museum in Hamburg, became its director in 1914, and became professor of zoology when the University of Hamburg was founded in 1919. He discovered and named “nannoplankton,” as an important food of many planktonic animals in 1901. Germany was also where Anton Dohrn (1840–1909) was born and educated, before he left to establish a marine station at Naples.

Germany was one of four nations that sponsored Antarctic expeditions around the beginning of the 1900s (Raraty 2002). Its expedition was commanded by Erich von Drygalski (1865–1949), the main goals of which were physical oceanography, but plants and animals were also collected, and Drygalski edited Deutsch Südpolar Expedition, 1901–1903 (20 volumes text + 2 volumes atlas, Berlin, 1905–1931). Walter Lenz (1990) surveyed German marine research in the Atlantic Ocean between the world wars, and unsuccessful efforts in the Pacific during that time (2002).

Anton Dohrn had traveled to Messina, ITALY, in 1868 to study crustaceans, and by 1871 he had obtained permission to build his Stazione Zoologica in a city park in Naples (Kofoid 1910:7–32 + 8 plates, Egerton 2014c:349–351). By having different countries rent tables in his laboratory for research, Dohrn promoted competition in marine biology among countries involved. Later, he began publishing three marine biology journals (Ravera 1981:224). Although most of his students and patrons were from outside Italy, his station also exerted some influence upon Italian biology. The station continues to flourish and has the most comprehensive international library for marine biology in Europe. Italy’s first chair of ecology was established at the University of Perugia in 1924. Perhaps the example of Stazione Zoologia helped influence Rosa Curioni de Marchi to found at Pallanza on the shore of Lake Maggiore an Instituto Italiano de Idrobiologia Marco di Marchi, with Edgardo Baldi (1899–1951) director, 1939–51. Its focus is the limnology of lakes in northern Italy, and it publishes a limnology journal. A. Boussoulengas (1990) briefly surveyed eighty years of research in the Aegean Sea. Italy’s navy sponsored three circumnavigations of the Earth by its corvettes, 1866–1885, which were not primarily scientific, but which nevertheless collected oceanographic specimens and observations (Croce 2002).

Science arose in ancient GREECE, and Elmer Yglesias’ critical bibliography on Greek science (2000) is limited to the history of ancient science. After Greece was conquered by the Roman Empire, its
Fig. 14. (a) Victor Hensen. Web. (b) A. H. Karl Brandt (c) Hans Lohmann, about 1930. Mills 1989:45, 133.
scientific culture remained uninterrupted but grew more slowly. A free but devastated Greece emerged in 1928 (Gerakis 1981:157–159). Its School of Forestry had been established in 1917 at the Athens Technical University, and a government Forest Service was established in 1922. In 1927, the School was transferred to the University of Thessaloniki. In 1920 a Higher School of Agriculture was founded in Athens. These schools encouraged ecological thinking, as did the botany and zoology departments at the universities of Athens and Thessaloniki. Academic progress ceased in 1940–1949, during the Greek Civil War. Gerakis’ only pre-1946 citation was to botanist C. A. Ganiatsas, “Untersuchungen über die Vegetation auf den Salzböden bei Saloniki” (1936), published in a German botanical journal.

