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THE FERN ALLIES:

A SUPPLEMENT TO THE

FERNS OF GREAT BRITAIN.

ILLUSTRATED BY

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PROPRIETOR OF SOWERBY'S ENGLISH BOTANY.

THE DESCRIPTIONS, SYNONYMS, &c.

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FERN ALLIES.

From the earliest period of botanical arrangement certain vegetable forms, corresponding throughout a greater or lesser number of individuals, have afforded the means of constructing groups styled *genera*, and of associating these genera into larger and, for the most part, equally definite assemblages, that are now, not unaptly in many instances, denominated *natural orders*. The classification of these orders upon similar principles is a desideratum yet so imperfectly attained, that few naturalists agree in their arrangement of them; this is the case even among the higher and most elaborately organized of the phanerogamous plants, in which distinctive and associative points of structure are most readily traceable, in consequence of the greater number of features afforded by the diversified structure and disposition of the parts constituting their flower, fruit, and seed: but the difficulties are greatly enhanced in the cryptogamous or flowerless series, owing not only to the proportional paucity of characters they present for our examination, but to the minuteness and frequently indefinite nature of the organs of fructification or reproduction. Thus, while the structural resemblances between an Elm-tree and a Nettle are universally acknowledged by botanists, and even the gradations of development between these and the Rose, the Thistle, and the Magnolia are capable of demonstration, so far as to justify their arrangement in the same grand division or class of flowering plants —the association of the Fern, the Moss and the Lichen rests entirely upon the assumed absence of flowers, that is, of stamens and

pistil, in all three; in other respects, so great are the differences between them, that they appear to constitute groups as widely separated as is the class in which they are placed, from the rest of the vegetable kingdom.

Certain small families among these flowerless groups, similarly segregated by general aspect and structure as are those above named, have been occasionally classed together under the collective name of "*Fern Allies*," a title for which there is really no foundation, the differences in their mutual organization, whether of growth or reproduction, being equally palpable, as it is opposed to that of the order with which caprice or misconception of the laws of physiological affinity has connected them.

These plants are highly interesting in many points of view, often elegant, and, with slight exception, easily cultivated: and, as two of the principal forms contrast harmoniously with those of the Ferns in plantations of that beautiful tribe, figures and descriptions of the British species have been considered necessary as a supplement to our illustrations of the latter; although, in a structural sense, the so-called alliance is at the best a forced—an unnatural one—and only admissible in a work of the present form for convenience sake, or in compliance with popular arrangement.

The British genera belong to four orders:—

EQUISETACEÆ.

1. Equisetum.

MARSILEACEÆ.

2. Pilularia.

LYCOPODIACEÆ.

3. Isoëtes. 4. Lycopodium.

CHARACEÆ.

5. Chara. 6. Nitella.

EQUISETACEÆ.

Leafless plants, with branched, striated, fistular, jointed stems; the articulations separable, surrounded at the base by a membranaceous toothed sheath. Fructification in terminal cones or spikes, consisting of stalked peltate polygonal scales bearing thecæ on the under surface. Sporules ovate or subglobose, spirally encompassed by elastic, hygrometrical, club-shaped filaments. The order consists of a single genus.

EQUISETUM. Horse-tail.

Gen. Char. The same as that of the order.

The species of this remarkable and most isolated of all the vegetable forms at present extant are few, probably not more than from ten to fifteen, certainly under twenty; but they are widely distributed, growing in moist ground and on the borders of lakes, ditches, and rivers in various parts of the world, from Lapland and Siberia to the countries within the tropics. Their habit is herbaceous, the stems being annually renewed from a creeping rhizoma, although in some instances they retain their vitality for indefinite periods after the cessation of growth. The largest of the European species has a height of five or six feet, but within the tropics one, at least, attains that of fifteen or sixteen. In some instances the rhizoma extends so widely and rapidly beneath the soil as to render them troublesome weeds. The true stems are rigid, rough to the touch, longitudinally striated, and tubular; the principal or central cavity being often surrounded by many smaller ones, and interrupted at intervals by the separable joints. Although destitute of true leaves, each articulation is invested at its base by a toothed membranaceous sheath, apparently formed by the union of several rudimentary verticillate ones; from beneath which, in the greater number of the species, spring whorls of branches, jointed like the stem, similar to it in general structure, and corresponding in number to the teeth of its sheaths and the striæ upon its surface.

The fructification of these plants is occasionally developed on separate stems, which make their appearance previously to those of general growth, and are, ordinarily, unbranched, succulent, and so different in aspect from the others, that the uninitiated observer would find a difficulty in recognizing the species to which it appertains. Under all circumstances the structure of the cones is peculiar, and so nearly alike that the description of one will suffice for

those of the whole genus: the surface, at first smooth or indistinctly reticulated, eventually splits into numerous, generally octagonal, spirally arranged, brownish facets, which, when separated from the rachis, are found to be stalked, and to bear on the under side four or eight pendent sac-like bodies of a whitish hue—these are the thecæ, which open on the inside by a longitudinal slit for the discharge of the sporules—in general form the whole might be fancifully compared to a miniature lady's work-table with several bags. The sporules with their curious club-shaped filamentary appendages have occasioned much speculation regarding their actual nature; the former having been regarded as ovaries or as naked seeds; while the latter, attached to them like stamens around the base of a pistil, have had an office assigned to them analogous to that of those organs in flowering plants, between which and the flowerless the Equisetaceæ have been sometimes regarded as a transitional group. Our space does not admit the discussion of a subject upon which at present opinions are more problematical than plausible. The filaments are attached to one extremity of the sporule, and are rolled spirally around it while moist, but rapidly uncoiling as they become dry, cause the sporule to leap about as though it were alive; these movements, simply hygrometrical, are admirably adapted to aid the dissemination of the plants.

The rigidity of the stems and branches in this interesting tribe is due to the abundance of silica contained in the cuticle, which has been ascertained to amount in some species to as much as thirteen or fourteen per cent.; the ashes of the entire plant yield an average of more than half their weight of that earth, which is disposed in a crystalline form over the whole surface. It is to these crystals that the peculiar roughness is owing, which has acquired for the most common of our indigenous Equiseta, *E. arvense*, the name of Shave-grass, as well as the striated character belonging to the genus generally; which latter is due to their regular arrangement in parallel longitudinal series. In some instances they are so closely set, that the whole of the vegetable fabric may be removed by careful maceration without destroying the form of the part or disturbing their arrangement: the prepared stem of *E. hyemale* furnishes beautiful microscopic objects, especially under the influence of the polarizing apparatus.

The immediate economical value of these plants is trifling: as herbage, they contain little nutritive matter, hence are rarely eaten by cattle unless compelled by hunger or a deficiency of more grateful food. In a medical point of view they are slightly astringent and stimulating, and were formerly esteemed as possessing diuretic qualities, but have long been out of use. The roughness of their crystalline stems renders them useful for several mechanical purposes, as for scouring utensils of wood and metal, and for smooth-

ing the work of the cabinet-maker, turner, and whitesmith previous to the process of polishing; but their employment by the manufacturer declined on the introduction of glass-papers and other contrivances of the kind, more easy of adaptation than these natural files. In their place in the vegetable world, they are important as colonists and contributors to the progressive elevation and fertilization of the soil.

The British species are all amenable to cultivation, and, when once established, easily kept and less liable to suffer from casualties than are many of the Ferns. The admirers of the latter will not fail to appreciate the beautiful contrasts of form which they afford, when carefully grouped among their more familiar and more highly prized, because better known, favourites.

The English name, Horse-tail, and the Latin generic, from *equus*, a horse, and *seta*, a bristle, are characteristic of the general appearance of the branched species.

* *Stems of two kinds: fertile ones simple, succulent, of a brownish hue, appearing in the spring before the sterile ones and soon dying away: sterile ones with whorled branches, harsh, green, remaining throughout the summer.*

EQUISETUM ARVENSE. Corn Horse-tail. Field Horse-tail. TAB. I.

Fertile stems unbranched; their sheaths distant, loose. Sterile stems slightly scabrous, with twelve or fourteen furrows and striæ; teeth of the sheaths lanceolato-subulate; branches simple, erecto-patent. General outline attenuated upwards.

Equisetum arvense, *Linnæus*. *E. B.* 2020. Generally adopted.

The most common British species. Frequent in corn-fields and pastures as well as on road-sides, chiefly, but not exclusively, in low moist ground, and especially where water accumulates during the winter. The fertile stems appear about the end of March, and are from seven to nine inches high, erect, smooth, succulent, of a pale brownish hue, with from three to five distant, furrowed, brown-toothed, somewhat inflated sheaths. Cone about an inch in length, encircled at the base by the membranaceous rudiment of a sheath. The barren stems are either procumbent or ascending, very rarely erect, and vary greatly in length in different soils and exposures, from a few inches to one or two feet; with numerous whorls of slender, generally simple branches, that become gradually shorter upwards, while several of the uppermost joints of the stem being bare, the whole has a somewhat attenuated lanceolate outline; the sheaths of the stem are many-toothed, those of the branches three- or four-toothed only, each tooth long and acute with a rib extending to its point.

