
Edward Forbes was a wide-ranging British naturalist who was at the center of a movement to investigate marine life in European waters. Philip Gosse was a largely self-taught naturalist who conducted capable original research, but achieved more prominence as a popularizer of coastal marine life. Most naturalists become so after developing interests in nature during their early years, when they read popular nature books such as Gosse wrote (Hedgpeth 1947, Yonge 1963:21–24). Any lasting movement must recruit new members, and for that Gosse’s books were important.

Before their time, several naturalists made notable contributions which were usually isolated achievements, and thus did not create a movement (Rehbock 1979a:294–298). Italian Count Luigi Ferdinando Marsigli (1658–1730), whom we met in Part 30 (Egerton 2008), wrote the first treatise on oceanography (McConnell 1999). The term “oceanography” is anachronistic, but indicates the scope of his Brieve ristretto del saggio fisico intorno alla storia del mare (1711), which was expanded in French in 1725 as Histoire physique de la mer (1725, 1999), includes studies on the physical environment and on marine life. He used an oyster dredge and, at Cassis, a sponge-fisherman’s gear, to collect “plants” (kelp, corals, sponges) from shallow waters of the Adriatic Sea and along the French Mediterranean coast. Marsigli’s 1681 observations on the currents at the Bosporus are now translated into English (Deacon 1978:33–44, Soffientino and Pilson 2009). An Italian physician-naturalist, Vitaliano Donati (1713–1763), published an essay towards a natural history of the Adriatic Sea (in Venice, 1750) which Abraham Trembley summarized in the Royal Society’s Philosophical Transactions (1756); Donati’s book was translated into French in 1758. An English naturalist, John Ellis (1710–1776), published a well-illustrated Essay towards a Natural History of the Corallines (1755), in which he asserted that corals were animals, not plants (Allen 1978:126). In the 1770s, Danish field naturalist Otto Frederik Müller (1730–1784) was first to dredge in deeper waters, in southern Norway fjords, using a modified oyster dredge (Spärck 1932, Anker 1950, Snorrason 1974). He first described many marine organisms, and he began an ambitious Zoologia Danica (Two volumes, 1779–1784; other zoologists later added two more volumes).
Marine biology had an early start in France. The earliest known use of a long-handed dip net to study organisms at the surface of the ocean was by two French naturalists, François Péron (1775–1810) and Charles-Alexandre Lesueur (1778–1846), during a French expedition to Australia under Captain Nicholas Baudin, 1801–1804 (Ord 1849, Wells 1973, Jovet and Mallet 1974, Wallace 1984, Horner 1987:367–368, 1988, Bonnemains 1988, Bonnemains et al. 1988, Laissus 1988, Goy 1995). Péron was one of five zoologists who sailed on the expedition, but two of them deserted in Mauritius (along with botanist André Michaux, discussed in Egerton 2009a), two others died, and Lesueur, an artist, filled the vacuum. Péron and Lesueur made plankton collections on the expedition, and afterwards in the Mediterranean Sea, and published some reports of their findings. They also collaborated in publishing Volume I of their expeditionary report (1807), and were far along on a second volume when Péron died. That second volume was given to another member of the expedition to finish, and when it was published in 1816, 129 pages of Lesueur’s illustrations were omitted (Horner 1987:336, Bonnemains 1988:22). Lesueur’s drawings show use of long-handed dip nets along both the Australian and Mediterranean coasts, and those illustrations are among his illustrations from that expedition of jellyfish and Péron’s commentary are now published (Goy 1995). On 16 November 1815 Lesueur left Falmouth, England for Barbados, which he reached on 29 December, and on 26 April 1816 he left Santa Cruz Island for New York, which he reached on 10 May. On both voyages he used his net to sample plankton, took notes, made drawings, and published some of his discoveries (Lesueur 1817). If Péron had not died so young, he might have established an ongoing tradition of such studies in France in the 1810s. However, Jean-Victor Audouin (1797–1841) and Henri Milne-Edwards (1800–1885), working on the Normandy and Brittany coasts, founded French marine biology in 1826–1829 (Théodoridès 1968, 1970, Anthony 1974). Forbes acknowledged their Recherches pour servir à l’histoire naturelle du littoral de la France (1832) as “the first impulse to the scientific investigation of the distribution of marine animals” (Forbes and Godwin-Austen 1859:90, 1997).