RUSSIA and USSR

Russia grew from a modest size during the Middle Ages to a continent-wide empire before World War I. During the 1700s, Russia’s government supported a number of eastern expeditions that included naturalists, whose reports were later published (Egerton 2008c). The Czar’s government collapsed in 1917, and the Communist Party under Lenin seized power and created the Soviet Union, which lasted until 1989, when it also collapsed and reverted to Russia and a group of smaller countries on its western border. There were drastic political and cultural changes in the 1920s–1930s and again in the 1990s; science changed to some extent, but there was also some continuity across these changing periods. Botanic gardens, museums, and institutes arose along with universities, and particular ecologists became attached to one or more institutions. Elizabeth Haigh provides a panoramic view in her critical bibliography, “Russia” (2000). Very important for all sciences was (and is) the Russian Academy of Sciences, the history of which is the subject of Simon Werrett’s essay (2000). An English-language account of some of this history is in American taxonomic botanist Stanwyn Shetler’s The Komarov Botanical Institute: 250 Years of Russian Research (1967), which received an appreciative essay review from this historian (Egerton 1968). The institute whose history Shetler discussed is in St. Petersburg (then Leningrad). A university, botanic garden, and botanic museum were established there by Peter the Great in the early 1700s. Early botanical research in these institutions was mostly in plant taxonomy, and some in phytogeography—that is, an inventory of Russia’s botanical resources (Shetler 1967:71, Vucinich 1984:14, Egerton 2008). Since these three institutions in St. Petersburg were separate, there was some duplication in their research and their collections. After the Russian Revolution in 1917, the Leningrad botanical institutions were left alone until 1931, when the botanic garden and museum were merged into a botanic institute. Its first elected director, 1931–1936, was a geobotanist-ecologist, Boris A. Keller (1874–1945), who in 1936 became director of the Principal Botanic Garden of the USSR in Moscow (Shetler 1967:72–73). In 1937, the Botanical Institute produced a Map of the Vegetation of the USSR, and in 1939 a larger-scale version of it (Shetler 1967:94–95). The institute began publishing Vegetation of USSR (two volumes, 1938, 1940), which was never completed because of World War II. In 1940 the institute was named the Komarov Botanical Institute, though Vladimir Komarov (1869–1945) was still alive, to honor him for his supervision of Flora SSSR (30 volumes, 1934–1964). During World War II, which was especially brutal for Leningrad, work at the Institute ceased, but its geobotanists were evacuated to Moscow to make a geobotanical map of European USSR (Shetler 1967:100). A notable plant ecologist, Leonty G. Ramensky (1884–1953), never held a prominent position in Soviet botany (McIntosh 1983, Johnson and French 1981:347). Independently, and at about the same time as Henry Gleason, he became skeptical of the community concept and developed a continuum concept as an alternative. His most important paper on it appeared in 1924 (excerpted in McIntosh 1983), and it
Fig. 15. Department of Geobotany, built in 1829. Komorov Botanical Institute, St. Petersburg. Shetler 1967:after 194.
attracted little interest until the 1960s (a fate similar to Gleason’s).

Christiane Groeben and Sergei Fokin (2013) discussed Russians at the Naples Zoological Station, 1874–1934. Arkady Alekseev and Igor Rostov surveyed “Russian Oceanographic Investigations of the Pacific Ocean” (2002), emphasizing physical oceanography; however, their study is useful background for marine ecology.

OCEANIA

In 1867, Sir George Grey founded the NEW ZEALAND Institute, a general science society that published its transactions. In 1933 it became the Royal Society of New Zealand and continues to flourish. Leonard Cockayne (1855–1934), whom we met in part 48 (Egerton 2013d:349–350), emigrated from England to New Zealand about 1880 and began publishing on plant ecology in 1898 (Moore 1967). Cockayne’s work was fully appreciated by contemporaries; Munich University conferred an honorary Ph.D. on him in 1903 and he won the Hector Medal in 1912. In 1898 he compared vegetation in a burned-over area with similar areas not burned, and in 1932 he and J. W. Calder repeated his surveys and published on the changes. Plant ecology benefited from Cockayne’s influence, and his contributions are still appreciated (Mark 1981:418, Thomson 1982, 1983). A field station was established with government and local funds at Portobello, Otago Harbor, in 1909 for fisheries research (Mark 1981:433). The New Zealand Institute of Foresters was founded in 1927 and the New Zealand Ornithological Society in 1939. Some ecologists joined one or both of these societies. Two botanists, L. N. Cranwell and L. von Post, adopted the new science of palynology to gain insights into the history of vegetation, and Alan Mark (1981:423) called their “Post-Pleistocene pollen diagrams from the Southern Hemisphere” (1936) a “classic study.”