The rhizoma of this species extends itself very rapidly beneath the soil at a considerable depth below the surface, and branching in all directions, like that of the Common Brake, *Pteris aquilina*, is very difficult to eradicate; hence it is one of the most troublesome weeds in arable land that the farmer has to contend with. When growing in pastures it is said to be injurious to cows, probably in consequence of the abrasion produced by its siliceous surface; they seem, however, never to eat it unless in the young state, and where the herbage is scanty when they are first turned out in the spring.

The Field Horse-tail is not a very desirable plant to introduce into the Fern Garden or among rock-work, on account of its spreading undergrowth, which is liable to interfere greatly with that of others, and even to destroy them; but as it will grow in almost any kind of soil, and is indifferent to exposure, it may be advantageously employed to cover the sunny side of a bank, or planted about the root of a tree, always taking care that the situation is sufficiently isolated not to admit of its doing mischief. Making all due allowance for its natural habits, which place it in the catalogue of vegetable moles, equally insidious as are the Common Bindweed and the Colts-foot, the rich green hue of its young sterile shoots and the singular parasitic aspect of the earlier fertile ones, render it more worthy of a place in our home collections than many of those exotics that are cherished with equal inconvenience and far inferior claim to notice.

EQUISETUM UMBROSUM. Blunt-topped Horsetail. TAB. II.

Fertile stems unbranched; their sheaths approximate, appressed. Sterile stems scabrous (especially upwards) with prominent points, with about twenty striæ; teeth of the sheaths subulate, appressed; branches erecto-patent, simple. General outline obtuse upwards.

Equisetum umbrosum, *Willdenow. Babington. Moore.* E. Drummondii, *Hooker, E. B. Supp.* 2777.

This species is either very rare in these islands, or otherwise it has been overlooked in consequence of the resemblance of its sterile stems to those of *E. arvense*, the fertile ones, which are very strikingly different to those of the latter plant, being usually scantily produced, and at a period of the year too early to encourage the researches of any but the more enthusiastic botanists in those localities where it is most likely to be found. We are indebted to Mr. T. Drummond for its earliest recognition as a native of Britain; he met with it growing on the banks of the Isla and Esk in Forfarshire, Scotland, "extending up the valleys almost to the sources of those rivers." Though a local plant, it has since been collected in

several other parts of the island, and may prove not less common than some other partially distributed species. I have seen specimens of its barren stems collected this summer in Kent, Sussex, and Berkshire.

The rhizoma creeps under the soil like that of *E. arvense*, sending up at intervals three forms of stems. Of these, the earliest, which make their appearance in March or April, are fertile, five or six inches in height, unbranched, and nearly covered with numerous striated, very pale green or whitish sheaths; which are less inflated than those of the preceding, and terminate in from twelve to twenty long subulate, chocolate-coloured teeth: the cone is pale brown, and about an inch in length. As these, which may be regarded as the normal fructifying stems, mature and decay, the others make their appearance, and, occasionally, one or more of those first developed present a form intermediate between the strictly fertile and sterile states; bearing several whorls of from four to six short branches, and terminating in a small and usually abortive cone. The sterile stems attain a height or length of one or two feet, and are very rough, in consequence of the prominence of the siliceous crystals on their ridges: the sheaths are small and distant, but resemble those of the fertile stems in hue, and four or five of the lower ones are without branches, the remainder, to the summit, having whorls of from twelve to sixteen long slender ones, usually simple, and more or less ascending, so as to render the general outline obtuse; the joints of the branches, eight or ten in number, have the sheaths elongated and terminating in three or rarely four blunt or very short teeth, in which the rib terminates below the apex.

Moist woods and shady spots near water seem to be the favourite habitats of this species. I have not had it under cultivation, but the same objection exists to its introduction among other plants as in the case of *E. arvense*, viz. its tendency to spread underground, a habit which the soil usually required in the Fern Garden would in all probability encourage: setting this circumstance aside, it is a much more ornamental plant.

Equisetum telmateia. Great Horsetail. Tab. III.

Fertile stems unbranched; their sheaths crowded, ample, loose, with numerous slender subulate teeth. Sterile stems nearly smooth, with about thirty striæ, and many whorls of slender, suberect, simple branches; their sheaths close.

Equisetum Telmateia, *Ehrhart. Babington. Moore, Newman, Hist. Brit. Ferns*, &c. ed. 2. 67. E. fluviatile, *Linnæus*? *Withering. Smith. E. B.* 2022. *Hooker.*

Far from unfrequent in marshes and bogs, in watery places in woods, and about the banks of rivers and ponds, growing among the taller species of Cyperaceous plants, reed grass and rushes; often in exposed situations and drier ground, especially where the soil is stiff loam or clay, on which water lies during the winter. It is the largest of our indigenous *Equiseta*, its barren stems frequently attaining the height of six or seven feet, while its whorls of slender branches, from twelve to fifteen inches in length, present a truly magnificent appearance, and give an almost tropical aspect to the vegetation among which it occurs.

The rhizoma creeps widely in a moist loose soil, sending up its fertile stems about the end of March: they vary considerably in height according as the situation is more or less exposed, from four or five inches to a foot or more; they are thick and succulent, and of a pale brown hue, nearly covered with their large, loose, deeply-toothed sheaths, which are pale, sometimes almost white, at the lower part, while the teeth, from thirty to forty in number, are much darker and occasionally even black. The cone is between two and three inches long. The sterile stems are of a pale bright green, often more than an inch in diameter below, and varying from a few inches to the height above mentioned; they are almost smooth, but marked with from thirty to forty striæ, and, in luxuriant specimens, about the same number of slender quadrangular, deeply grooved, scabrous branches, in a whorl at each joint, which are at first nearly erect, but eventually spread out and at length become pendulous or arched: the sheaths of these stems are appressed, surrounded at the top with a well-defined blackish-brown band, the teeth being of a lighter hue and smaller and narrower than those of the fertile ones; the sheaths of the branches are four-toothed, each tooth with two denticulated ribs. Occasionally, as in *E. umbrosum*, the earlier barren stems terminate in a small imperfect cone.

According to Haller, the lower classes in ancient Rome used this species as food, and it is said, that in some parts of the continent of Europe the peasants mingle it with the food of cows, under the impression that it increases the quantity of their milk. Cattle, however, when left to their own choice, seem to leave it untouched; though Mr. H. C. Watson observes, "it is a notion among the rustics of Cheshire, that horses get 'bogged' by their endeavours to graze on this plant in the muddy pools of that county." It is more probable that such catastrophes result from their desire to escape the annoyance of the fly, than owing to their fondness for a plant, of which most writers who have mentioned the subject concur in affirming their dislike.

The highly ornamental character of the Great Horsetail renders it one of the most desirable of its tribe in cultivation, and no collec-

tion should be without it in which room can be afforded for its admission. To ensure success in planting, some of the horizontal branches of the rhizoma should be taken up, as although the lower part of the upright shoots or stems will generally vegetate, the growth is slow and dwarf. The situation ought to be shaded, and the soil a mixture of about one part of peat to two of strong yellow loam, the more adhesive the better. If this soil be placed above a thick layer of crumbled brick or shards, and surrounded after planting by four or five inches of the same material, well trodden down, the encroachment of this splendid plant upon the surrounding larger species of Ferns will be in a great measure prevented, and the contrast between its graceful feathery outline and their breadth of foliage obtained in the greatest beauty. Like many other semiaquatics, it is capable of existing, and indeed of flourishing, in any situation sufficiently retentive of moisture to prevent its roots becoming dry, but its more frequent habitats, and the size attained by it where shade and moisture are the concurrents of luxuriant growth, will point out to the cultivator the circumstances under which that desirable state may be secured. The change of name, which is now adopted by most English writers, is so far valuable as it expresses a situation in which it is often met with, namely "growing in swamps," while *fluviatile* ill accords with a plant that rarely grows actually in water; but the contradictory accounts of recent collectors regarding its favourite localities, may be compared with those of the three travellers in the fable concerning the hues of the chamæleon, and are about as near to the truth; so indifferent is the species before us to superficial moisture or dryness, when once established in its habitat.

** *Fertile stems similar to the sterile ones, whether simple or branched, and appearing at the same time.*

EQUISETUM SYLVATICUM. Wood Horsetail. TAB. IV.

