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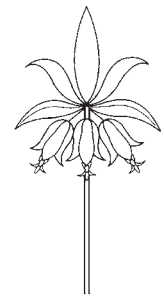

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Graphic developments: Lichen illustration in scientific publications, 1679–1900

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Abstract

The earliest naturalistic figures of lichens appeared in herbals of the mid-16th century. Those woodcuts convey little of a small-scale nature, and it was not until 50 years later that the art of engraving on copper was employed to render fine botanical detail; that procedure and its sister process, etching, largely prevailed during the following two centuries. Lichen morphology was first closely depicted in the late 1670s, at which time microscopical investigation of the group was also initiated. Though the 18th century produced very few botanists with the initiative, or opportunity, to apply microscopy to the study of lichens, some commendable drawings of reproductive and vegetative anatomy — revealing basic compositional aspects of those organisms — were published. Skillful figures of entire thalli began to appear in the closing years of the century when floristic interests ensured that national floras then in course of publication included good lichen coverage. At much the same time there was a distinct falling off in the quality of microscopical illustration, a decline not reversed until achromatic microscopes became available in the late 1820s. Ascospores then came under scrutiny for their taxonomic potential and were, on occasion, extensively depicted. By this time lithographic procedures were being widely employed, and some of the morphological and structural diagrams of lichens so produced display considerable artistry. When, in the late 1860s, lichens were recognized as organisms consisting of algae and fungi, several genera of the former were soon identified and confirmatory figures published; depiction of the latter was largely in the context of ascocarp ontogeny. While lichen illustrations had up to this point appeared almost exclusively in European books and journals, representations of thalli, sections and ascospores were published for the first time in New Zealand during the 1870s, with Australia following a decade later. But these developments were to be short-lived because there, as elsewhere, the camera would soon replace the craftsman for the purposes of scientific illustration.

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Introduction

Though a common and often conspicuous feature of the environment, lichens rarely appear in landscape studies. A comprehensive survey by Behling (1967) of plant portrayal in an area of medieval painting records few works that give prominence to lichens (pp. 119, 125, 154), and Schöller (1997, pp. 206–211) reveals the scant notice paid them by artists of subsequent centuries. On the other hand, lichens have been extensively portrayed in specialist books and journals.

The earliest printed illustrations of plants are found in herbals dating from the last quarter of the 15th century, but the figures in those inventories of materia medica are, for the most part, little more than "symmetrical, schematized, structurally ambiguous decorations to the text" (Reeds 1991, p. 31); it was not until the 1530s that herbals offering authentic depictions of the organisms treated — mainly spermatophytes — began to appear. Lichens make but a poor showing in those compendia because few species were reputed to possess curative properties. Foremost among these was *Lobaria pulmonaria*, then widely prescribed in the treatment of respiratory conditions by virtue of its vaguely lung-like cortex; a fine illustration of that species was published by Fuchs (1542, p. 637). In fact, however, the only lichen then in use that has any real beneficial effect is *Cetraria islandica*, which seems to have been first portrayed in Mattioli (1586, p. 783) though not, it may be said, with anything like the skill of Fuchs' artists. Because figures in

publications of this period were printed from woodblocks, they include little by way of fine detail, a shortcoming not remedied until metal engraving and etching became the procedures of choice late in the 16th century; in the case of lichens, metal engraving was not employed until more than 70 years after Columna ([1606–]1616, 1:330–335; 2:83–84) published the earliest etched figures.[1]

Ventures into magnification

Marcello Malpighi (1628–1694), professor of medicine at the University of Bologna, is best remembered for his work concerning the capillary network linking arteries and veins, but to botanists he is known principally for the fundamental contributions detailed in his *Anatome Plantarum* (1675–1679). The engravings for that work were prepared from drawings by Malpighi, and, as remarked by Arber (1942, pp. 14–15), "[w]e cannot but wish that it were now possible to see the originals, which, in the case of the second volume, are described in the Royal Society's records as 'a great number of… delineations most curiously drawn with distinction of black and red for the better explanation'; but we have to be content with the reproductions of them, which have probably lost a good deal in being copied without Malpighi's supervision." Two lichens, representing the genera *Cladonia* and *Parmelia s. str.*, are discussed in that second volume (pp. 63–64). Here Malpighi drew attention to the presence on his *Parmelia* material of small cortical fissures containing grey particles ("cinerei globuli") that he regarded as possibly representing seeds ("semina"); his corresponding illustration (see Fig. 1A, M) is very likely the earliest of the structure now known as a soralium. However, since Malpighi also reported the presence of coralloid outgrowths, now termed isidia, he would appear to have been dealing with two separate species: possibly, to judge from the morphological detail in evidence, *P. saxatilis* and *P. sulcata*. Both the *Cladonia* (see Fig. 1B) and *Parmelia* thalli are shown well fertile, and it is a measure of Malpighi's acumen that he should have referred to their fruit bodies — designated C, K and L on his diagrams — as "fungi" (p. 63).

Fifteen years later, fruit bodies were again depicted when Joseph de Tournefort (1656–1708), professor of botany at the Jardin du Roi, made their morphology the basis of his new genus *Lichen* (1694, 1:437); the engravings in question (see Fig. 2) are among several hundred prepared by the French artist Claude Aubriet (1665–1742) for Tournefort's *Elemens de Botanique*, the first work to which Aubriet contributed (Duprat 1964, p. 456).[2] Tournefort reports (p. 438) that the concave bodies labelled B–D are filled with a very fine dust that seemingly functions as seed "because this dust viewed under the microscope appears much as shown at E."[3] Krempelhuber (1867–1872, 1:29, n. 104) and Smith (1921, p. 155) construed this statement as evidence of Tournefort's having seen ascospores, though whether or not he did is open to question: the discs figured at B and C are sessile ascomata of, respectively, *Ramalina fraxinea* and *Anaptychia ciliaris*, but D is a chalice-shaped, carpogenic structure — comprising a stalk (podetium) and a cup (scyphus) — peculiar to the genus *Cladonia*. *A. ciliaris* and *R. fraxinea* ascomata are not filled with fine dust, but the scyphi of numerous *Cladonia* species produce minute asexual propagules (soredia) that may be described as such. If Tournefort had been looking at soredia under his microscope, he would have seen spherical, algal unicells similar to the roundlets displayed at E; if, on the other hand, he had been viewing ascospores released by either *A. ciliaris* or *R. fraxinea*, he would have seen unmistakably oblong cells and possibly observed them to be uniseptate.