In England, marine biology began with a practical orientation. For example, William Scoresby Jr. (1789–1857) was the son of a prosperous whaling captain, and he became one himself, but only after attending the University of Edinburgh, where Professor of Natural History Robert Jameson encouraged him to write his Account of the Arctic Regions, with a History and Description of the Northern Whale-Fishery (1820, 1969), Volume I being a natural history of the Arctic and Volume II a treatise on whaling (Hardy 1969, Stamp and Stamp 1976, McConnell 1986, Baigent 2004, Haines 2004). Volume I includes geography, a hydrographical survey of the Greenland Sea, meteorology, and a survey of aquatic and land mammals, birds, and a few fish, Crustacea, and worms. It has two maps of Arctic regions and illustrations of six kinds of whales and of a few other animals. Scoresby’s volumes provided a good foundation for Arctic marine biology, and their failure to inspire similar studies was likely due to a lack of Arctic travel opportunities by other naturalists. Scoresby continued to publish scientific studies after 1820, but never wrote another synthesis. He published a brief article on his discovery of “animalcules” floating near Greenland (1821), but did not explain how he obtained the water sample in which they lived, nor did he ask a zoologist to identify them.

In 1823, at the founding meeting of the Zoological Society of London, the entomologist William Kirby commented on the slow progress in describing British invertebrates, especially aquatic ones. A zoologist who took up that challenge was Robert E. Grant (1793–1874), who had received his M.D. degree from
the University of Edinburgh in 1814 and remained there until 1827—long enough to advance Charles Darwin’s interest in shallow-water marine animals and to advocate Lamarckian evolution (Desmond 1984, 2004a, b, Sloan 1985:73–86, Secord 1991, Stott 2003:3–19). Although Grant did not persuade Darwin to accept Lamarck’s theory, Darwin was sufficiently impressed with Lamarck as a zoologist for him to make a copy of Lamarck’s classification of invertebrates from *Système des animaux sans vertebres* (1801) for his own use (Egerton 1976).

An English army surgeon and later hospital administrator, John Vaughan Thompson (1779–1847), was an early naturalist who described using what we now call a plankton net (Wheeler 1968, 1976, Davis 2004, Valier 2004). He was anticipated by John Cranch, who used a similar tow net on James Tuckey’s expedition to the Congo in April 1816 (Wheeler 1976:355). Thompson first used one in 1816, while returning home from Mauritius, though he only published his account in 1830. He trailed a muslin hoop net over the ship’s stern and caught “such a profusion of…marine animals altogether invisible while in the sea, as to induce a continued use of it on every favorable opportunity” (1828–34:47; 1968). Thompson’s plankton studies led to his discovery that Crustacea go through metamorphic stages as they grow, and that barnacles were crustaceans, not mollusks as commonly thought (Windsor 1969a:102, 1969b:294–300 + figures 1–7, Campbell 1989, Love 2002:270–272). He published his findings in both zoological journals and in his own pamphlets (1828–1834).

Charles Darwin (1809–1882) was the next known user of a plankton net, on the voyage of the *Beagle*, beginning on 10 January 1832. It was inspired by an Edinburgh friend’s sketch of an oyster dredge, though he also had Thompson’s work on the *Beagle* (Stott 2003:48, 54). Although he did not include his crude sketch of the four-feet deep net in his *Journal of Researches*, he did mention using it (1839:189); and it is now published (Darwin 1988:21). Darwin may have been first to discuss the many organisms that live on kelp (*Fucus giganticus*), with the implication of a complex food web (1839:304–305; discussed in Egerton 2010b). He also studied corals in both the Atlantic and Pacific oceans and developed the accepted theory of coral reef formation (Darwin 1842).