Stems with about twelve striæ, and several whorls of slender, spreading or deflexed, compound branches. Sheaths loose, terminating in three or four blunt-toothed lobes.

Equisetum sylvaticum, *Linnæus*. *E. B.* Generally adopted.

The most elegant species of the genus. A native of moist woods, thickets, hedge-banks, and other shaded situations throughout the kingdom, but more frequent in mountainous and subalpine or rocky districts. The stems vary from a few inches to a foot or even a foot and a half in height, those bearing fructification being generally shorter than the others, and occasionally, in the earlier part of the season, destitute of branches; in the latter case they wither and disappear after the dispersion of the sporules, resembling in this

respect, and in their more succulent habit, those of the preceding section. The number of the striæ varies with the luxuriance of the plant from ten to sixteen, but the crystalline ridges are so little elevated that the stems are nearly smooth to the touch. The sheaths are more loose than in any other indigenous species, and split about half-way down into from three to six blunt and usually toothed lobes; they are of a bright tawny-brown colour above, passing gradually below into the pale green hue that characterizes the stem. The fertile stems have occasionally six or eight, but seldom more than three or four, whorls of branches; which, being of nearly equal length throughout, occasions them to present a peculiarly abrupt termination after the decay and obliteration of the cone; this latter is of a pale brown colour, about an inch long, and is perfected about the end of April or the beginning of May. The sterile stems are pyramidal in their general outline, the whorls of branches in luxuriant specimens often fifteen to twenty in number, gradually diminishing toward the apex, which generally droops gracefully on one side, being too slender to support its own weight. The branches, ten to twenty or more in a whorl, sometimes numerous, are compound, very slender, long, and drooping.

This is less objectionable to cattle than most of the species, and is generally eaten down by them when it grows within reach. In some parts of Sweden it is collected for winter fodder, especially for horses.

The surpassing beauty of form, and the lively green hue of its long feathery branches, render the Wood Horsetail worthy of an introduction into every shaded garden and shrubbery, while in the Fernery its presence should never be dispensed with, where space can be spared for its reception. The tendency of the rhizoma to creep, and the copious moisture necessary to maintain it in a luxuriant condition, are circumstances easily obviated and provided for, by planting in a large pot, closed at the bottom and sunk in the soil over the rim, a contrivance well adapted for growing these plants generally.

EQUISETUM LIMOSUM. Smooth Horsetail. TAB. V.

Stems smooth, slightly but copiously striated; often simple. Branches few, simple, suberect. Sheaths close, with many rigid sharp-pointed teeth.

Equisetum fluviatile? *Linnæus.* E. limosum, *Linnæus.* *E. B.* 929.
Generally adopted.

Common on the shallow sides of rivers, in ponds, ditches, and watery places generally. The rhizoma spreads widely, branching and rooting in all directions, so as to form a densely matted mass, that contributes to the solidification of the mud in which it vegetates,

and at the same time to the gradual contraction of the water limit; hence it is an active agent in the conversion of pools into swamps or morasses, which it abandons as the soil becomes elevated so as not to admit of the retention of water on the surface. The plant presents, in different situations, a variety of aspects, being sometimes so entirely destitute of branches as to resemble rushes, while at others, the branches, though usually few, are so abundantly developed, that a person not acquainted with its protean character might readily regard it as a distinct species. Such variations in habit are not constant in any particular localities, but their extremes will occasionally occur on the same spot in two successive years. The stems vary from one to three feet or more in height, and are almost universally submersed at the lower part, the difference of length being dependent for the most part upon the depth of the water in which they grow. They are smooth to the touch, but distinctly striated, the numerous ridges being so little elevated as to be distinguishable rather by the slight difference of their hue than by their roughness and projection. The branches are of variable length and number in each whorl, simple, and directed upwards, forming an acute angle with the stem. The sheaths are comparatively short, closely fitting to the stem, and of a similar green hue, but terminating in from sixteen to twenty sharply pointed dark-brown or blackish teeth. The cone is ovate, about an inch long, and usually invested at its base by the terminal sheath; it is perfected about the commencement of July, and, decaying soon afterwards, falls off, leaving the fructifying stems blunt-topped.

Much uncertainty exists respecting the association of this species by the older authors with *E. fluviatile*, *E. Telmateia* of recent botanists. That it is the plant recorded under the former name by Linnæus appears probable, as *E. Telmateia* is not a native of Sweden; but our limits preclude the discussion of a question of no present importance. From *E. palustre*, the following species, to which in its branched condition it approaches most nearly in general aspect, its thicker, smooth, not furrowed stems, and close green sheaths, at once distinguish it.

Cattle will frequently devour the Smooth Horsetail, when it grows within their reach, especially when the season is dry and the pasture over-stocked.

It is not a plant of sufficient beauty to render it worthy of attention in confined cultivation, but may be easily kept in a tub or shallow tank, partly filled with common garden soil, with a few inches of water over the surface: under such circumstances, however, it admits of no rivalry, soon overpowering most other plants that may be introduced to its companionship, or dying away itself if the natural colonizing propensity is restricted for their preservation.

EQUISETUM PALUSTRE. Marsh Horsetail. TAB. VI. & VII.

Stems rough, deeply furrowed, with six or eight broad, prominent ridges. Branches simple, suberect. Sheaths loose, with acute wedge-shaped teeth.

Equisetum palustre, *Linnæus*. *E. B.* 2021. Generally adopted.

Very frequent in marshes and watery places about the banks of rivers and ponds, especially in a black boggy soil; often accompanying *E. limosum*. The stems, from a foot to eighteen inches high, are somewhat rough, and generally branched throughout, the whorls gradually diminishing towards the apex. The branches have a similar upward direction to those of the preceding species, are uniformly simple, and the number in each whorl varies from six to ten, being frequently less, and very rarely more than that of the ridges. The sheaths are pale-coloured, loose, often somewhat inflated, terminating in acute wedge-shaped dark-brown teeth, with pale membranaceous edges, equalling in number the ridges of the stem. The cone is narrower than that of the last, being elongated oblong instead of ovate, and matures rather earlier in situations where they grow together.

The earlier European botanists seem often to have confounded this species with *E. arvense*, with which, at first sight, an inexperienced collector might consider it as having some resemblance, as well as with the more copiously branched specimens of *E. limosum*. Attention to the striking difference in habit, and to the features noted in description, will render any mistake as to their individual distinction scarcely possible.

Two, or perhaps three varieties of this common plant have been described, viz.—

1. *Polystachion*, in which the branches of one or two of the uppermost whorls terminate in small cones; the terminal one being often abortive, or of the reduced size of the others, very rarely presenting the character of full development. TAB. VII.

This variety has been noticed by most of our earlier botanists, and is far from being uncommon; sometimes growing apart, but frequently accompanying the usual form. The difference was supposed at first to be occasioned by the extremity of the primary stem having been bitten off or injured; but this, of course, cannot be the case where the terminal cone is produced, an occurrence quite as frequent as is its absence. The London collector may meet with the "many-spiked Horsetail" plentifully distributed in several localities along the banks of the Surrey Canal, between Camberwell and Rotherhithe; and this summer I found the specimen figured on the side of an enclosed portion of the old Croydon Canal, near Annerley.

2. *Nudum*. Stems nearly or quite simple, dwarf. *E. palustre* γ. *nudum*, DeCandolle.

Grows in sandy places on which water accumulates, and on loose sand hills and banks. Found in Scotland, Yorkshire, Lancashire, Devonshire, and Cornwall. Specimens from different localities varied, from six or eight inches to less than two, in the length of the stem, and are otherwise so diversified in character, that a simple figure would be insufficient to convey a general idea of the variety. Mr. Newman, who, in his "History of British Ferns and Allied Plants," ed. 1844, p. 49, has given a figure of a Devonshire specimen, remarks, "Some of the examples are erect, others prostrate; and those which grow on sand-banks have the roots densely fibrous and clothed with minute fibrillæ. The small size, often prostrate habit, branchless stems, sandy habitat and densely clothed roots, have induced many botanists to consider this plant a variety of *E. variegatum* rather than of *E. palustre*; but, after a careful examination, I am unable to find any character whereby to distinguish it from the latter; the root, stem, sheaths and catkins seeming to me nearly identical with those of the usual form of the species." With these observations I concur at present, but only from examination of dried specimens; cultivation of the three may hereafter lead to an opposite opinion, or even to the establishment of this as a distinct species.

3. *Alpinum*. Smaller upper branches abortive. Sheaths with four or five angles and teeth. Hooker, British Flora, p. 451. "Boggy places near springs on the higher parts of the Breadalbane mountains." Perhaps an intermediate form.

It may be grown in the manner recommended for *E. sylvaticum*, and the variety *polystachion* is very ornamental when in fructification.