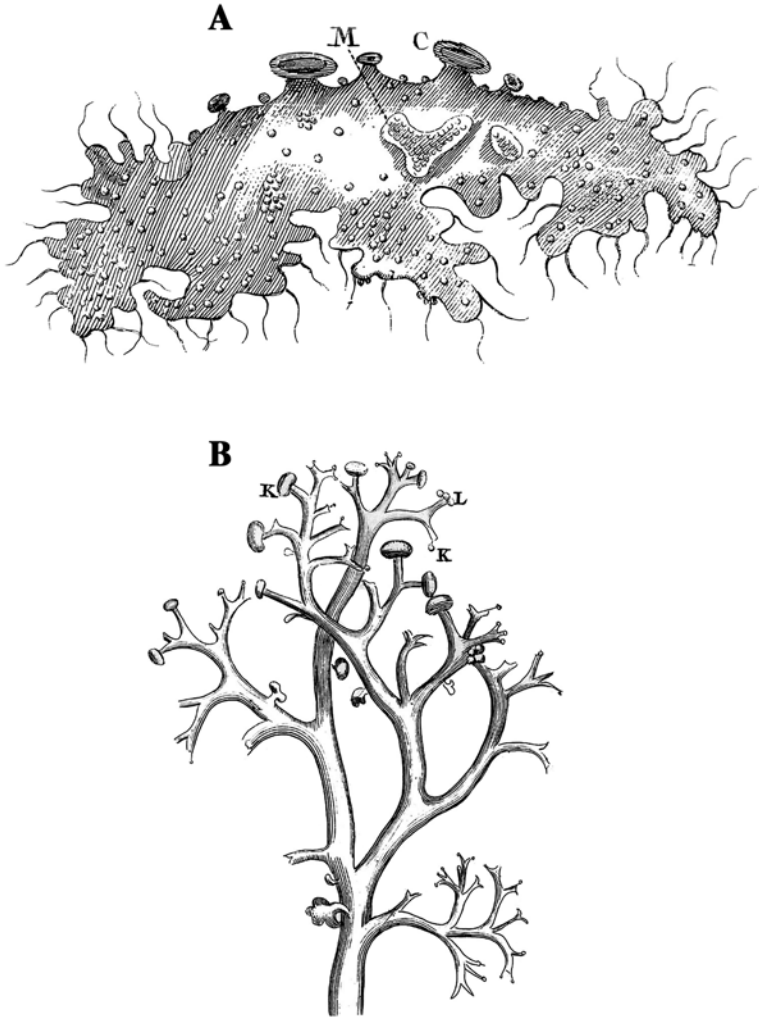


Figure 1. *A*: *Parmelia* cf. *sulcata*, cortical features; *B*: *Cladonia* sp., habit. (From Malpighi 1687, 2:141.)

The many plant illustrations that appeared over the following 30 years include few lichens. Only one of the 166 plates — together "representing something like 2,000 species" (Vines and Druce 1914, p. lx) — in the third volume of *Plantarum Historiae Universalis Oxoniensis* (1680–1699) by Robert Morison (1620–1683) and Jacob Bobart (1641–1719) is devoted to lichens: the 20 commendable figures that make up its Plate 7 are the work of the Dutch artist Michael Burghers (1650–1721). Similarly, the 1,500 drawings prepared by Jacques Barrelier (1606–1673), a French Dominican, for his account of an extensive collection from southern Europe, include just six lichen species (1714, pls. 1277–1278). A substantial work on the flora of Paris and its environs by Sébastien Vaillant (1669–1722) contains numerous excellent illustrations on 33 plates (1727); these include about 30 lichens (see Fig. 3) and were drawn by Aubriet but not engraved until four years after Vaillant's death when Herman Boerhaave (1668–1738), professor of medicine and botany

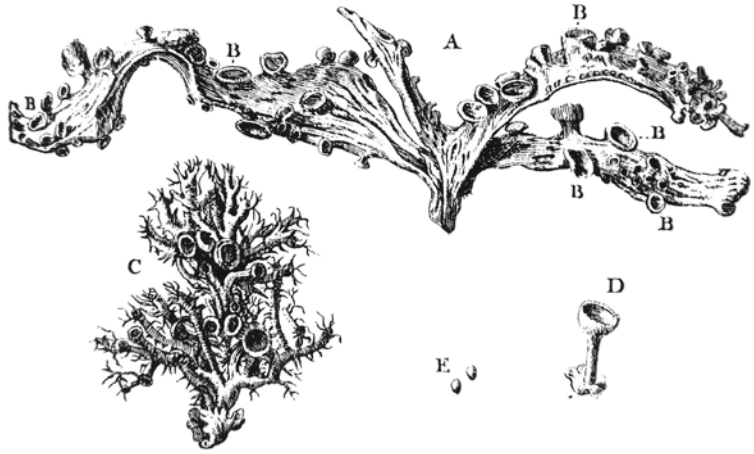


Figure 2. *Anaptychia ciliaris*, *Cladonia* sp. and *Ramalina fraxinea* together with algal unicells, or possibly ascospores. (From Tournefort 1694, pl. 325.)

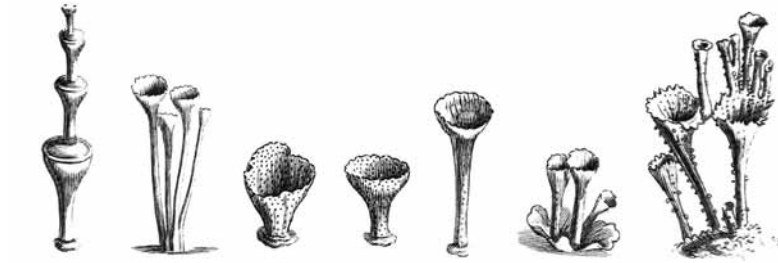


Figure 3. Podetia of *Cladonia* spp. (From Vaillant 1727, pl. 21.)

at the University of Leiden, commissioned his fellow Dutchman Jan Wandelaar (1690–1759) to undertake the work. Mention may also be made of the few lichens represented among the portraits of eastern European plants issued by the German botanist Johann Buxbaum (1693–1730), who may also have been the artist responsible (1728–1740, 2: pls. 5–7). The total of 60-odd lichen illustrations contained in those four publications served to increase early awareness of morphological variation in the group but otherwise contributed little of consequence because all were prepared without benefit of the microscope.