Edward Forbes, Jr. (1815–1854) was from Douglas, on the Isle of Man in the Irish Sea, midway between Britain and Ireland (Wilson and Geikie 1861, Herdman 1923:12–36 + 3 plates, Ritchie 1956:41–58 + 3 plates, Merriman 1965, Egerton 1972, Rebcock 1979a, b, 1983:123–187, Browne 1981, Mills 1984, 2004, White 2004). At age seven he began collecting specimens for his own natural history museum, and later his banker father even added a room to their house for it. Although sociable, while other boys played athletic games, he collected bugs. At age 12 he wrote *A Manual of British Natural History in all its Departments*. He went to London in 1831 to study art, but after four months he went on to the University of Edinburgh to study medicine. Like Charles Darwin and Hewett Watson before him (Browne 1995:44–64, Egerton 2003:15–37), he showed more interest in natural history courses than in medical ones, and left without a degree. Like them, he planned to depend on inherited wealth to support his research. Forbes was an outgoing conversationalist, and publishing was an extension of that impulse. He also had a playful streak in his personality, illustrated by a spoof he published in the Edinburgh *University Journal* in 1834 “On the Phrenological Development of the Cheese-Mite.” More seriously, in the same magazine he published his first scientific note, “On British Species of *Patella,*** in which he noted both habitats and localities of these marine mollusks. The following year he began publishing
“Records of the Results of Dredging” in the Irish Sea (1835–1836), describing new species of mollusks and comparing them to known species.

Dredging for marine specimens was not yet a common activity among naturalists when William Christy, Jr., a member of the Linnean Society of London, wrote to Forbes about his desire to obtain a proper dredge for this purpose. Forbes’ reply, written about 10 June 1836, provided elementary instructions on its use (Rehbock 1979a:306). At age 21, Forbes was already a well-known authority! Also in 1836, Forbes first attended the annual meeting of the British Association for the Advancement of Science, which had been founded in 1831 (James 2000). Thereafter, he attended all its meetings until he died, excepting three years when he was out of the country. The BAAS became the most important organization for sponsoring marine research during his lifetime.

Yet he was not single-mindedly devoted to marine zoology. He also published brief notes on plants, and after a tour in the Alps, he published “On the Comparative Elevation of Testacea in the Alps” (1837), pointing out that “The influence of elevation on the distribution of plants is at present a popular theme with the botanists, whilst the same influence on that of animals is comparatively neglected,” especially for invertebrates. However, he only listed the snail species that he found at different elevations and in different vegetations, without making any generalizations or drawing any conclusions. But that was only a step toward a more ambitious project, which he presented to the British Association for the Advancement of Science in 1838 and 1839, on the distribution of pulmoniferous Mollusca in the British Isles and in Europe (Forbes 1838a, 1839). It was a Humboldtian project, though not necessarily influenced directly by Humboldt’s own work. He established six natural districts for terrestrial and freshwater Mollusca in Europe and 10 smaller zoological districts (he first called them provinces) for the British Isles. He specified the six European districts by merely listing the countries in each, but for the 10 British districts he described the topography, climate, and kind of rocks. Then he constructed five tables indicating the relationship between species within genera, and either the district or the rock substrate; two of these tables are in Fig. 1. In 1838 he also published his first separate work, a 63-page booklet with three plates, on mollusks in and around the Isle of Man—“a simple but thorough catalogue” (Rehbock 1979a:304).

In 1839, after Forbes’ report on his and John Goodsir’s dredging in June near Shetland and Orkney (Forbes and Goodsir 1839), BAAS established a Dredging Committee, with a grant of £60 for dredging and another £50 for illustrating specimens in print. Between 1839 and 1867, BAAS provided a total of £1605 for the Dredging Committee’s research (Schlee 1973:83, Rehbock 1979a:323–325, Rice and Wilson 1980:375–378). There were no collected records of the published results of those dredgings at the time, but Rehbock (1979a:359–368) has compiled a table of them, year by year, indicating who did the dredging, what was found, and references to resulting publications.

This BAAS commitment of time, money, and effort inspired both Forbes’ further research and his artistic creativity. Not only did he draw a playful illustration of a dredge on the sea floor (Fig. 2), he also wrote “The Dredging Song,” having four verses and a chorus. Here is the first verse and chorus (Forbes 1840a; the work is quoted from Rehbock 1979a:326).
Fig. 1. Tables I and II on distribution of Pulmoniferous Mollusca in the British Isles. Forbes 1839:140. (Three other tables are not numbered.)
Hurrah for the dredge, with its iron edge,
And its mystical triangle,
And its hided net with meshes set,
Odd fishes to entangle!
The ship may rove through the waves above,
Mid scenes exciting wonder;
But braver sights the dredge delights
As it roveth the waters under!
CHORUS
Then a dredging we will go, wise boys!
Then a dredging we will go!