EQUISETUM HYEMALE. Rough Horsetail. Shave-grass. TAB. VIII.

Stems simple, very rough, with from fourteen to twenty ridges. Sheaths close, with as many dark, slender, subulate, deciduous teeth as ridges.

Equisetum hyemale, *Linnæus*. *E. B.* 915. Generally adopted.

Though rather to be regarded as a local than a common species, this is very widely distributed over the different parts of the kingdom, in England and Wales, in Scotland and Ireland. Its favourite localities are wet woods, bogs, marshes, and the borders of rivulets. In England it is more frequent in the northern and midland counties than in those of the south. The stems, branching from the rhizoma near the surface of the soil, rise to the height of two or three feet, sometimes, but rarely, producing a single lateral

branch here and there, but never any of those whorls that so strikingly characterize the species already described; they are of a dark green colour, and rough like a file, owing to the prominence of the double row of sharp siliceous crystals of the ridges: the barren ones become so much attenuated towards the extremity as to lose the naturally erect position and curve over to one side, but the fertile ones are nearly equal in diameter throughout, shorter, and rigidly erect. The sheaths closely invest the stem, and are at first of a similar green colour, but ultimately acquire a pearly whiteness in the middle part, forming very conspicuous bands at intervals of two or three inches throughout its whole length; these bands are rendered more distinct by the base of the sheath having a broad dark or blackish-brown border, and a narrower margin of the same hue formed by the blunt bases of the dark deciduous teeth. The cone is very small, dark-coloured, and terminates in an apiculus. It is matured about the beginning of August. The barren stems usually present rudiments of fructification at the apex.

This is the species chiefly employed for mechanical purposes, on account of its roughness, and its long simple stems are largely imported from Holland under the name of Dutch Rushes, being used for polishing hard woods, ivory and metal by turners and other handicrafts. Some botanists have expressed a doubt respecting the identity of the continental with our indigenous species, but except in its larger size, and consequently more numerous striæ and corresponding fistular cavities in the interior of the stem, no positive character of distinction is traceable. The British plant from Gamlingay Bog, Cambridgeshire, cultivated in my garden for thirty years, frequently rivals the imported "Dutch Rushes" in these respects, the number of ridges and smaller tubes varying from twenty to twenty-eight in the larger stems. Lightfoot informs us that "in Northumberland the dairymaids employ it to scour and clean their milk-pails," a purpose for which the more common *E. arvense* is often used elsewhere. Its medicinal qualities, dependent upon a slight astringency, though formerly extolled, have long been disregarded. Cattle seldom eat it; indeed it is said to occasion the teeth of cows to drop out, and to be injurious to sheep, evils probably due rather to the marshy condition of the land on which it grows than to any deleterious quality of the plant itself, as it has the reputation of being wholesome to horses.

It is easy of cultivation, and as the rhizoma does not extend so rapidly as to become injurious to its neighbours, no confinement is necessary; while the tall dark-green stems with their white band-like sheaths form compact tufts, that contrast agreeably with the feathery fronds of the larger Ferns. Though it grows naturally in

wet places, any shaded situation in the garden where the soil is at all retentive of moisture may be selected according to convenience; and being evergreen, and little affected by the severest cold of an English winter, adds greatly to its ornamental value in the shrubbery or Fern plantation.

The claim of the four following to rank as species is very equivocal. If it be admitted, they will constitute, with a few others of exotic growth similarly circumstanced, a group of marked character, of which E. hyemale *may be regarded as the type. Such group will be distinguished from the other plants of the genus by the greater roughness and rigidity of the stems, and their tendency to a simple form of development; by the branches, when present, being produced singly and alternately, and according with the principal stem in structure and appearance, instead of assuming the contracted form and verticillate disposition exhibited by those of their congeners. To these features may be added the comparatively small size of the fructifying cone and its universally apiculate termination.*

EQUISETUM MACKAII. Mackay's Equisetum. TAB. IX.

Stems erect, simple or slightly branched, very rough, with from eight to twelve ridges. Sheaths close, ultimately wholly black, with long, aristate, somewhat flexuose, persistent teeth.

Equisetum Mackaii, *Newman, Hist. Brit. Ferns*, &c. ed. 1844. 25. *Babington. Moore.* E. elongatum, *Hooker.* Not of *Willdenow.*

A native of mountain glens in Ireland and Scotland. First observed by Mr. Mackay in August 1833, "on moist banks near a waterfall, at the upper end of Colin Glen, Belfast;" since by Mr. Moore and others in many of the glens and ravines of the north of Ireland, and in Scotland. The stems grow erect from the height of one to three or four feet, forming tufts like those of *E. hyemale,* which they resemble in roughness, but are more slender; they are generally simple, but not uniformly so, being frequently branched, especially towards the upper part, as shown in our middle figure. The branches are always solitary, and, although springing like the whorled ones of other species from below a sheath, have rather the character of divisions of the stem itself, and assume the same erect position and indefinite development; occasionally, in very luxuriant specimens, they produce secondary branches, but always in a corresponding manner. The ridges resemble those of the preceding species, except that they are fewer in number. The sheaths are at first of a pale green colour, almost white, terminating above in a black rim, but eventually become wholly black. The teeth are

usually persistent; they are black, long, flexuose, and bristle-like, more or less dilated at the base. The cone is small, almost black, and terminates in a small pointed process (apiculus). It matures in August.

Leaving out of consideration the number of ridges and striæ, a feature liable to variation in these plants, depending, as experience demonstrates, upon luxuriance of growth and accidents of season and situation, the distinctive character of *E. Mackaii* rests almost exclusively upon the hue of the sheaths and the form of its teeth-like divisions. What importance may attach to such circumstances, in an order occupying so low a grade on the scale of vegetable organization as that before us, remains to be ascertained. In higher groups, colour, and even leaf-division, hold only a very subordinate value in the separation of species; the former indeed being rarely, if ever, resorted to by the scientific naturalist, while the latter is in many instances so susceptible of modification as to be next to useless.

The slender character of the stems in our plate, so different from those of the stouter *E. hyemale* immediately preceding it, and more especially its branched condition, would appear at first sight to render the previous remarks unnecessary, and the probable identity of the two plants chimerical; but the practical botanist will comprehend readily the association of such apparent extremes by intermediate forms, and the possibility that such may be the case in the present instance. *E. hyemale*, when luxuriant, occasionally branches in this manner at the upper part, while *E. Mackaii* is more commonly seen in the form of the left-hand figure, Plate IX., simple. Differences of this description are of such frequent occurrence as the result of circumstance, that they are utterly valueless in a question of specific correspondence; and in regard to the estimation they deserve in the allotment of the rank of species to varieties in *Equisetaceæ*, I may quote the authority of one of the most industrious and observing naturalists of his time, M. Vaucher of Geneva, who, in his monograph of the order, after remarking on the general habitats of these plants, observes on the contrary that, "we find them occasionally in sandy and dry situations, as, for example, *Equisetum multiforme*; but this species appears to be greatly influenced by the nature of the soil in which it grows, for sometimes it develops only a small number of slender and very short stems, while vegetating in richer ground, we find springing from the main tuft stems so much larger and more copiously branched that they might be supposed to belong to a different species." Similar causes may be implicated in the production of this and the three following British plants, as they have been in many other instances among the higher groups of the vegetable kingdom, leading to an unnecessary multiplication of species, in

the absence of all the more positive organic conditions of structure upon which alone they ought to be founded.

EQUISETUM WILSONI. Wilson's Equisetum. TAB. X.

Stems erect, simple or slightly branched, nearly smooth, with eight or ten furrows and broad intervening ridges. Sheaths close, concolorous with the internodes, but margined with black at the summit. Teeth short, obtuse.

Equisetum Wilsoni, *Newman, Hist. Brit. Ferns*, &c. ed. 1844, 39, a variety of E. variegatum. *Babington. Moore.*

First noticed by Mr. W. Wilson, growing in water, at Mucruss, Killarney. The stems are erect, often two or three feet high, simple, or occasionally branched, especially towards the lower part, as in our figure, the branches being usually single and alternate, but sometimes opposite; the number of ridges is not to be depended upon, varying in specimens before me from six to twelve, according to the thickness of the stems; but they are remarkable in all on account of their great comparative breadth and flatness, and the slight prominence of the siliceous crystals, which renders the plant much less rough than any of its immediate congeners. The sheaths are scarcely so close as those of *E. hyemale*, being slightly bulging or inflated above the insertion; they resemble the stem in colour, except at the upper margin, which is black where it passes into the bases of the short, broad, bluntly wedge-shaped teeth, the dark hue of which is relieved by a pale membranaceous border. The small, blackish, apiculate cone is characteristic of its near alliance, not with *E. variegatum* only, but with the species of which that may be regarded as a dwarfed and otherwise diminished type.