That instrument was soon to be ably employed, however, by the Florentine botanist Pier Micheli (1679–1737) in a discerning study of organisms ranging from algae to spermatophytes; his work, published in 1729, includes 108 plates engraved from drawings by the author.[4] Lichens appear in 21 of those plates, three of which (36, 52, 56) merit particular attention for their depiction of sectioned ascomata and ascospores (see Fig. 4A). His Plate 52 also provides the earliest illustration of a crustose thallus (*Ochrolechia* sp.), and Plate 46 is similarly of note as the first to represent the tufted cephalodia ("*Dendriscocaulon umhausense*") characteristic of *Lobaria amplissima* (see Fig. 4B). In the event, Micheli's concern with detailed investigation proved little more than a false dawn—further microscopical figures of lichens were not published until almost a half century after his

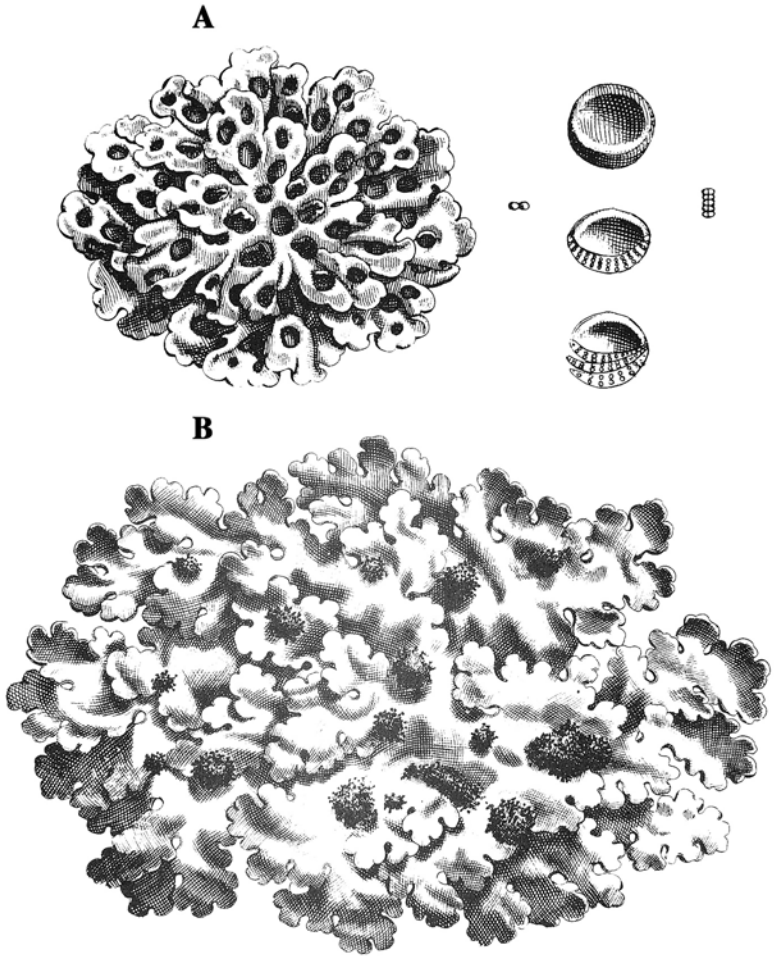


Figure 4. *A*: *Solorina saccata*, habit, ascomata and spores; *B*: *Lobaria amplissima*, habit and cephalodia. (From Micheli 1729, pls. 46, 52.)

death. That period is nonetheless noteworthy for the copiously illustrated *Historia Muscorum* published by Johann Dillenius (1687–1747) in 1742. A native of Darmstadt, Dillenius became professor of botany at Oxford University where he took a particular interest in cryptogamic plants. Lichens, which Dillenius believed to have an affinity with bryophytes, feature prominently in the *Historia*, to the extent that almost a third of the volume's 85 rather crowded plates, all drawn and etched by Dillenius, depict taxa assigned to his genera *Coralloides*, *Lichenastrum* and *Usnea*.[5]

Stylistic diversity

Several highly rated publications from the last decades of the 18th century owe their standing in no small degree to the artistry of Johann Capieux (1748–1813). The two plates he contributed to *Tentamen Historiae Lichenum* (1782) by Carl Hagen (1749–1829), a German physician, include a delicate portrayal of *Cladonia botrytes*. The lichen illustrations provided by Capieux for works by the Austrian cryptogamist Johann Hedwig (1730–1799) are less subtle, a reflection perhaps of their having

been prepared from the author's drawings in what was, at times, an uneasy alliance (Nissen 1966, pp. 198–199); those illustrations include the earliest detailed diagram of a soralium (see Fig. 5A) and an anatomical study of *Endocarpon pusillum* (see Fig. 5B). Hedwig was, however, alone at this time in applying microscopical technique to the study of lichens.[6] An elaborate work published by Hedwig's near contemporary Georg Hoffmann (1760–1826), then professor of botany at Göttingen University, contains 72 elegant plates composed mainly of his own drawings engraved by Capieux (see Fig. 6), but, apart from one slightly magnified section of a *Mycoblastus sanguinarius* apothecium (1790–1801, 2: pl. 41), these lack detail. That Hoffmann was conscious of this shortcoming is evident from his preface (1:iii) in which he is at pains to explain how aesthetic and financial considerations decided him to forgo anatomical particulars. Such are also wanting in the fine lichen portraits distributed over the four volumes of text and engravings issued by Nicolaus Jacquin (1727–1817) between 1786 and 1790.

In a study of microscopical illustration in relation to entomology, Lehmann-Haupt (1973, p. 488) noted that "the artistic refinement of seventeenth and eighteenth century microscopic images gives way, at the turn of the nineteenth century, to a more matter of fact, even trivial style of delineation," an observation equally true of lichenology. The genus *Lichen* had been in service for just over a century when the Swedish botanist Erik Acharius (1757–1819) introduced groupings based on the growth form of the many species it then accommodated (1799); he subsequently replaced the old collective name with a range of new genera (1803). Acharius illustrated those works with plates — for many of which he is also known to have undertaken the coloring (Kärnefelt and Thell 2007, pp. 68–69) — of about 50 crustose and foliose taxa but included no fine detail. The German botanist Kurt

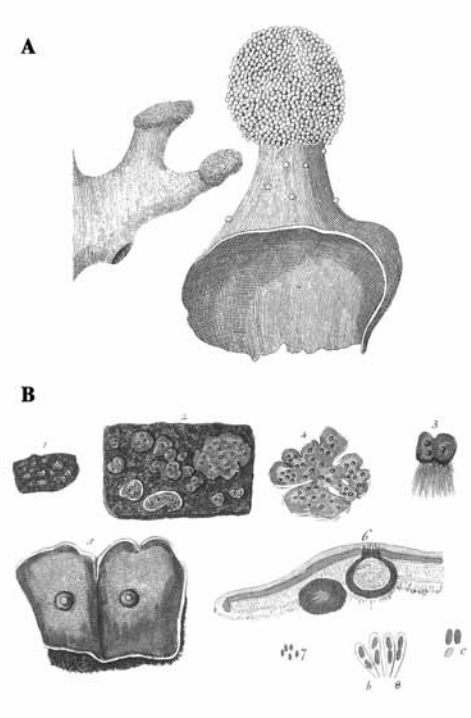


Figure 5. *A*: *Hypogymnia tubulosa*, soraliate lobes and soredia. (From Hedwig 1784, pl. 31); *B*: *Endocarpon pusillum*, habit and reproductive anatomy. (From Hedwig 1787–1797, 2: pl. 20.)