Fig. 2. A dredge on the sea floor: one of Forbes’ playful cartoons. Forbes and Godwin-Austen
By 1840, Forbes’ dredging yielded enough data for him to divide the British coasts into four depth zones, reminiscent of his 1837 work on snail species found in different Alpine zones (Forbes 1840b, from Rehbock 1979a:320 and Mills 1978:512–513):

1) the Littoral Zone, lying between high and low tidal marks;
2) the Laminarian Zone, from low water to a depth of 7–15 fathoms (13–27 m), dominated by the seaweed Laminaria;
3) the Coralline Zone, from 15–30 fathoms (27–90 m), containing the coralline algae in abundance; and
4) the Zone of Corals, averaging sixty fathoms in depth (90–beyond 100 m), inhabited by the true corals, a region as yet but imperfectly known.

Unfortunately, he published this in an obscure journal, where it attracted little attention. However, continental naturalists had already begun publishing similar studies, and Rehbock (1979a:320–321) provides a bibliography of them. In 1957 Joel Hedgpeth wanted to standardize the classification of marine environments, and he commented that although later researchers had adopted Forbes name of “littoral zone,” not all of them limited it to the intertidal zone, and that “intertidal” would therefore be a clearer term. He also pointed out that naming a zone after a common plant or animal, such as “Laminarian Zone,” was unsatisfactory for parts of the world where that genus did not exist (1957c:93–94).

In 1841 Forbes published *A History of British Starfishes, and Other Animals of the Class Echinodermata*, which described 63 species in 30 genera in 6 families. Rehbock (1979b:176) says it was his “most popular book and the first ever to be devoted to British echinoderms,” and Maurice Yonge (1963:53) called it “one of the most charmingly written and certainly the most delightfully illustrated of all books on British marine animals.” Forbes’ introduction (1841:xi–xvi) shows the influence of William MacLeay’s speculations on classification (Winsor 1969a:89–90), which never attracted Darwin.

In March 1841 Forbes joined Captain Thomas Graves on H.M.S. *Beacon* for one-and-a-half years to survey the Aegean Sea. In 1841–1842 Forbes sent back to natural history magazines brief reports on his discoveries, and in 1843 he presented to the BAAS a long report on more than 100 dredgings in the Aegean Sea and along the southern coasts of Greece and Anatolia, ranging from 1 to 230 fathoms deep (1 fathom = 6 feet). He thought distribution in the shallows was primarily influenced by climate, depth, and “sea-composition” (a vague concept based on salinity and organic matter), and secondarily by substrate, coastal configuration, tides and currents, and the influx from rivers of freshwater, mud, and organic material (Forbes 1843, Rehbock 1979a:330–331). His 1843 report has many tables and species lists, the most important being a “Diagram of Regions of Depth in the Aegean Sea” (1843:169–170), which is copied by Rehbock (1979a:333–334) and discussed by Mills (1978:513–514). While the four zones he had described around Britain and Ireland only went down to about 180 m, his dredging in the Aegean went down to at least 420 m, and he divided the Aegean depths into eight regions. He found no plants below 230 fathoms, and he speculated near the bottom of this diagram that “Zero of Animal Life possibly about 300 fathoms” (Forbes 1843:170). He repeated this speculation again the next year (Forbes 1844b:321–322), and it became his most-remembered statement. Yet John Ross had already dredged up annelid worms, starfish, and crustacean from greater depths than 300 fathoms in Baffin
Bay in 1818 (Rice 1975); there was no good reason to take Forbes’ speculation as applicable beyond the Aegean Sea, but it was taken as a broader claim (Deacon 1971:281–282, Schlee 1973:84, Rehbock 1979a:348–357). In 1843 Forbes was elected to the Linnean Society of London, and he submitted to it for publication his descriptions of 61 new species of Mollusca.