EQUISETUM VARIEGATUM. Variegated Rough Horsetail. TAB. XI.

Stems decumbent, simple or slightly branched, very rough, with from four to ten ridges. Sheaths slightly enlarged upwards, black, with pale, membranaceous, obtuse teeth, each tipped with a dark deciduous bristle.

Equisetum variegatum, *Willdenow. Weber and Mohr. Smith, E. B.* 1987. *Hooker. Newman, Hist. Brit. Ferns*, &c. ed. 1844, 31. *Moore.* E. variegatum, β. arenarium, *Babington.* E. multiforme, α. variegatum, *Vaucher. Macreight.*

A native of sandy ground, especially on dunes near the sea, on which it often accompanies *Ammophila arundinacea* and other sand-binding plants; likewise of mountain valleys among the sand and

other debris washed down by torrents. The plant varies very much in size in different habitats; being sometimes almost minute and with stems not more than an inch or an inch and a half in length and nearly prostrate, when it is *E. reptans*, *α*, of Wahlenberg. In its most common and maritime form in this country, as represented on our plate, its habit is rather decumbent and spreading than prostrate, and the stems attain a length of six or eight inches, though they are often nearly buried in the drifting sand, among which the rhizoma branches and extends occasionally to a considerable distance. The stems are very slender compared with those of other species, sometimes almost filiform; they are deeply furrowed and exceedingly rough, equally so indeed as those of *E. hyemale*. The sheaths are rather loose and gradually expanding upwards, where they divide into longish wedge-shaped teeth terminating in a fine bristle, which however soon drops off. The colour of the sheaths varies, frequently on stems from the same root; in general they are black at the lower part and with a black border at the base of the teeth, but sometimes the greater portion is of the same hue as the stem, the blackness being confined to the upper margin, where it generally extends into the middle part of the teeth, and contrasting with their white membranaceous edges, and the ordinary pale green hue of the stems, has obtained for the plant its characteristic specific name, though that of *arenarium*, expressive of its usual habitats, would have been more consistent. The small cone is apiculate, and invested at its base by the widely expanding terminal sheath, a general feature of the group: it matures in August.

The above description applies only to the form represented in this work, or as it is met with growing in sand; any deviation from specific characters as given in others, and particularly those of older date, must be ascribed to the prior association of this with the two preceding and, perhaps, the following one likewise.

The greater value of characters founded upon differences or resemblances in the internal structure of organic bodies, over the superficial ones of colour and outline, is a point universally admitted by naturalists; and it cannot be denied that important evidence of specific identity may be afforded by comparison of the interior organization of the stems of the Equisetums. Mr. Newman in the work above quoted, has, with much good taste and careful drawing, given magnified transverse sections of those of all the British species, and no one who may either contrast these figures of the first seven as they stand in the foregoing arrangement, or, what would be more satisfactory to the practical botanist, examine for himself, could do otherwise than admit their positive distinctness of character; but it is otherwise with the four following. In all of these, as in *E. hyemale*, a single peripheral series of tubes,

alternating with the ridges, surrounds the large central one of the internode, differing only in number according to the diameter of the stem, if we except a slight deviation of form expressed in that of *E. variegatum*, a circumstance probably originating from Mr. Newman's drawings having been made from dried objects: examined in the recent state, I have almost uniformly found the smaller tubes of the circumference cylindrical.

It is due to the author of the talented work referred to in these remarks, to state that he is indisposed to the unnecessary multiplication of species, and only yields, in according such rank to some of the non-verticillate forms of Equisetum, in deference to the views of other botanists of deserved reputation.

Equisetum Moorei. Moore's Equisetum. Tab. XII.

Stems erect, simple or slightly branched, rough, with from ten to fourteen ridges. Sheaths slightly enlarged upwards, black at the lower part, pale above; teeth black, obtuse, terminating in long, pale membranaceous subulate awns.

Equisetum Moorei, *Newman, Phytologist.*

The only specimens I have seen of this plant are in the dried state, and, except in the generally variegated hue of the sheaths, they are not distinguishable from those of *E. Mackaii.* In a tuft now before me, kindly forwarded to Mr. Sowerby by Mr. Moore, from Rockfield, Wicklow, Ireland, the longest stems, terminating in fructification, measure three feet. In habit it does not differ from the other upright species or varieties, and it approaches in roughness that last named (see our Tab. IX.); though none of the examples that have come under my notice show any tendency to branch in the manner there represented, in the middle figure, while in the present instance every stem is simple. The number of ridges, depending as it does on luxuriance of growth, is a feature of no value in specific distinction; neither is the proportional roughness, as it is not attended by any different arrangement of the siliceous particles upon which it depends, but only upon their greater or less prominence. The pale brownish hue of the middle part of the sheaths is a striking feature, but one of very equivocal importance, and, though a general one in this plant, the lower sheaths are almost always wholly black, while those of the upper part of the stem are frequently concolorous with it, the teeth excepted.

One circumstance, if correctly stated, is certainly indicative of variation from the ordinary character of the group: it is remarked that it "dies down in winter." Unacquainted with it in the living state, I am unable to testify to this peculiarity, which no observable

difference in structure seems to warrant. All of the other immediate allies of *E. hymenale* resemble it in the evergreen habit.

ISOËTACEÆ.

This order consists of a single genus, which has been variously disposed by different botanists. Its structural affinities are not very readily traceable either with Lycopodiaceæ, where it is placed by DeCandolle, and most others who have adopted his arrangement generally, or with Marsileaceæ, to which it was transferred by Bartling and latterly by Dr. Lindley, as well as by myself in Vol. 8 of the second edition of 'English Botany,' 1841. In the present instance, closer comparison of its fructification with those of its supposed allies has induced me to adopt the separation as an order, proposed by the late Professor Burnett, of King's College, London, 'Outlines of Botany,' i. 310,—an allotment apparently warranted by the peculiarity of habit and structure, independently of that of the reproductive organs. By some botanists it is associated with a group of aquatic plants under the title of Hydropterides or Water-Ferns.

ISOËTES. Quill-wort.

Gen. Char. Seeds or sporules contained in membranaceous cases or conceptacles, imbedded in the dilated bases of the leaves. Conceptacles of the inner leaves filled with minute particles forming an impalpable powder: those of the outer containing an indefinite number of rough angular or subspherical granules.

The germination of the granules of the outer leaves has been observed by many botanists, and indeed frequently takes place within the conceptacles; hence their character as seeds, or at least as reproductive bodies, is beyond dispute, but it is otherwise with regard to the powdery particles included in those of the inner ones. It is still a subject of speculation whether these latter be only abortive forms of the true sporules, or whether they fulfil any specific function, as some have supposed, according with that of the pollen in flowering plants. All of the small natural orders, however, occupying in modern botanical arrangements an intermediate position between the higher and lower forms of vegetation, are more or less similarly circumstanced in this respect; some of them have even been at times referred to the Phanerogamous group; while, collectively speaking, the little positive evidence hitherto obtained, together with the frequent occurrence of two distinct forms of the reproductive apparatus among the lower grades of the Cryptogamous series, as the sea-weeds and lichens, militates against the opinion that these forms are other than contingent modifications of

the same, or, at most, only prefigurations of organs requiring a higher state of structural development for the performance of their relative functions. That such is or is not the case in the genus before us is a point incapable of present decision.

The plant—for the existence of more than one species is doubtful—is aquatic and always grows submerged. It is met with throughout the north of Europe and North America. The generic name is derived from ἴσος, equal, and ἔτος, the year, and was bestowed on it by Linnæus in allusion to the evergreen habit.

Isoëtes lacustris. Lake Quill-wort. Tab. XIII.

Leaves radical, subulate, bluntly quadrangular or semicylindrical; consisting internally of four longitudinal series of angular cells.

Isoëtes lacustris, *Linnæus. E. B.* 1084. *Hooker, Lond.* 131. *Newman, Hist. Brit. Ferns, &c.* ed. 1844, 381.

Always found growing submerged, at the bottom of lakes and other still waters, in alpine districts especially. In many of the clear rocky lakes of the north of England, Wales, Scotland and Ireland it is most abundant, covering them so densely with its grassy-looking foliage as to give them the appearance of submerged meadows. The stem is a kind of cormus or tuber, about the size of a hazel-nut in large plants, fixed by thickish, white, tubular, generally simple, root-fibres. The leaves, growing in a circular, erect, or slightly spreading tuft from the crown of the cormus, are smooth, semi-transparent, and of a somewhat horny texture: their structure is remarkable, and may be described as consisting of four parallel tubes, divided transversely into numerous cells, and very brittle in the direction of their septa, which are visible externally. The fructification is about the size of a small pea, imbedded in the dilated and bulging bases of the leaves, and concealed by them, except on the inner face, where a circular opening displays the membranaceous conceptacle, sufficiently thin and transparent as it approaches maturity to admit of the granules being seen through it; it is in the best state for examination about the end of July.