Nations sponsored exploratory ocean expeditions, which I previously surveyed (Egerton 2014c). Since several of them were important for AUSTRALIA, one example is cited: the Baudin Expedition from France, 1800–1804, the natural history contributions of which are well documented (Carr and Carr 1976, Jones and Jones 1980, Bonnemains et al. 1988). After the failed Revolution of 1848 in Germany, botanical explorer Richard Schomburgk (1811–1891) and his brother Otto led a German colony from Berlin to South Australia, near its capital, Adelaide—a story similar to Fritz Müller’s move to a German colony in Brazil in 1852. Schomburgk was the second head of the Adelaide Botanic Garden, 1865–1891 (Payne 1994). He wisely maintained a balance between scientific research and popular appeal with displays, and so did not share the fate of two other Germans who were dismissed from directorships of botanical gardens in Sydney and Melbourne for paying too little attention to public expectations. The British Association for the Advancement of Science, meeting in Australia in 1914, aroused interest in plant ecology among some Australian botanists, who were also encouraged by the appearance of BES’s Journal of Ecology (1913) (Specht 1981:387–388). However, World War I intruded, and it was only afterwards that ecologically inclined botanists began to study Australian plant communities. In 1921, British war veteran and entomologist Alexander Nicholson (1895–1969) immigrated to the University of Sydney (Nicholson 2014:156), and in 1928 another British war veteran and entomologist, James Davidson (1885–1945) immigrated to the Waite Agricultural Research Institute, University of Adelaide. Both of these insect ecologists studied populations of agricultural pests, and publication of Elton’s Animal Ecology (1927) was also helpful for developing Australian animal ecology. In 1927, both the Council of Scientific and Industrial Research (CSIR), at Canberra, and the Waite Agricultural Research
Institute, at Adelaide, established entomology departments. British transfer of ecology to Australia was very successful, as Specht’s detailed survey (1981) shows.

ASIA


Before they gained independence in 1947, Pakistan and India were both part of the British colony of India. Now, Pakistan is a Moslem country and India is pluralistic with a variety of religions.

INDIA had an early literate civilization. Kapil Raj (2000) has written a critical guide to the general history of India’s science.

Plant ecologist Abdur Beg wrote the PAKISTAN chapter in Kormondy and McCormick’s Handbook, and the closest he came to discussing animal ecology was a brief paragraph on “Wildlife Habitats” (1981:595) which is really also on plants. Pakistan has both extensive deserts, and annual floods of the Ganges River when monsoons occur. Its inhabitants need very much to understand the ecology of both its wild and its cultivated vegetation, and Beg’s essay illustrated how Pakistani plant ecologists were meeting that challenge.

The Dutch established Jardin Botanique de Buitenzorg (now Bogor) in its East Indies colony on Java (now part of INDONESIA) in 1817 for practical, not ecological reasons. However, it lasted into the period when biologists traveled to the tropics to investigate ecological questions. Pieter Honig and Frans Verdoorn compiled Science and Scientists in the Netherlands Indies (1945) that included articles on Buitenzorg, its Visitors’ Laboratory, and its mountain facility at Tjibodas; due to Melchior Treub’s efforts, the latter became available by 1884 to accommodate European investigators (Bernard 1945, Dammeman 1945a, Fairchild 1945, Jack 1945:55, Koolhaas 1945, Went et al. 1945, Vass 1981:234; on Treub: Zeijlstra 1959, Van Steenis 1976). Other articles are only on research at Tjibodas (Dakkus 1945, Dammerman 1945b, Docters van Leeuwen 1945, Went 1945b). Krakatau volcano erupted in 1883, which stimulated studies on primary ecological succession. Kartawinata (1981:527–528) cited early ecologically relevant studies published (1888–1938) concerning what is now Indonesia.

SINGAPORE is 137 km north of the equator and its main island (of 54 islands) is 41.8 × 22.5 km = 584 km² and is connected to Malaysia by a 1056-m causeway (Chow 1981:607). Singapore has a very long coast, and has 2500 mm rainfall yearly, evenly distributed over the year. It lacks typhoons, cyclones,
Fig. 16. Frederick S. Bodenheimer. Bodenheimer 1960–72, I: frontispiece.
Fig. 17. Biological Laboratory at Tjibodas, Java.
Honig and Verdoorn 1945:415.
Contributions

and earthquakes. It’s 2.3 million people (in 1980) are 76% Chinese, 15% Malays, and 7% Indians. It had no science education before World War II. In 1819 the East India Company of London established a trading settlement, which began clearing the rain forest. In 1895, however, over 5000 ha were set aside as a forest reserve. There is also 2718 hectares of watershed protected. Chow (1981:609) quoted an outline of Singapore vegetation—both wild and cultivated—which A. Johnson had published in 1973. Chow then discussed each heading of Johnson’s wild vegetation before discussing wild animals, aquatic freshwater life, and aquatic saltwater life. Chow also explained human impact upon land and aquatic (freshwater and saltwater) life, and air pollution.