Sprengel (1766–1833) was somewhat more enterprising in the lichen section of a work on cryptogamic botany (1802–1804, 3:321–374): of his ten plates, all engraved by David Hoppe (1760–1846), three (8–10) include lichens, and, while capably done as far as habit is concerned, these fall well short of earlier work in the area of anatomical representation. Acharius made further key contributions to the development of systematics in *Lichenographia Universalis* (1810), which remained a primary work of reference for 50 years. He himself illustrated the volume with 14 plates of figures extending from morphological features of the thallus to moderately magnified ascomatal sections, but the execution of those figures leaves a good deal to be desired, and it is difficult to disagree with Krempelhuber's description of them as somewhat crude ("ziemlich roh"; 1867–1872, 1:111, n. 386)

Acharius' publications stimulated widespread interest in lichen identification, and engravings of numerous species were provided in such national surveys as the *Flora Danica* of Oeder et al. (1762–1883) and Smith and Sowerby's *English Botany* (1790–1814). New World lichens were well portrayed in 1811 when the Swedish botanist Olof Swartz (1760–1818) published the first, and only, fascicle of a projected report on collections made between 1783 and 1786 during a voyage that took him to "North America, Cuba, Haiti, Puerto Rico and the north eastern coast of South America" (Arvidsson 1999, p. 28); its eight plates, engraved by Jacob Sturm (1771–1848), do not run to anatomical detail. In that regard, what may be the earliest lichen illustration to appear in North America scores little better: the engraving published by John Torrey (1796–1873), then a New York City physician, in connection with his description of *Usnea fasciata* includes only a rudimentary sketch of a section through one of the gall-like bodies characteristic of that species (1823; see Fig. 7).

The technique of lithography—a German innovation of the late 1790s—was now finding widespread acceptance because that procedure enabled the artist to work more quickly than allowed by engraving and the result was cheaper to print. The earliest lichenological publication so illustrated appears to be the study made by Dominique Delise (1780–1841), a French army officer, of the foliose genus *Sticta* (1825); the work comprises a volume of text and an "Atlas" containing 18 impressive plates of figures drawn by various hands and lithographed by J.(?) Langlumé (fl.1820s), though no magnification was employed in their preparation. By the late 1820s, however, optical problems that had seriously limited the appeal of microscopical research had largely been resolved. Among the first lichenologists to employ the improved instrument was Antoine Fée, professor of natural history at Strasbourg, for whom ascospores were a particular interest; he had originally worked as an apothecary, and his observations on spores occur in the second part of a well-illustrated study of cryptogams

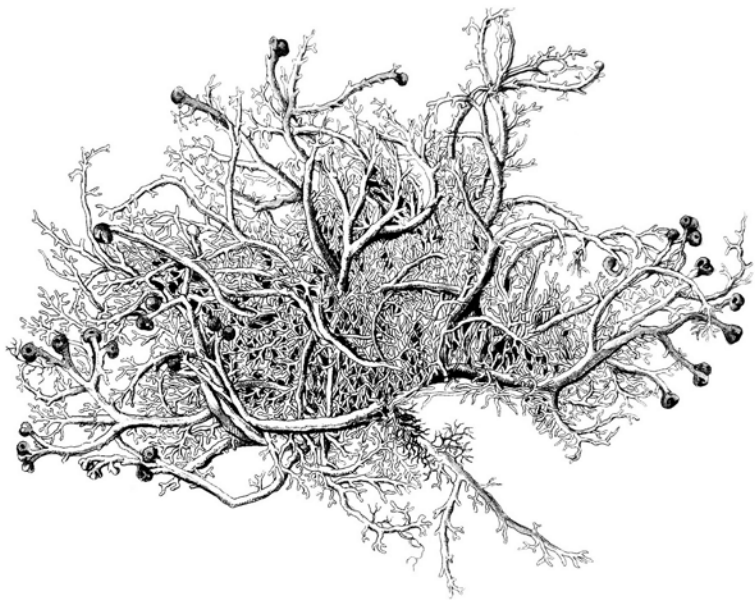


Figure 6. *Sphaerophorus globosus*, habit. (From Hoffmann 1790–1801, 2: pl. 31.)

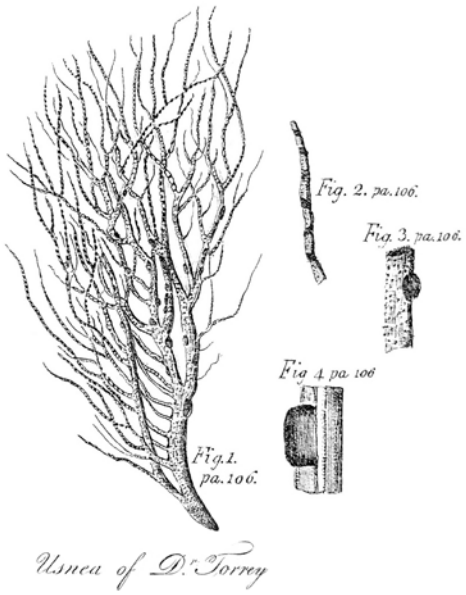


Figure 7. *Usnea fasciata*, habit. (From Torrey 1823, pl. 9.)

associated with cinchona and other species of medicinal value (1824–1837). The first volume contains 33 plates of actual-size drawings by Antoine Poiteau (1766–1854)—engraved by various hands—while the second has nine plates lithographed by Emil Simon (fl.1830s), the last five of which provide several hundred ascospore sketches attributed to the author (see Fig. 8).[7] Fée's influence can be discerned in the drawings produced by Buhse (1846), and his work also prompted Notaris (1846) to introduce several genera based on spore properties.

Other contemporary researchers chose to interest themselves in fruit body anatomy: Holle (1849) published diagrams that merit attention for offering the earliest accurate delineation of paraphyses from lichen material, and Leighton (1851) provided numerous ascomatal sections of British and Irish perithecate taxa on 30 poorly lithographed plates.[8] Quite a different standard was in evidence when the French mycologist Louis-René Tulasne (1815–1885) published his painstaking study of lichen structure (1852): many of its illustrations—drawn by Tulasne's brother Charles (1816–1884) and engraved by a variety of hands—display a blend of artistry and microscopical expertise that contributed in no small degree to the work's widespread influence. The elder Tulasne had taken a particular interest in lichen reproduction, and his brother's portrayals of a sectioned apothecium and germinating ascospores are admirably observed (see Fig. 9). The taxonomic importance of ascospores was now widely accepted: beginning in 1852 the Veronese botanist Abramo Massalongo (1824–1866) issued a series of publications—some illustrated (e.g., 1852, 1853)—in which he created a multiplicity of genera, many of which have proved ephemeral, while the German physician Philipp Hepp (1797–1867), then living in Zürich, published careful illustrations of spores representing almost 1,000 taxa in the years from 1853 to 1867.[9] However, not all lichen systematists active at the time endorsed this emphasis on the spore, a circumstance that resulted in the emergence of two overtly hostile schools of taxonomic thought.