This plant is liable to variation in different localities as regards both the size and the direction of the leaves, which are usually erect, but sometimes widely spreading, and in the latter case are generally broader, so as to have occasioned some botanists to regard them as different species.

Isoëtes lacustris admits of cultivation in shallow clear water, and increases rapidly, but to insure successful growth the bottom should be covered with sand an inch or two in thickness over the soil, so as to keep the water transparent, which must at the same time be

sufficiently deep to avoid freezing throughout. Under these circumstances it may be grown with *Lobelia Dortmanna, Pilularia globulifera,* and other plants of similar habit; but a turbid or muddy condition of the water quickly destroys it, probably by excluding the light.

MARSILEACEÆ.

Aquatic, perennial, creeping plants, with alternate erect leaves having a circinate vernation. Fructification axillary, sessile; consisting of oval or spherical coriaceous conceptacles, usually of one form, but containing either individually or respectively two dissimilar forms of reproductive organs. The genera associated in this order are very uncertainly charactered by structural affinity, and correspond chiefly in habit. They are distributed in standing waters over most of the temperate parts of the world. A single species is indigenous to these islands.

PILULARIA. Pill-wort.

Gen. Char. Conceptacles solitary, nearly sessile, globose, coriaceous, four-celled, four-valved; each cell containing bodies of two kinds attached to a common receptacle.

The fructification resembles a pill or pepper-corn, hence the name, from the Latin *pilula,* a pill.

The single known species of which this genus consists, occupies a more equivocal position in the vegetable kingdom than *Isoëtes.* The globular conceptacles include numerous small bodies, attached to a membranaceous lining, which, extending from each of the valves, forms the four cells, as shown in the enlarged sectional figure on the right in Tab. XIV. The bodies occupying the upper part of each cavity contain a yellow powder resembling the pollen of a flowering plant; those of the lower part are larger, more turgid, and terminate in a small projecting point, which may be compared to a stigma: of these two forms the upper ones have been supposed to be anthers, the lower pistils; and under this view, the four-valved conceptacle including a mass of inflorescence is usually described as an involucre. Admitting such an explanation of the œconomy of the parts in question to be correct, *Pilularia* is here misplaced: it is a monœcious flowering plant; and experiment on the propagating capabilities of the dissimilar contents of its conceptacles is in favour of this decision. The supposed anthers are inert, while the pistils vegetate, pushing forth first their radicle to fix them to the soil, and afterwards a leaf or cotyledon. In this respect they resemble those of *Zostera* and some other aquatics of low organization, the first especially, the simple inflorescence of

which, inclosed in the hollow of its sheathing stems (see Eng. Bot. tab. 467. 2nd ed. tab. 4), approaches that of the plant before us. Still it must be admitted that the subject of vegetable propagation is, in regard to the inferior orders of plants, one of great complication and uncertainty, and that although, in the idea of the general or superficial botanist, a determinate limit may seem to exist between the flowering and flowerless species, such distinction is only the result of the absence of immediate proof that influence, analogous to that of the pollen of the former class, is concerned in maturing the reproductive germs of the latter. Among Ferns, and even among Mosses and Lichens, deviations from the normal character of species are not of unfrequent occurrence, and to an extent that, if it does not confirm their hybrid origin, tends to suggest its probability. The application of the term *Cryptogamous* to all these plants, records the doubt entertained by its author and admitted by his successors, concerning the existence of a difference of such vast importance; and every real step that we make forward in the study of their obscure physiology contributes to expand into universality our belief, that the same grand principle operates to the perpetuity of every existing form of organic being.

The peculiarities of *Pilularia* and the œconomy of its fructification, growth, &c. were made the subject of a valuable essay by M. Bernhard de Jussieu, in the "Mémoires de l'Académie Royale des Sciences, 1739," and more recently by Mr. Valentine, in the 18th volume of the "Transactions of the Linnean Society," both of which are well worthy the study of the physiological botanist; but our space will not admit of extract.

PILULARIA GLOBULIFERA. Pill-wort. TAB. XIV.

Rhizoma slender, elongated, creeping; producing leaves and roots at regular intervals. Conceptacles axillary, nearly sessile on the rhizoma, hairy.

Pilularia globulifera, *Linnæus. E. B.* 521. *Hooker, Fl. Lond.* tab. 83. *Newman, Hist. Brit. Ferns,* &c. ed. 1844, 393.

It may be regarded as a local rather than a common plant, but is at the same time widely distributed, and where met with generally most abundant. The long slender rhizoma creeps along the surface of the mud or sand in shallow water about the margins of lakes and pools, and sometimes in places only occasionally overflowed, especially on sandy and gravelly heaths, forming often, by its abundant branching and entanglement, a dense covering over the soil, to the complete exclusion of other plants. Some botanists have remarked that the *Pilularia* is never found in deep water nor

in a state of constant submersion, but this is certainly incorrect, as I have met with it in Llyn Ogwen, Llyn Idwel, and in some parts of the Lake of Llanberis, covering the bottom at a depth of between one and two feet, in situations where it could rarely, if ever, be left exposed: under these circumstances the leaves were longer and exceedingly slender, and no fructification appeared to be formed; indeed the latter is only abundantly produced where the plant grows in open and comparatively dry places unfavourable to the more luxuriant development characterized in our upper figure. The leaves are coiled in vernation like those of the Ferns, erect, smooth, and slender, and, under water, even hair-like; in height they vary according to circumstances from one to four or five inches, forming clusters or tufts arising at intervals from the rhizoma opposite to similar tufts of rootlets. In fertile plants the leaves and rootlets are seldom more than three or four at each node, and the former not above one or two inches long; but in barren specimens the tufts of both are crowded and indefinite, and the leaves especially so, as well as more slender and taller. The solitary conceptacles spring from the axils of the leaves, supported by a pedicel so short that at first sight they appear sessile; they are nearly globular, but with a tendency to become conical at the apex, about the size of a small pepper-corn, brown, and hairy. Divided transversely they are seen to be four-celled, and separate in maturity into four equal valves. The upper half of each cell is lined with minute sessile, somewhat elongated or club-shaped, yellowish bodies, the stamens or anthers of Jussieu and others; the lower half is occupied by larger roundish or oblong sessile, one-seeded thecæ or ovaries, crowned with a small blunt projection, which is probably a stigma. The relative number of these bodies varies in different conceptacles, which, appearing in May, become successively matured to the end of autumn.

Our figures will convey a general idea of the barren and fertile states of this very curious plant, only it must be remarked that the leaves vary from the size represented to an almost hair- or bristle-like fineness.

It is easily cultivated on an artificial bog, or in a shallow pan with a mixture of peat soil and sand just covered with water, a situation in which fructification is sometimes abundantly produced, under a moderate exposure to the sun.

LYCOPODIACEÆ.

Perennial plants, resembling Mosses in the arrangement of their foliage and in general aspect, but in no other respect, their structural characteristics being widely different. To Ferns they bear

about an equal relation with the rest of the *allies* so called, but are considered more especially to approach them in the structure of their stems, which contain an abundance of the large woody vessels denominated annular ducts. Dr. Lindley, in his 'Vegetable Kingdom,' has remarked, that the larger kinds "seem to imitate Coniferous Gymnogens (the Pine or Fir tribe) in their manner of growth, and in their tendency to collect their spore-cases in cones," and again that they are "intermediate, as it were, between Ferns and Coniferæ on the one hand, and Ferns and Mosses on the other,"—observations that, however imaginative, and consequently not perhaps strictly scientific, their basis, are still valuable as showing the difficulty experienced by even our best systematic botanists in the arrangement of these outlying orders of the vegetable kingdom.

The stems of the Lycopodiaceæ are generally slender and creeping, but occasionally erect, their texture solid and wiry; the creeping ones often extending several feet or even yards in length. The leaves are small, sessile, without veins, in most instances very closely set, and often imbricated. The fructification consists of minute cases or thecæ, sessile in the axils of leaves or bracts, and two kinds are usually met with on the same plant: the one, bivalvular, and containing a powdery substance, the particles of which under a high magnifying power are seen to be globular; the other, three-valved, enclosing a few comparatively large subspherical granules, which are marked with three prominent ridges radiating from one extremity. The relative position of these thecæ, differing chiefly in their contents, is, upon the elongated axis of a *Lycopodium*, similar to that of the conceptacles upon the shortened or rather abortive one of *Isoëtes*,—that is, those the contents of which are powdery occupy the upper part of the axis, corresponding to the centre of the cormus of the latter plant; while the granule-bearing ones are developed below them, or in the situation representing the outer part of the cormus. This circumstance has been noted, as justifying the reference of *Isoëtes* to the order before us, notwithstanding the striking difference of its habit; but it is chiefly important on account of its coincidence with the ordinary disposition of male and female flowers among the higher orders of plants, and thus lending some equivocal support to the opinion of those who consider the upper cases *anthers*, their contained powder *pollen*, while the lower ones are *pistils* and their granules *seeds*: this opinion has, however, been reversed by Link and others, and the whole subject is yet under speculation. That the granules are seeds, or at least sporules, is certain, as their germination has been frequently observed; but we have not yet any positive evidence respecting the functions fulfilled by the powdery particles, which Willdenow states grow likewise. I have tried them several times without success.