CHINA had one of the oldest literate civilizations in the world. Fa-Ti Fan (2000a, b) has provided critical bibliographies for general works on its history of science and more specifically on history of China’s natural history studies. Joseph Needham’s monumental Science and Civilization in China includes Botany (volume 6, part 1), which I had the pleasure to critique in manuscript during a week as his guest at Cambridge University, in 1968. Elleanor Crown surveyed “Traditional Chinese ichthyology and its encounter with Jesuit science” (1980), without bibliography or mention of the relevance of Needham’s encyclopedia. Song Zhenghai et al. (1990) surveyed Chinese oceanography from antiquity to 1840, and Xu Qi Wang and Wu Ke Chin (1990) surveyed the same for the 1900s.

The very large island of TAIWAN is inhabited by Chinese, but was controlled by Japan, 1895–1945, during which the Japanese established a university now named National Taiwan University (Chow 1981:629). Little ecological research was conducted during Japanese rule, and Chow’s survey (1981) covers the period after 1945.

A U.S. Navy fleet brushed aside JAPAN’s self-imposed isolation in 1854, and by the 1860s Japan was sending students abroad and hiring European and American educators to come to Japan. One student sent abroad was M. Miyoshi, who would become a professor at Tokyo University (Numata 1981:561). He studied plant ecology, physiology, and systematics in Germany, and after returning wrote in Japanese Plant Communities (1903) and General Plant Ecology (1908). In 1921, Y. Yoshii began teaching plant ecology at Tohoku University and T. Kawamura began teaching animal ecology in Kyoto University. A Plant Ecological Society published three volumes of Annals (1941–1943). Morris Low (2000) published a general guide to the history of science in Japan.

The only pre-1946 ecological publication for KOREA which Kye Chil Oh cited (1981:575) was R. G. Mills, “Ecological Studies in the Tongnai River Basin, northern Korea” (1921). Ralph Garfield Mills (1881–1944) was an American physician, who, at the time, was on the faculty of the Peking (now, Beijing) Medical College. He had studied at the universities of Illinois (A.B., 1903), Northwestern (MD, 1907), and Chicago (1912–13). Some of Mills’ botanical specimens are now in the Harvard University Herbaria.

AFRICA

EGYPT had one of the very first literate civilizations. Its First Dynasty began about 3100 BC. Alexander of Macedonia took control of Egypt (without a fight) in 332 BC and founded Alexandria by 331. Julius Caesar conquered Egypt for Rome in 48 BC. Arabs conquered Cairo in 640, and it became a center of Muslim learning. Muslims absorbed much of Greek learning from medieval Byzantium.
In 1761, one of Linnaeus’ most promising students, Peter Forsskål (1732–1763) joined a Danish expedition and reached Egypt in the autumn (Eriksson 1972). In October, 1762 the expedition traveled to Arabia, where Forsskål died of malaria, 1763. By then he had written his *Flora Aegyptiao-Arabia*, published in Copenhagen in 1775. In 1798, French botanist Alire Delile (or Raffeneau-Delile, 1778–1850) accompanied Napoleon’s invasion of Egypt and returned to France in 1801 (Motte 1971). His publications on Egypt’s flora (1809–1824) were a substantial addition beyond Forsskål’s *Flora* (El-Kassas 1981:447). Three German physiologists studied the adaptations of Egyptian plants: G. Volkens (1887), O. Stocker (1929), and A. Seybold (1929). The Egyptian University (now University of Cairo) was founded in 1925, and plant ecologist Francis (Frank) Oliver, whom we met in part 48 (Desmond 1977:472; Egerton 2013:355–356), taught there, 1929–1935, and was succeeded by British plant geographer Francis J. Lewis (1875–1955, who had a doctorate from the University of Liverpool, and taught there in 1945–1947 (Desmond 1977:383–384, El-Kassas 1981:448). Oliver taught two Egyptians, 1931–1933, who earned M.S. degrees: A. M. Migahid and A. H. Montasir, studying desert plants. Both remained active in researching ecological aspects of Egypt’s flora (details: El-Kassas 1981:448–450). Selim Morcos has summarized developments in “Marine Sciences in Egypt” (2013).