Meanwhile the influence of the Tulasnes' text and plates was becoming apparent in the papers and illustrations of such botanists as Speerschneider (1854) and Lindsay (1859), the latter of whom figured the pycnidia and conidia of several hundred European and exotic taxa; others, however, cultivated individual styles that tended, on occasion, to the baroque (see Fig. 10). Until the early 1860s, continued adherence to the Acharian contention that lichens are autonomous plants had very largely restricted progress in lichen research to the areas of structure and systematics[10]—any meaningful investigation of their physiology being effectively precluded. A questioning of that contention had, however, been brewing for some time, and lichens soon came to be viewed in an altogether novel light.

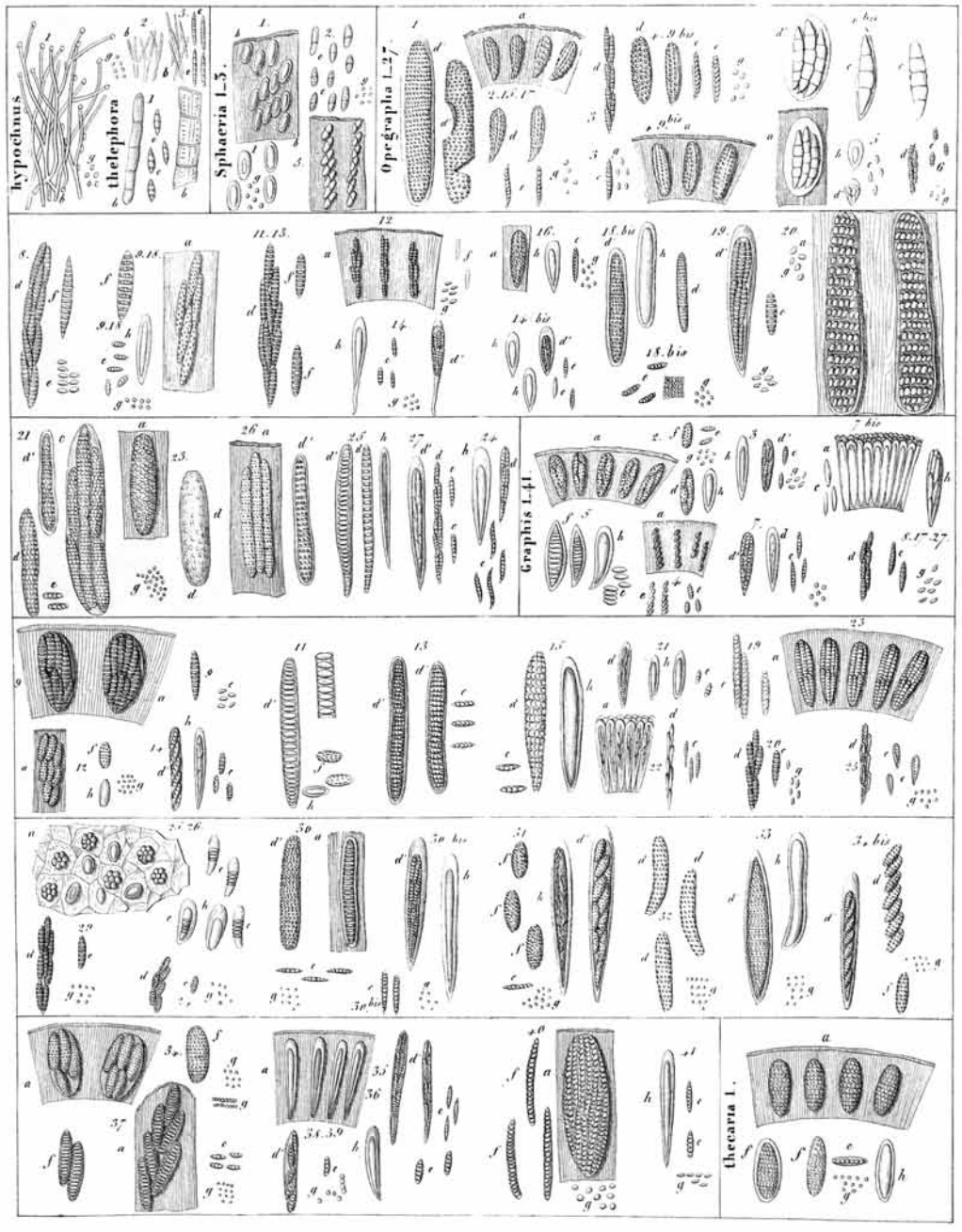


Figure 8. Ascospores of several lirellate genera. (From Fée 1824–1837, 2: pl. 39.)

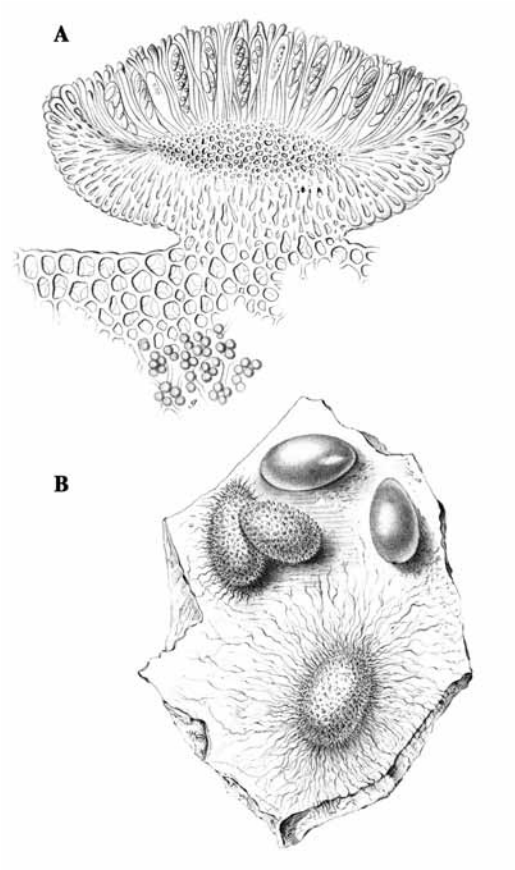


Figure 9. *A*: *Scutula miliaris*, v. s. of apothecium; *B*: *Ochrolechia parella*, spores. (From Tulasne 1852, pls. 14, 16.)