The genera of this order are few; three or at most four are capable of being well charactered, and of these the normal one alone contains the few species indigenous to Great Britain.

LYCOPODIUM. Club-Moss.

Gen. Char. Fructification either in the axils of the leaves, or contained in erect bracteated spikes. Thecæ one-celled: some two-valved, including minute powdery particles; others three-valved, or rarely four-valved, containing from one to about four nearly spherical rough sporules.

The generic name, from λύκος, a wolf, and πούς, a foot, seems to have been founded upon some fanciful resemblance between the branches or spikes of some species and the paw of that animal.

The species, about 200 in number, are very widely distributed, some being adapted to support the extreme cold of lands within the Arctic Circle, and others to vegetate under the corresponding excess of tropical heat; the latter forms are, however, the most abundant. They are all evergreen plants of a rigid habit, usually growing prostrate, and rooting at intervals; their stems clothed throughout with numerous small scale-like leaves, which are either more or less densely imbricated, or spreading in two principal series. These dispositions of the leaves and their minuteness, added to the general form of growth, give to the Lycopodiums very much of the aspect of gigantic mosses; though the internal structure indicates a far higher grade of organization, approaching indeed to that of the flowering plant, while the economy of their fructification is altogether dissimilar.

Those of Europe, and other temperate and cold climates, generally occupy the most exposed situations, growing on open heaths and moors and on the declivities of mountains, but very often in woods and other sheltered places. *Lycopodium alpinum* and *L. Selaginoides* are said to cover extensive tracts of country in Lapland almost to the exclusion of other vegetation, the former especially clothing the sides of the mountains. In the warmer parts of the world and within the torrid zone, the order is almost exclusively confined to moist shady situations, chiefly abounding in the dense humid forests of India, Tropical America, and the islands of the adjoining seas.

Though hitherto little employed in Europe either in medicine or the arts, these plants seem to possess some important properties, which, if the elaboration of active proximate principles affords any standard of organic complexity, would place the Club-mosses higher on the scale than any of the groups among which they are classed by botanists. *Lycopodium rubrum*, *L. catharticum*, Hooker, is powerfully cathartic, and is administered in Spanish America, suc-

cessfully it is said, for the cure of elephantiasis; its violent action has obtained for it the popular name of *Yatum condenado*, from *Yatum*, great devil, *condenado*, accursed: similar qualities, though less in degree, belong to some of our indigenous species, as well as to others of tropical countries.

Though growing naturally in the most exposed places, the British Lycopodiums are not easy of cultivation in the open ground, especially in the vicinity of London,—a fact due, perhaps, rather to the loose character of the surface soil in which they are planted, and the absence of sufficient moisture in the atmosphere during the principal season of growth, than to any other circumstances: in a close frame or in a shaded greenhouse they may be grown very luxuriantly. All of the exotic species, especially those of warm climates, succeed well as house plants, and, from their trailing habit, are admirably adapted for covering the surface of the soil around the larger species of Ferns.

LYCOPODIUM CLAVATUM. Common Club-Moss. Wolf's-Claw. TAB. XV.

Stem creeping. Leaves scattered, finely serrated, incurved, hair-pointed. Fertile branches erect. Spikes stalked, two or three together; their scales ovate-acuminate, finely toothed.

Lycopodium clavatum, *Linnæus*. *E. B.* 224. Generally adopted.

A native of upland heaths and high pastures in many parts of the kingdom, but most abundant in rocky and mountainous districts. The procumbent, repeatedly branched stems spread in all directions, but on declivities chiefly downward, to the length of many feet or even yards, throwing out strong root-fibres at intervals of a few inches, which fix them firmly to the ground; hence the plant is exceedingly useful on the steep sides of hills and mountains, as it serves to bind the soil and prevent the looser particles from being washed away by the rain and spring torrents. The leaves are crowded, entirely covering the stem, and curving upwards from the latter as it lies along the ground; they are linear-lanceolate, terminating in a white filament, and slightly toothed or serrated on the edges. The fertile branches vary much in height, from three to six or eight inches; they are erect, densely leafy like the others at the lower part, but clothed above only with a few scattered, narrow, pale green or yellowish, closely appressed scales: at the summit each stalk bears from one to three, but usually two, cylindrical spikes of a pale greenish-yellow or sulphur colour and one or two inches long, composed of imbricated bracts, broad at the base but acuminated upwards so as to be somewhat triangular in their general outline; the small, yellowish, kidney-shaped thecæ are

developed singly in the axils of these bracts, and ripen towards the end of August, opening transversely to discharge the almost impalpable powder by which the species is propagated.

A decoction of the plant is employed in Poland for the cure of that most horrible of human disorders, the Plica Polonica. The powdery contents of the thecæ are collected in large quantities for sale, under the name of Lycopodium, or Vegetable Sulphur. This powder is highly inflammable, consuming instantaneously and with a slight explosion; hence it has been employed in Germany to produce imitative lightning in the theatres, and very extensively there and elsewhere in the manufacture of fireworks: so repellent is it of moisture, that, if scattered over the surface of water in a basin, a stone may be picked up from the bottom without wetting the hand. It is sold by the druggists in this country, as an absorbing powder to prevent excoriation in young children, and for application to skin wounds; for which purposes it is imported from different parts of northern and eastern Europe, where large quantities of the spikes are collected in the autumn to supply the demand, which is far from inconsiderable.

This species seems to be distributed throughout the northern hemisphere. The elegance of its long trailing and variously branched stems renders it a general favourite, and few plants are equally capable of adaptation to ornamental purposes, especially in the form of wreaths and festoons. Linnæus, in his 'Flora Lapponica,' mentions his having seen the Lapland children with their heads decorated with garlands, formed by so wreathing it that the double spikes projected on all sides, recalling to his mind the idea of the fauns and satyrs of the old mythology; and in some parts of the continent, where it grows commonly, its graceful curvatures are usually conspicuous among the winter decorations of the houses and churches.

To cultivate the Common Club-Moss successfully, it should be removed from the heath with the soil attached to the central or principal root; and in planting, whether in pot or on the ground, especial care is needed to ensure the drainage which in the wild state is always provided, and without which indeed the plant will not subsist, as due observation of its natural habitats will evidence. A poor soil and one incapable of retaining much moisture is no less essential. The manner in which the British Lycopodiums are generally offered for sale by the Fern collectors precludes all but the remotest chance of their after-growth: in the case of the present species, the elongating stems are simply torn from the ground without reference to the root from which they emanate, and the few scattered fibres attached to them, even if perfect, which they are not, would be insufficient for their maintenance; added to which the length of time, often several weeks, that elapses between their

removal and replanting, renders the existence of life rather problematical at the period when the latter occurs, and in most instances we might as reasonably expect the Christmas holly branch, planted in May, to grow, as the *Lycopodium clavatum*, fresh and green as it may appear, from the collector's basket.

LYCOPODIUM ANNOTINUM. Interrupted Club-Moss. TAB. XVI.

Stem creeping: branches ascending. Leaves spreading, obscurely five-rowed, linear-lanceolate, minutely serrated, acutely pointed. Fertile branches erect. Spikes oblong cylindrical, sessile, terminal, solitary.

Lycopodium annotinum, *Linnæus*. *E. B.* 1727. Generally adopted.