Fig. 3. Rosy feather-star (*Comatula rosacea* Link.). Forbes 1841:5.
Whereas De Candolle and Lyell had discussed a dynamic economy of nature with hypothetical examples (Egerton 1968:231–240, 2010a:26–34), Forbes could do so by drawing conclusions based on his actual data (Forbes 1844a:173)

The eight regions in depth are the scene of incessant change. The death of the individuals of the several species inhabiting them, the continual accession, deposition and sometimes washing away of sediment and coarser deposits, the action of the secondary influences and the changes of elevation which appear to be periodically taking place in the eastern Mediterranean, are ever modifying their character. As each region shallows or deepens, its animal inhabitants must vary in specific association, for the depression which may cause one species to dwindle away and die will cause another to multiply. The animals themselves, too, by their over-multiplication, appear to be the cause of their own destruction. As the influence of the nature of sea-bottom determines in a great measure the species present on that bottom, the multiplication of successive generations of Mollusca, &c. will of itself change the ground and render it unfit for the continuation of life in that locality until a new layer of sedimentary matter, uncharged with living organic contents, deposited on the bed formed by the exuviae of the exhausted species, forms a fresh soil for similar or other animals to thrive, attain their maximum, and from the same cause die off.

A general discovery that Forbes reported (1844a:172–173) was that colored mollusk shells only occur in shallow waters, those at greater depths being either white or colorless. Later, he pointed out (read at the Royal Society on 23 March 1854; published 1856) that this observation could be used as an indicator of the depth at which mollusks with colored shells had lived before becoming fossils.

Although his dense, detailed report was an important contribution for specialists, his summary of it for a talk was undoubtedly more widely read. In it, he reached seven italicized conclusions, followed by explanations not italicized. Since the article is reprint-accessible (Deacon 1978:346–355), only his italicized conclusions are quoted here (Forbes 1844b:319–325).

1. Living beings are not distributed indifferently on the bed of the sea, but certain species live in certain parts, according to the depth, so that the sea-bed presents a series of zones or regions, each peopled by its peculiar inhabitants.

2. The number of species is much less in the lower zones than in the upper. Vegetables disappear below a certain depth, and the diminution in the number of animal species indicates a zero not far distant.

3. The number of northern forms of animals and plants is not the same in all the zones of depth, but increases either positively, or by representation, as we descend.

4. All varieties of sea-bottom are not equally capable of sustaining animal and vegetable life.

5. Beds of marine animals do not increase to an indefinite extent. Each species is adapted to live on certain sorts of sea-bottom only. It may die out in consequence of its own increase changing the ground.

6. Animals having the greatest ranges in depth have usually a great geographical, or else a great geological range, or both.

7. Mollusca migrate in their larva state, but cease to exist at a certain period of their...
metamorphosis, if they do not meet with favourable conditions for their development; i.e. if they do not reach the particular zone of depth in which they are adapted to live as perfect animals.

In summer 1842 Forbes had planned to travel from the Aegean to the Red Sea for further dredgings, but he was prevented from doing so by contracting malaria and by news from home: his father’s banking
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losses meant that he no longer had an independent income, and a friend had obtained a professorship in botany for him at King’s College (within the University of London), beginning in September.

However, he found that the pay was low (less than £100), and he also became curator for the Geological Society of London (paying £150). Later, he resigned from this second position in order to take another second position as paleontologist at the new Geological Survey of Great Britain. The BAAS petitioned the government for funds to publish all of Forbes’ expedition findings as a collected work, and £500 was allocated, but his two full-time jobs prevented him from finding the time to complete it. However, he did become the junior author of a book based upon the Beacon’s 1841–1842 hydrographic survey of the Aegean, *Travels in Lycia, Milyas and the Cibyratis* (two volumes, 1847), the senior author being Lieutenant Thomas Spratt (1811–1888). Forbes contributed part of the introduction and also Chapter 1 to Volume 1, and Chapters 11–14 to Volume 2 (Wilson and Geikie 1861:407). They dedicated the book to Captain Graves.

Forbes provided a brief survey of all the land animals (Chapter 11), marine animals (Chapter 12), land plants (Chapter 13), and geology (Chapter 14) that he was able to discover in a year-and-a-half. He cautioned that this was not a complete catalog, but rather “a general sketch, exhibiting the more striking features of the zoology and botany of the country” (Spratt and Forbes 1847, II:61). Where he could, he commented on the relationship between his findings and those found in Aristotle’s *Historia Animalium*, there having

Fig. 5. Temperature data from the Aegean Sea, 1845–1847. Spratt 1848.
been rather little information published on the area’s animals in the centuries separating the two works. Although Forbes provided rather limited information that we could call ecological for most species, he invariably indicated the elevation where the species was found, in elevation above sea level for land species and below sea level for marine species, and also how common it seemed to be. Since his 1843 report to the BAAS on the Mollusca and Radiata was quite dense and only meaningful to specialists, he briefly summarized his findings for mollusks and referred the reader to the 1843 report for more details (Spratt and Forbes 1847, II:102–108). For the plant species, he gave not only their elevation, but also the features of each vegetation region, sometimes including the kind of rocks; this information had not been given elsewhere in more detail. His chapter on geology continued the discussion of which species of plants prefer which kinds of rock, and he showed a persistent interest in comparing fossil shells with related living species.