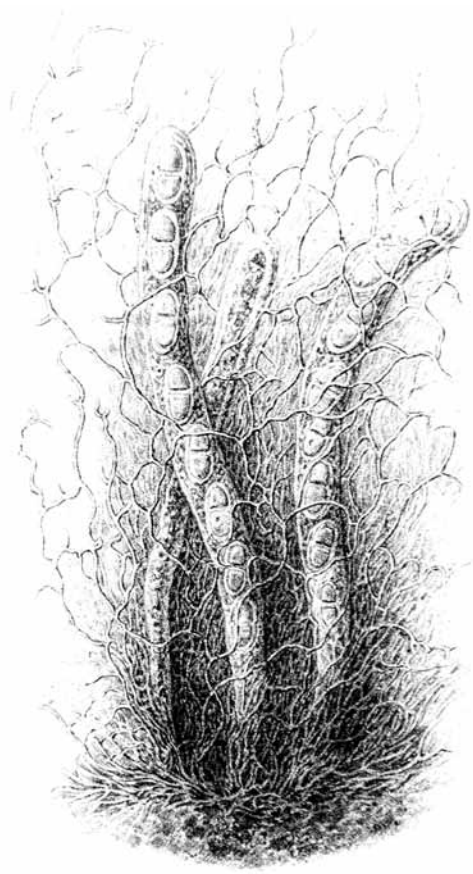


Figure 10. *Acrocordia conoidea*, asci and anastomosed paraphysoids. (From Garovaglio 1864–1868, 2: pl. 4.)

Emergence of a fresh perspective

For 40 years onward from the 1820s, lichenologists by and large had believed the green constituents of a lichen thallus to be reproductive bodies. This belief arose because the green cells were seen to correspond to those of soredia (Fig. 3), which had long been correctly understood as agents of dispersal. The correspondence between lichens' green cells and certain microalgae had also been noted by several workers, but conventional wisdom prevented the logical conclusion being drawn. Finally, further evidence of identity led Anton de Bary (1831–1888), professor of botany at the University of Freiburg, to air the possibility (1866, p. 291) that rather than being autonomous plants, gelatinous lichens were to be individually construed as the union of an alga and an ascomycete. Simon Schwendener (1829–1919), then at the University of Basel, realized that de Bary's suggestion could apply to all lichens and, having advanced this hypothesis, went on (1869) to assign the green cells of several lichens to algal genera; the three plates of *in situ* and isolated algae contained in that work (see Fig. 11) were drawn by the author and lithographed by C. Laue (fl.1860s).[11]

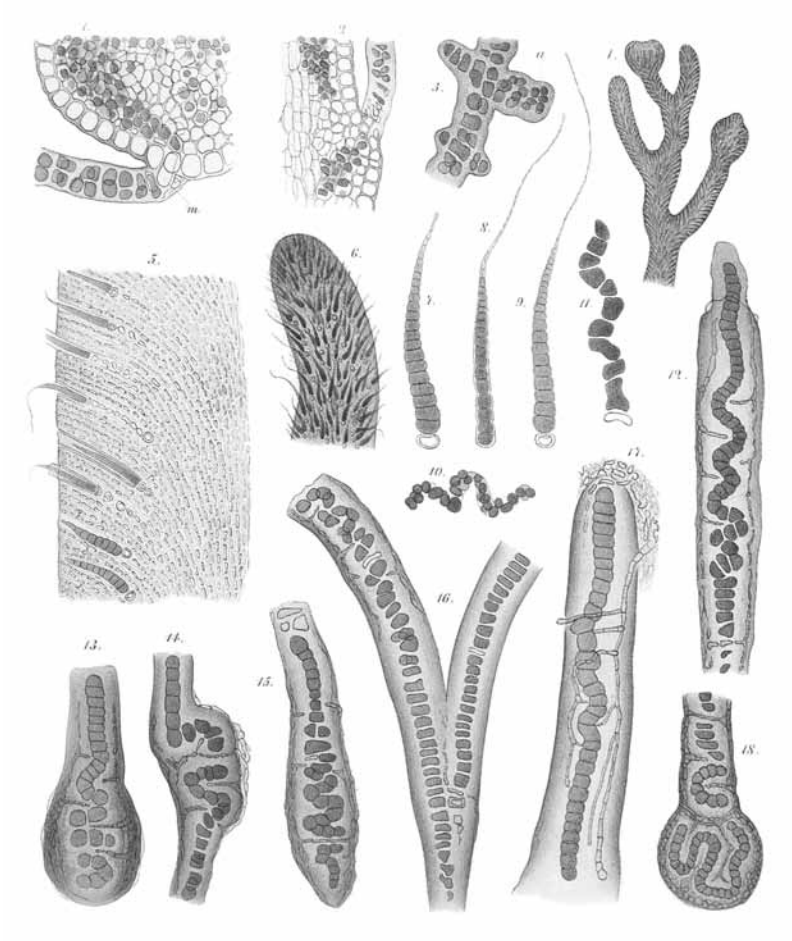


Figure 11. Cyanoprokaryote constituents of *Polychidium muscicola* (1–3), *Lichina confinis* (4–10) and *Placynthium* sp. (11–18). (From Schwendener 1869, pl. 1.)

Up to this point, depiction of lichen anatomy had remained in the hands of European botanists, a circumstance that changed — though not artistically for the better — when the Massachusetts newspaper editor Henry Willey (1824–1907) published a short paper (1871) incorporating 15 scraperboard diagrams of sectioned thalli, ascocarps and pycnidia.[12] Willey was among those who remained unwilling to accept the new interpretation of lichens' green cells, even when the artificial synthesis of a *Collema* thallus was announced and recorded in carefully prepared diagrams by Reess (1872). This achievement was soon followed by a report from the French phycologist Edouard Bornet (1828–1911) on his, inevitably unsuccessful, attempt to synthesize a heteromerous thallus by sowing lichen ascospores on colonies of *Desmococcus olivaceus* (1873). That paper does, however, detail Bornet's notable identification of the algae occurring in 60 lichen genera, and its 11 fine, engraved, plates include the earliest figures of green algal cells encountering invasive hyphae from germinating spores (see Fig. 12). Also at about this time, the first lichen illustrations to appear outside Europe and the United States were published in New Zealand

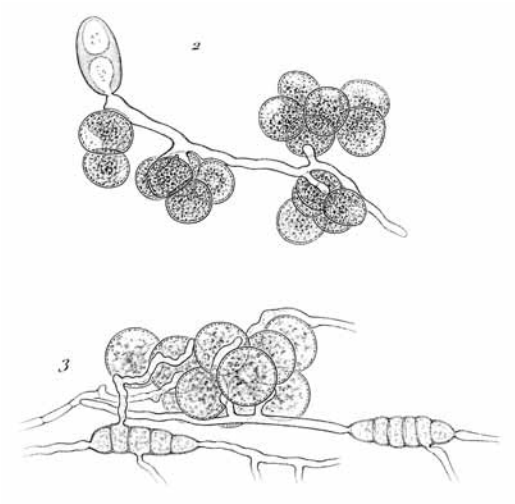
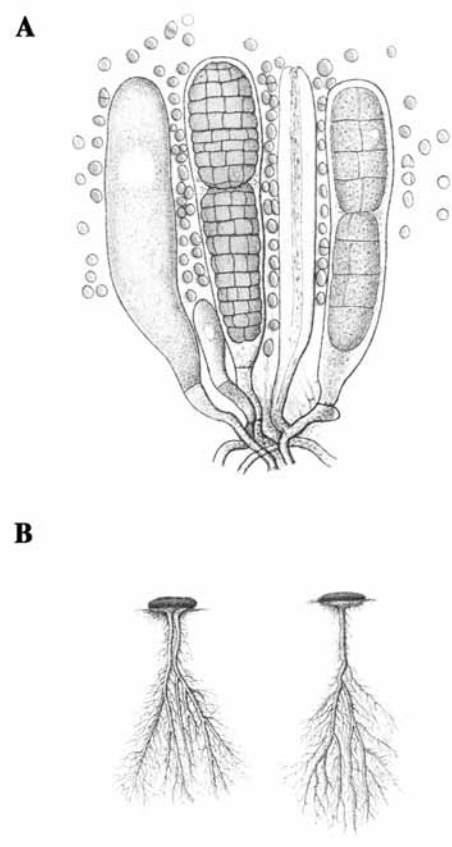