SUDAN is south of Egypt and shares the Nile River and deserts with Egypt. Ecological studies began there in 1896, centered at the Nile, but with emphasis on physical science, not biological before 1946 (Beshir and Obeid 1981:512).

Dutch settlers established a fueling station for the Dutch East India Company at the Cape of Good Hope, SOUTH AFRICA, in 1652, and it gradually grew into a Dutch colony. In 1795, the British captured it to prevent Napoleon from doing so, and in 1814 Britain gained permanent possession. Dutch Afrikaners have remained a significant population, but did not focus on science. Scotsman John D. F. Gilchrist (1866–1926) earned his Ph.D. at Jena University (1894) and immigrated to Cape Town, where he became both a professor of ichthyology and Director of Fisheries and Biological Survey. He began studying both sea and freshwater fishes in 1895, and his work stimulated development of fisheries (de Graaff 1981:491, Brown 1997). Scotsman John William Bews (1884–1938) earned his D.Sc. at Edinburgh University (1912), after having immigrated to South Africa in 1910, becoming Professor of Botany at Natal University (Gale 1954, Bizley 1984). He became a successful professor—who introduced ecology into his teachings—and university administrator, and he was a productive publisher, his books including *Grasses and Grasslands of South Africa* (1918) and *The World’s Grasses: Their Differentiation, Distribution, Economics and Ecology* (1929).

The Mascarene Islands are much closer to Madagascar than to Australia, and so fall under the heading of Africa. MAURITIUS is slightly smaller than Réunion, but is the island included in Kormondy and McCormick’s *Handbook*. During the 1500s, the Mascarenes lacked human inhabitants. Portuguese ships took monkeys, pigs, and goats to Mauritius and probably unintentionally released rats there (Owadally 1981:457–458, Cheke and Hume 2008:21). During the 1600s, Dutch visitors left a description of vegetation, exterminated palms, tortoises, and large birds, though the introduced fauna probably contributed to extinctions (Owadally 1981:458, Cheke and Hume 2008:21–26). In 1715, Frenchmen arrived and took half of the island for agricultural settlers and introduced foreign trees and shrubs (Owadally 1981:458–459, Cheke and Hume 2008:27–30). In 1759, the French governor, Antoine Desforges, learned that mynas birds *Aridotheres tristis* in India were effective at controlling
Fig. 18. Mare aux Songes, Mauritius. Dodo is in center at bottom. All animal species in painting are identified in Cheke and Hume 2008:401.
grasshoppers or locusts and imported some, which was effective—the first known successful use of biological control (Cheke and Hume 2008:94–95). Two notable French naturalists visited Mauritius: Philibert Commerson (1727–1773) arrived in November 1768 and studied, collected, and described fish and plants before dying there (Laisissus 1971:365–366, 1978, Cheke and Hume 2008:94–95); Jacques Henri Bernardin de Saint-Pierre (1737–1814), with botanical interests, in 1768 went to Mauritius for three years and reported that a later introduction of crows to control rats had backfired, as crows found it easier to eat chicks from farmyards. His Voyage à l’Île de France (1773, English, 1775) was widely read. Two French botanists, Du Petit-Thouars (1801) and Bory de Saint Vincent (1804), contributed further to knowledge of Mauritius’s flora, leading to W. Bojer’s comprehensive list of plants with distinctions between native and introduced species: Hortus Mauritanus (1837; Owadally 1981:459–460). Later French and British botanists visited the Mascarenes and added more precision to the understanding. E. Liénard (1887) surveyed Mauritius Crustacea. “The first true land ecological studies started in the late 1930s by [R. E.] Vaughan and [P. O.] Wiehe (1937, 1939, 1941, 1947) when they set about mapping the vegetation. They explained plant succession…” (Owadally 1981:460).

Conclusions

Spain initiated the exploration and settlement of the Americas, and it had a number of explorer–naturalists who published their American observations during the 1500s and early 1600s, but then such studies declined sharply, with Ulloa being the only prominent explorer to publish observations during most of the later 1600s and the 1700s. That situation correlates with Basalla’s observation (1967) that Spanish science was eclipsed by English and French science from the 1600s onward.