Forbes’ 1843 dredging report to the BAAS inspired Spratt to supplement it with temperature data from the Aegean Sea in Forbes’ eight regions of depth, which he collected in 1845–1847 (Fig. 5). Spratt (1848:170) found that the most reliable way to measure the temperature at different depths was to scoop up mud from that depth and quickly stick the thermometer into the mud when it reached the deck of the Beacon.

Forbes had concluded that the species that have the broadest distribution at different depths also have broad geographical ranges, and Spratt’s data supported this conclusion. More generally, he concluded that temperature is an important factor in explaining marine distributions (Spratt 1848:173).

Forbes’ botanical and geological positions in London took him away from the sea. His important publication, “On the Connexion between the Distribution of the Existing Fauna and Flora of the British Isles and the Geological Changes which have affected their Area” (1846) was “the most detailed attempt so far to correlate the present-day patterns of florals and faunas over Europe with geological upheavals and submersions of the past.” (Browne 1983:115). It had indirect significance for oceanography, as William Herdman explained (1923:26–29). Forbes realized that few British plants and animals could have crossed the English Channel; mostly, they must have come across dry land during a period of
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glaciation. He identified and mapped five different regional floras in Britain, and indicated where he thought each originated in Europe. He also pointed out that the coastal marine flora and fauna would have been influenced by the same Ice Age sea-level changes. Forbes wrote to a friend, William Thompson, that this study could revolutionize the geography of botany and zoology (Wilson and Geikie 1861:394; see also Browne 1983:115–117). Botanist Hewett Watson, who had published a six-region division of the British flora, would have disagreed (Egerton 2003:121–128).

Although unable to return to marine research, Forbes already had some collections and acquired others to enable him to publish A Monograph of the British Naked-eyed Medusae (1848) and to coauthor, with Sylvanus Hanley as junior author, A History of British Mollusca, and Their Shells (Four volumes, 1848–1853). Both works were well illustrated. His Medusae contained more than systematic descriptions, for he recognized that study of developmental histories could alter assumptions about relationships between taxa (Winsor 1969a:77–78). Forbes and Hanley’s British Mollusca was “one of the first malacological works to include data on the geographic distribution of each species. Many descriptions also included information on the depth, habitat, substrate and geological age of the species” (Rehbock 1979b:177). These were the last books he himself published. Thomas Huxley’s estimate of Forbes in a letter to William MacLeay, 9 November 51, was widely shared (Huxley 1900:I, 94).

...he has more claims to the title of a Philosophic Naturalist than any man I know of in England. A man of letters and an artist, he has not merged the man in the man of science—he has sympathies for all, and an earnest, truth-seeking, thoroughly genial disposition which win for him your affection as well as your respect. Forbes has more influence by his personal weight and example upon the rising generation of scientific naturalists than [Richard] Owen...

Personally I am greatly indebted to him (though the opinion I have just expressed is that of the world in general).

Huxley was obviously grateful for Forbes’ assistance when Huxley obtained a position at the Royal College of Science (later, Imperial College).