Figure 12. *Above*, Hyphae from germinating spores of *Xanthoria parietina* (2) and *Myxobilimbia sabuletorum* (3) invading green algal cells. (From Bornet 1873, pl. 10.)

Figure 13. *Right*, *Endocarpon pusillum*, *A*: asci, spores and hymenial algae; *B*: synthesized thalli. (From Stahl 1877, 2: pls. 5, 6.)

by Charles Knight (1808–1891), surgeon and government official; his lithographed drawings include ascomatal sections and spores of 20 taxa (1875).[13]

Despite all these depictions and developments, the notion that parasitic associations between microorganisms have the capacity to generate such conspicuous and durable plants as lichens continued to be at best conjectural in the eyes of many. Soon, however, Ernst Stahl (1848–1919), a native of Alsace, produced empirical evidence that convinced all but a scattering of diehards. Working under the direction of de Bary, who had moved to Strasbourg in 1872,[14] Stahl's assignment was the then unrealized spore-to-spore synthesis of a lichen, and to this end he concerned himself principally with *Endocarpon pusillum* (see Fig. 5B), one of the few species whose ascomata house algal cells adapted to joint dispersal with the spores (see Fig. 13A). Stahl germinated the alga and spore combinations (1877, 2:15) and succeeded in raising minute thalli (see Fig. 13B) that produced mature perithecia and pycnidia, neither of which he chose to illustrate.[15] At this time, ascomycetes were the only fungi known to form lichens, but within a few years Oreste Mattirolo (1856–1947), a native of Turin, also working at Strasbourg under de Bary's direction, recognized the fungal components of *Cora* (*Dictyonema*) spp. as basidiomycetes; Mattirolo's capable sketches (1881, pls. 7–8) have been reproduced on several occasions, e.g., Smith (1921, p. 152).



Thalli could now be understood as structures elaborated by fungi whose variously, and sometimes extensively, modified hyphae are a response to nutritional dependence on particular algae. The hyphae of more than 500 lichen taxa have the capacity to form a secondary alliance with an alga other than that of the parent thallus, a condition that results in the formation of morphologically diverse bodies termed cephalodia (Fig. 4B). These structures were comprehensively studied by the Swedish botanist Karl Forssell (1856–1898) whose report (1883) includes a carefully observed diagram of a sectioned *Lobaria amplissima* cephalodium (see Fig. 14).

Of the few lichenologists active during the last decade of the century, most were systematists and their publications offer little by way of illustration. A sprinkling of other topics did, however, receive attention in Germany and the United States. At Harvard University, William Sturgis (1862–1942) undertook an extensive anatomical study of material belonging to ten genera; his report (1890) has eight lithographed plates, the seventh of which includes an interesting sketch of ascocarp development in *Lempholemma polyanthes*. Gustav Krabbe (1855–1895), a lecturer at the University of Berlin, demonstrated in a thorough and impressively illustrated account of thallus development in the genus *Cladonia* (1891) that the podetia characteristic of that family (see Figs. 1B and 3) are not of vegetative origin but develop from ascocarp primordia in the basal squamules. A series of papers on the comparative morphology of lichens published between 1894 and 1896 by Johannes Reinke (1849–1931), professor of botany at the University of Kiel, contains over 200 drawings representing whole and sectioned thalli, ascomata and pycnidia; many of these, the work of an artist known to us only by the surname "Fürst," were reproduced by Zahlbruckner (1903–1908, 1926).[16] Much of the information available at the mid-1890s on the subject of lichenology was ably summarized by Albert Schneider (1863–1928) in a textbook (1897) prepared during his tenure of a fellowship at Columbia University. Over half of that work is devoted to "[d]escriptions of the families and genera occurring in the northeastern United States" (p. 108), descriptions that include numerous original observations on reproductive and vegetative anatomy; according to Schneider (p. viii), the careful drawings supporting those observations (see Fig. 15) "were made by Mr. F. Emil," an artist now almost as invisible as his contemporary Fürst.

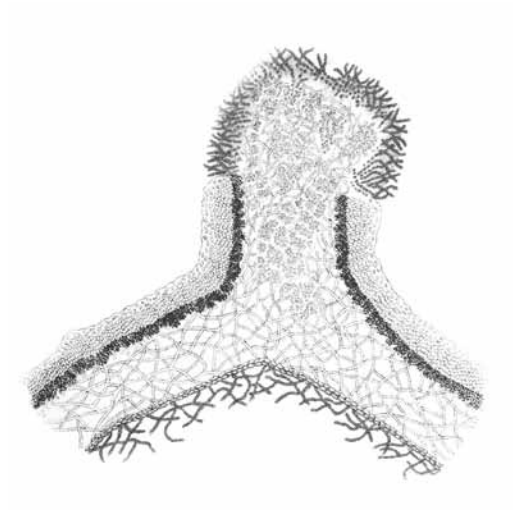


Figure 14. *Lobaria amplissima*, v. s. of cephalodium. (From Forssell 1883, pl. 1.)

The obscurity that overtook Emil and Fürst came in the wake of tehnological developments that made manual illustration all but obsolete in the area of scientific publishing; theirs were the last lichen drawings of note to appear before the century's end, by which time, as Blunt and Stearn (1994, p. 268) observed, "the photographer had driven the artist from the field."