Early institutional encouragement for ecology came from universities and colleges, biological research stations, museums, herbaria, and learned societies. The four ecological sciences that developed from the 1870s into the 1920s, previously discussed—plant ecology, animal ecology, limnology, and marine ecology (Egerton 2013d, 2014a, b, c)—had all benefited from such institutional support.

The first ecological societies arose in Britain (1913) and North America (1915), with no other such societies arising before 1946, because ecologists in other countries instead depended upon national natural history societies, botanical societies, and zoology societies. Progress in ecology in these other countries can still be followed, and to the extent that these stories are known to me they are surveyed here. However, before 1946, the history of ecology was on a modest scale in terms of participants and publications. Enough was achieved, however, to serve as a firm foundation for development of ecology into a major science after World War II.

Literature cited

Adsersen, H. online. Bibliography of Christensen Raunkiaer. 16 pages.
Agassiz, J. L. R., and E. Agassiz. 1868. A journey in Brazil. Ticknor and Fields, Boston, Massachusetts,
USA.
Barbour, T. 1943. Naturalist at large. Little, Brown, Boston, Massachusetts, USA.
Israel.


Chalier, R. H. 2013. More Belgian bio-marine contributions since 1830. Pages 105–123 in C. Groe-
Contributions

Chapman, F. M. 1929. My tropical air castle: nature studies in Panama. D. Appleton, New York, New York, USA.
Cullen, V. 2005. Down to the sea for science: 75 years of ocean research, education, and exploration at the Woods Hole Oceanographic Institution. WHOI, Woods Hole, Massachusetts, USA.
Contributions


Egerton, F. N. 1968. Review: Stanwyn G. Shetler, The Komarov Botanical Institute: 250 years of Rus-
Cambridge, Massachusetts, USA.
Fye, P. M. 1980. The Woods Hole Oceanographic Institution: a commentary. Pages 1–9 in M. Sears and


Hartt, C. F. 1870. Thayer Expedition: scientific results of a journey in Brazil by Louis Agassiz and his traveling companions: geology and physical geography of Brazil. Fields, Osgood, Boston, Massachusetts, USA.

Hasler, A. D. 1945. This is the enemy. Science 102:431.


Jahn, A. 1950. Prof. Henri Pittier. Boletín de la Sociedad Venezolana de Ciencias Natura-

Jahreshefte. Pages 343–383 in E. J. Kormondy and J. F. McCormick, editors. Handbook of con-
Johnstone, K. 1977. The aquatic explorers: a history of the Fisheries Research Board of Canada. Uni-

versity of Toronto Press, Toronto, Ontario, Canada.
Jónsson, J. 1990. The development of marine knowledge and oceanographic research in Icelandic wa-
Jovet, P. 1954. Flore et phytogéographie de la France. Pages 242–268 in A. D. de Virville, editor. His-
Karp, W. 1965, The Smithsonian Institution: an establishment for the increase and diffusion of knowl-
edge among men. Smithsonian Institution, Washington, D.C., USA.
Kimor, B. 1990. Development of oceanographic research in Israel. (Fourth International Congress
Leitão, C.: see Mello Leitão, C.


France.
Miller, R. R. 1968. For science and national glory: the Spanish expedition to America, 1862–1866. University of Oklahoma, Norman, Oklahoma, USA.


Parry, J. H. 1963. The age of reconnaissance. World Publishing, Cleveland, Ohio, USA.


Royte, E. 2001. The tapir’s morning bath: mysteries of the tropical rain forest and the scientists who are trying to solve them. Houghton Mifflin, Boston, Massachusetts, USA.


Contributions


Verdoorn, F., editor. 1945. Plants and plant science in Latin America. Chronica Botanica, Waltham, Massachusetts, USA.


Wang: see Xu Qi Wang.


Zhenghai: see Song Zhenghai.


Acknowledgments

I thank for their helpful comments: Regina Horta Duarte, Department of History, Universidade Federal de Minas Gerais, Pampulha, Brazil, on Latin America; Eric L. Mills, Emeritus Professor, Department of Oceanography, Dalhousie University, Halifax, Nova Scotia, Canada; Vera Schwach, Department of Historical Studies, Norwegian University of Science and Technology, Trondheim, Norway, on Norway; Jean-Marc Drouin, Muséum National d’Histoire Naturelle, Paris; and Anne-Marie Drouin-Hans, Université de Bourgogne (both retired).