Forbes began another book, The Natural History of the European Seas, and completed five chapters (126 pages) before he died in 1854. Fortunately, his friend Robert Godwin-Austen (1808–1884), “a pioneer in the elucidation of the history of the English Channel and among the first marine geologists” (Dunham 1972), completed it with six more chapters (162 pages) that drew upon both Forbes’ notes and his own knowledge (Van Riper 2004). In his introductory chapter on all the European seas, Forbes ends with the abyss, and this time, not confining himself to the Aegean Sea, he wrote that it is “where life is either extinguished, or exhibits but a few sparks to mark its lingering presence. Its confines are yet undetermined, and it is the exploration of this vast deep-sea region that the finest field for submarine discovery yet remains” (Forbes and Godwin-Austen 1859:26–27, 1977). Furthermore, Godwin-Austen reported on page 195, possibly from Forbes’ notes, that Giovanni Antonio Risso (1777–1845) had collected Alepocephali and other fish from 2000 feet in the Mediterranean at Nice. That was well below the 300 fathoms that Forbes had suggested in 1843 as possibly an Azotic Zone in the Aegean Sea. Forbes and Godwin-Austen’s book surveyed the flora and fauna of all the European Seas, with accounts of the physical environments. It contains a fold-out map of these seas as a frontispiece (and this time, unlike the Humboldt reprint I discussed in Part 32, Arno Press did include the map in my 1977 reprint). Their
book was “the first treatise on marine ecology” (Hedgpeth 1957a:2) and the first summary of marine biogeography (Hedgpeth 1957b:359).

Ever since leaving the University of Edinburgh, Forbes aspired to return and succeed Robert Jameson as its Professor of Natural History. Jameson died on 19 April 1854, and on 15 May, Forbes, as the new professor, gave his Inaugural Address to an enthusiastic audience. Unfortunately, he had had kidney problems since December 1845 (Wilson and Geikie 1861:392), and he died on 18 November 1854, age 39. Forbes and Charles Darwin were friends, but Darwin never confided in him his ideas on the origin of species, knowing Forbes had quite different ideas on how to explain the fossil record and modern distributions of species (Browne 1983:144–155, 1995:451, Rehbock 1983:69–73, 102–113, Mills 1984:375–385). Some of Forbes’ biological ideas seemed overly speculative, and both Darwin and Joseph Hooker thought they were misguided (Darwin 1989:199–201).
Philip Henry Gosse (1810–1888) was the son of an itinerant miniature artist and, like Forbes, grew up in a port—Poole in Dorsetshire (Freeman and Wertheimer 1980:1–15, Wertheimer 1982, Stewart 1997, Croft 2000, 2004, Thwaite 2002:1–28, Smith 2004). Thomas Bell (1792–1880), a zoologist from Poole, was an older cousin, and Bell’s mother encouraged Gosse’s interest in collecting sea-anemones and insects. In 1825 Gosse had to leave school to work in a counting-house. He read in his spare time, and in 1826 his first literary creation appeared in *The Youth’s Magazine*. In 1827 he went to Carbonear, Newfoundland to work in a whaler’s office (Thwaite 2002:29–59). He bought a copy of George Adams’ *Essays on the Microscope* (1798) and taught himself to use a microscope to study Newfoundland’s insects. In 1832 he received word that his only sister was seriously ill. He vowed that if she recovered he would spend the rest of his life as an active Christian; she did, and he did. In 1835 he bought a farm in Compton, Lower Canada (Quebec), and in 1836 he wrote *The Entomology of Newfoundland*, which, however, remained unpublished. He failed at farming and in 1838 sold his farm and traveled to Philadelphia and met several naturalists before moving to Alabama, where he taught school to a dozen students on a plantation for nine months. He had ample time to study natural history and draw plants, animals, and scenes, all of which he organized into *Letters from Alabama (U.S.), chiefly relating to Natural History* (1859). In 1839 he sailed to Liverpool and during the voyage wrote *Canadian Naturalist*, which was published in 1840 and was well received (Thwaite 2002:98–120). He taught school but also wrote *An Introduction to Zoology* (1843), which earned him the attention of authorities at the British Museum; they sent him to Jamaica in 1844 to collect unknown birds, insects, and other animals. He spent a successful year and a half there (Thwaite 2002:121–140), collecting for the museum “8000 insect specimens; 800 living orchids; 1500 bird specimens; 3000 shells and more than 100 reptiles” (Croft 2000:78). After returning to London he wrote *The Birds of Jamaica* (1847), *Illustrations to the Birds of Jamaica* (1848–1849), and *A Naturalist’s Sojourn in Jamaica* (1851), the last being, in the opinion of his son Edmund, “one of the most valuable and best written of his books” (Gosse 1890:259). Gosse’s Jamaica books are now valuable as historical records (Lack 1976:73).