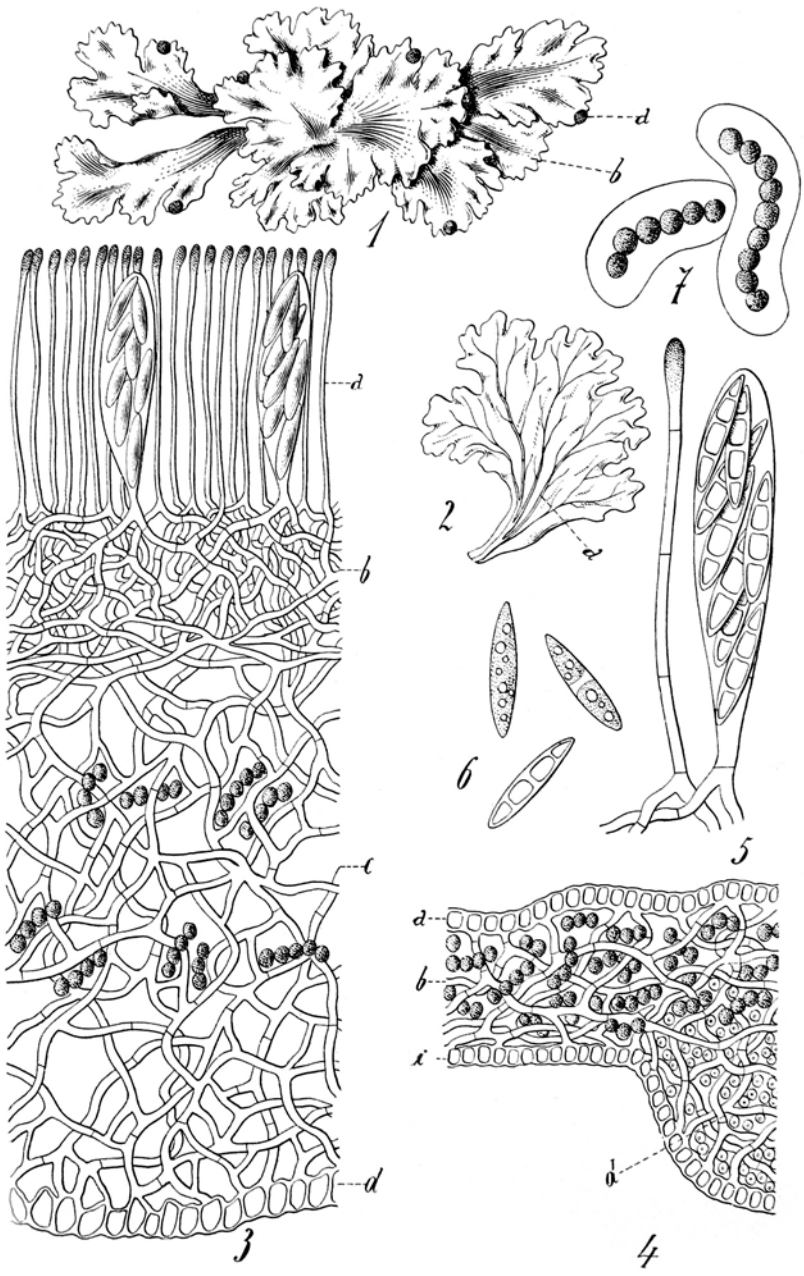


Figure 15. *Hydrothyria venosa*, habit and anatomy. (From Schneider 1897, pl. 64.)

Acknowledgments

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The figures were prepared by Mr. T. Keady, Galway, to whom I am also much indebted.

Notes

1. Most of the lichen woodcuts in Parkinson (1640, pp. 1308–1315) are reproduced from Columna.
2. Tournefort was reported to have trained Aubriet in "that scientific exactness which was to be one of the characteristic traits of his talent" (Calmann 1977, p. 35).
3. "…car cette poussiere vûe avec le microscope paroît à peu près telle qu'on l'a representée en E."
4. Hawksworth (1976, p. [5]) claimed that "Micheli was the first author to employ a microscope in the study of cryptogams," but this is to overlook, for instance, Malpighi's illustrated description of a moss protonema and that of Tournefort respecting *Ophioglossum* spores.
5. In the Dillenian system *Lichen* accommodated hepatics.
6. Though Christiaan Persoon (1761–1836) made occasional mention of having observed structures under relatively high magnification (e.g., 1794, p. 3), "he made more use of a hand lens than a microscope" (Ainsworth 1976, p. 258); in a letter cited by Roumeguère (1874, p. 201, fn.), Antoine Fée (1789–1874) remarked "poor Persoon had neither microscope nor lens, he used a piece of glass as a magnifier. I gave him his first lens!" ("Le pauvre Persoon n'avait ni microscope ni loupe, il s'aidait d'un fragment de verre amplfiant. Je lui ai donné sa première loupe!").
7. Hale (1984, p. 12) refers to "Eschweiler (1824) and Fée (1824)…using the microscope to examine spores for the first time," but Fée's observations did not extend to spores in that publication.
8. While Leighton's work was a valuable contribution to contemporary taxonomy, the quality of its plates—on a par with those of Dietrich (1833–1837)—evidently had a drastic effect on sales (Curle 1954, p. 81).
9. Microscopes were by now readily available and at competitive prices—interesting data in this regard are given by Lindsay (1856, p. 59 fn.) and Schacht (1854, pp. 279–283).
10. Publications in those areas sometimes carried illustrations, but, with few exceptions—e.g., Schaerer (1850, pls. 1–10), Babington (1855, pls. 122–130), Fries (1858, pls. 7–10), Nylander (1858–1860, 1: pls. 1–8)—these are undistinguished.
11. Schwendener's attention to detail is reflected in his figures, but the quality of these is such that Schneider (1897, p. 22) was largely justified in remarking "[n]ot much can be said in favor of the illustrations accompanying Schwendener's communications."
12. The same technique was employed, and to rather better effect, by Willey (1887, pls. 1–10). Another unconventionally illustrated work was published by Kummer (1874): Saunders (1995, p. 141) has noted that "[a] number of writers have used actual specimens to illustrate their books," but the sole such author in the field of lichenology appears to be Kummer, whose plates 1–2 have material of 14 macrospecies attached. Mention may also be made here of two publications featuring nature-printed illustrations: Heufler (1853) and Engel (1856). The former has several, mediocre, images of foliose and fruticose species on two of its seven plates; the latter item, an 11-page journal article, appeared without the figures referred to in its text—constraints specific to nature printing may have precluded their use—but that deficiency was evidently made good in the now elusive offprints, which are described by Krempelhuber (1867–1872, 3:102) as having "2 Tafeln Flechten-Abbildungen mittelst Naturselbstdruck."
13. The same author (1884) was responsible for what is evidently the earliest lichen illustration published in Australia.
14. De Bary's appointment followed Antoine Fée's removal from office in the wake of the Franco-Prussian war and consequent annexation of Alsace-Lorraine.
15. Stahl's results subsequently attracted a certain amount of criticism, but Ahmadjian and Heikkilä (1970)—having achieved the resynthesis of *E. pusillum*—commented "[a]lthough his findings were once doubted, our study, and that of Bertsch & Butin, have confirmed his reports."
16. The only published reference to Fürst appears to be that of Reinke (1925, p. 187) who states that the figures for some of his algal papers were also prepared by Fürst at Kiel Botanical Institute.

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