In 1848 he married Emily Bowes (1806–1857), and they had one child, Edmund William, born in 1849. Ever since returning from Jamaica, Gosse had worked very hard with his researches, his religious tracts, and his publishing, and by the end of 1851 he was in a state of nervous exhaustion. His doctor suggested that he leave London, and he moved his family to the Devonshire coast, where he began his research in marine biology. In 1852 he wrote an article, “On Keeping Marine Animals and Plants Alive in Unchanged Sea-water,” in which he explained that for eleven months he had kept marine animals alive in what he called an “aquarium,” by also keeping live plants with the animals and placing it in adequate light. With slight changes, he reprinted the article as an appendix to *A Naturalist’s Rambles on the Devonshire Coast* (1853:228–234). Also in 1853 Gosse published with his wife *Seaside Pleasures*, though it appeared anonymously (Freeman and Wertheimer 1980:46–47). In 1854 he published *The Aquarium: An Unveiling of the Wonders of the Deep*, with five colored plates, and it became one of his most popular books (Brunner 2005:35–37). There were a few earlier examples of naturalists keeping aquatic animals in tanks, beginning in 1830 (Rehbock 1980, Brunner 2005:28–50), and there had been four popular works on seaside life published in England between 1835 and 1849 that “bore feeble comparison to Gosse’s volumes” (Freeman and Wertheimer 1980:5). Gosse provided in his books the first marine environmental pictures in color. His readers nevertheless complained they could not identify what they captured and kept in their aquaria, and therefore he published a *Manual of Marine Zoology* (two volumes, 1855–1856), with almost 700 illustrations. It had the first comprehensive list of the British marine fauna (Freeman and Wertheimer 1980:51, Thwaite 2002:182). He also contributed a steady stream
Fig. 8. Starfish. Gosse 1854.
of scientific and popular articles to natural history and scientific society journals, 1841–1888, and he was a member of the Entomological Society, Linnean Society, Microscopical Society, and Royal Society—all of London (Freeman and Wertheimer 1980:14–15). His good fortunes ended in 1857, with the death of his wife and publication of his Omphalos: An Attempt to Untie the Geological Knot, which attacked the uniformitarian theory of Charles Lyell’s Principles of Geology (1830–1833 and later editions) and the evolutionary theory of Robert Chambers’ (anonymous) Vestiges of the Natural History of Creation (1844 and later editions). Omphalos was unfavorably received by both naturalists and the public (Gould 1985:100–112, Croft 2000:157–172, Thwaite 2002:204–227). Disappointed, he moved from London to St. Marychurch, where he lived the rest of his life.

There he wrote and profusely illustrated in color his great scientific monograph on sea-anemones, Actinologia Britannica (1858–1860). And his popular works continued to appear for the rest of his life, as did some scientific works. He thought his long esoteric article, “On the Clasping-organs to Generation in Certain Groups of the Lepidoptera” (read 1882) provided evidence for the overthrow of Darwin’s
Fig. 10. Sea-anemones. Gosse 1858–1860.
Contributions

theory of evolution. Here is a statement that he wanted to include in the published version, but Thomas
Henry Huxley convinced him it was inappropriate (quoted from Thwaite 2002:315–316)

Can these [species] be descended from a common parentage? And are the diversities merely
the result of changes in the climate, soil and food produced on a party of emigrants, in the course
of many generations? Or are they not, rather, powerful, if unexpected witnesses to the primal
diversity of Papilio niveus and Papilio bromius as distinct creations of the Almighty God?

Gosse’s published article (1883) contained no discussion of evolution; he remembered the reception
given Omphalos.

These two very different English naturalists were equally devoted to studying and publishing their
discoveries about marine fauna. Their scientific work pioneered new subjects and found receptive
audiences. Although Forbes and others had contributed to making an interest in seashore life into a
middle-class fad, most of the credit for that goes to Gosse (Allen 1978:136–137, Barber 1980:239–
250, Merrill 1989:190–214, Lightman 2007:1). Over three dozen books made Gosse probably the most
popular author on natural history during the 1800s (Stageman 1955, Freeman and Wertheimer 1980,
Thwaite 2002:1). Visiting public aquaria became very popular among the British people in the 1870s
(Fyne and Lightman 2007:11). Forbes and Gosse, each in his own way, led British naturalists to establish
a flourishing marine biology movement that was an example for the rest of the world.

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