The rarest of our indigenous species. The only spot on which it has been found in the southern division of the kingdom is on the side of the Glyder mountain, Carnarvonshire, above Llyn-y-Cwn, where, though formerly abundant, it is now of rare occurrence, if not, indeed, latterly exterminated. In Scotland it is rather widely distributed, though generally at considerable elevation, especially on the Cairngorum and Clova Mountains. The strong, wiry, tough stems do not spread to the same extent as those of *L. clavatum*, though they root at intervals in a similar manner, and the habit of the two is very different: in the present species the leaves spread out and are often even reflexed; the arrangement in five rows is not at first sight very evident, but it gives in recent specimens an angularity to the general outline of the branches especially that can scarcely be overlooked. The fructifying branches present a contraction in the foliage at the base of each annual elongation, giving them a jointed appearance, whence the specific name *annotinum*, literally, marked yearly. This peculiarity, eminently characteristic of the species, originates in the successive annual postponement in developing the spikes of fructification at the summit of the branches in question, each such branch requiring a varying number of years to elapse, apparently from three to seven, previous to its attaining the condition of fertility: this latter condition may occur earlier or later according to circumstances, and I have examined specimens in which a partial development of the spike had taken place at a previous period, but, proving abortive, the branch had elongated above it in the following year, leaving no other remains of the fructifying effort, except a more distinct separation of the two leafy extensions, bearing in the interval a few rounded scales or bracts in lieu of leaves. There can, I think, be little question that the assertion of Sir J. E. Smith, in the 'English Flora,' respecting the proliferous character of the axis of fructification, ori-

ginated from the observation of similar specimens; he describes the "flowering branches" as "erect, densely leafy, but little subdivided, each terminating in a solitary upright spike, whose scales, being deciduous, seem to leave the branch partly naked; but it afterwards bears proper leaves, except a few diminished ones just under where the spike had been, and produces, in the following season, another spike: hence the jointed or interrupted aspect of the branches." In modifying the description of the species for the second edition of the 'English Botany,' this explanation was retained as plausible; but my acquaintance with the plant rested at the time on a solitary preserved specimen: the after-examination of many both recent and dried examples, exemplifying an economy altogether different to that detailed in the work above quoted, has led to these remarks. The after-extension of an imperfect spike into a leaf-bearing branch in this plant, has its parallels in *Abies nigra* and some other Conifers, in which abortive cones become similarly elongated.

Its geographical range seems to be less limited than its frequency and abundance, and extends through the northern parts of Europe and North America, but with a general tendency to elevated habitats. It is recorded by Linnæus, however, as rare in Swedish Lapland and growing in woods, and similar localities are assigned to it in Canada and in the adjoining states of the American Union.

LYCOPODIUM ALPINUM. Savin-leaved Club-Moss. TAB. XVII.

Stem creeping: branches ascending, dichotomous, fasciculate. Leaves imbricated, in four rows, oblong lanceolate, keeled, acute, entire, appressed. Spikes sessile, oblong cylindrical, terminal; their scales ovate lanceolate, flat.

Lycopodium alpinum, *Linnæus*. *E. B.* 234. Generally adopted.

Frequent and often very abundant on the mountains and high moorlands of the north of England, Wales, Scotland, and Ireland, but, as the specific name implies, only to be met with in districts of considerable elevation. The stems are exceedingly tough and almost woody, creeping and rooting at intervals like those of the Common Club-Moss, which frequently accompanies and interlaces with it, and which they emulate in length and tenacity. The branches, from two to four or five inches high, spring in tufts from the rooted parts of the stem, dividing repeatedly in a dichotomous manner, all the divisions terminating on, or nearly on, the same level, and thus forming compact shrub-like groups. Both stems and branches are completely clothed with leaves, more or less densely imbricated, in four rows, which, differing in size and form on the alternate sides of the barren branches, give them the ap-

pearance of being somewhat flattened in one direction. The leaves are oblong approaching to lanceolate and rather obtuse than pointed, with an indistinct keel or midrib, and destitute of serratures. The fruit-bearing spikes terminate the upper divisions of the older branches, and, owing to the dichotomous character of the latter, are usually in pairs; they are about three-quarters of an inch in length, rather thicker than the branches, and of a paler hue; their scales or bracts are broad at the lower part which covers the theca, but narrower above, terminating somewhat obtusely like the leaves. The general hue is a dull bluish-green, but the spikes are yellowish, especially as they approach maturity about the end of July.

Of the properties of this plant but little is recorded that can be depended upon, except that it communicates a yellow dye to wool. Sir W. J. Hooker, in his 'Journal of a Tour in Iceland,' 1809, remarks upon its employment by the inhabitants of that island to the following effect:—"A vast heap of *Lycopodium alpinum* lying before the priest's house drew my attention, and, on inquiry, I found that it was used for the purpose of giving their *wadmal* (woollen cloth) a yellow dye; which is done by merely boiling the cloth in water, with a quantity of the *Lycopodium* and some leaves of *Vaccinium uliginosum*. The colour imparted by this process, to judge from some cloth shown me, was a pale and pleasant, though not a brilliant yellow." Other species of the genus yield a similar colour, among which is the continental *L. complanatum*, a plant often confounded with the present by the earlier botanists.

The Alpine or Savin-leaved Club-Moss is a very elegant species, well worthy of cultivation, and from my own small experience not more difficult to grow than its more common and more generally distributed congener, *L. clavatum*; but the same uncertainty, arising from the circumstances under which it is usually obtained, attends its introduction.

In geographical distribution, the tendency to elevated habitats appears to be the only limit to its extension in the temperate and colder districts of the northern hemisphere. The distinction between the European plant and the Canadian, *L. sabinæfolium* of Pursh, appears at least very problematical.

Lycopodium Selago. Fir Club-Moss. Tab. XVIII.

Stem short, erect or slightly decumbent: branches fastigiate, dichotomous, level-topped. Leaves densely imbricated, obscurely eight-rowed, very rigid, linear-lanceolate, acuminate, entire. Thecæ in the axils of the leaves.

Lycopodium Selago, *Linnæus*. *E. B.* 233. Generally adopted.

Frequent, and often very abundant, on heaths and barren sandy and stony uplands in most parts of the kingdom, though apparently preferring those which are elevated above the surrounding parts of the country. In mountainous and rocky districts especially, it is one of the most common and generally distributed of our indigenous species, and occupies in many places a greater elevation than any of them, *L. annotinum* perhaps excepted. The plants are like little compact bushes, varying in height, according to the soil or degree of exposure, from two or three inches to a span. When sheltered from the wind the growth is usually rigidly erect, but when exposed to its influence, the weight of the compact tuft in the larger plants occasions them to assume a decumbent position, and sometimes, rooting thus, the prostrate stem acquires a considerable length, and a habit is induced so different to that ordinarily met with, that it might at first sight be regarded as belonging to another species. The stems and branches, repeatedly dichotomous, are closely imbricated with rigid, glossy, linear-lanceolate acuminate leaves, obliquely disposed in eight rows, an arrangement most readily observed by holding the ends of the branches perpendicular to the eye. The fructification is very unlike that of any other British Lycopodium: no spikes are formed, but the thecæ are developed singly in the axils of the ordinary leaves, most abundantly, but by no means exclusively, towards the upper parts of the branches; indeed they are not unfrequently found throughout the plant: their production seems to take place at a certain age, or rather under a certain condition that occurs at periods varying in different individuals, and is associated with a peculiarity, unnoticed by any botanical author since it was referred to by Dillenius as a newly observed fact, in his 'Historia Muscorum,' until Mr. Newman called attention to it by the following passage in the 'History of British Ferns and Allied Plants:'—"On the Welsh mountains I have observed that only a portion of the plants appear to be in a thriving and healthy condition, the larger ones almost invariably being loaded with fructification, and exhibiting symptoms of incipient decay. With the exception of Dillenius, I think no author has noticed this peculiarity; and this learned writer rationally concludes that each plant exists for a definite term and then dies. Whether the term of its existence be biennial, triennial, or longer, I leave for future observers to decide; but I have not the slightest doubt that its existence has a fixed term, as suggested by the great muscologist." The condition of the older fructifying plants alluded to by Mr. Newman, attracted my attention in the Snowdon district many years back, but not being at that time familiar with the celebrated work of Dillenius, I was at a loss to account for a phænomenon which afterwards furnished an undeniable explanation of

the fact that specimens removed in the fertile condition uniformly died, while the others survived one, two, or even three years, and then died with the rudiments of fructification in the axils of their leaves. We may therefore, I think, regard *Lycopodium Selago* as a plant of biennial character, which, like others of the same ordinary duration, occasionally survives for a longer period when circumstances postpone the production of the thecæ.

It is frequently viviparous; small leafy buds, that eventually drop off and vegetate, being developed in lieu of thecæ in the axils of some of the upper leaves of the branches. This mode of reproduction is very common, especially at great elevations, and, as in similar circumstances among the Mosses as well as the higher orders of vegetation, seems to be often, but not constantly, attended by non-development of the true seeds or sporules. One of the middle branches on our plate represents two of these buds in the natural position: Mr. Newman has illustrated very fully their structure and œconomy (page 378 of the work above quoted), but an extract would be too long for our pages, and it will be sufficient further to remark that the buds in question afford a very convenient mode of introducing the plant to cultivation, as they quickly root and grow freely under glass. As they are often produced in considerable numbers, it is probable that in certain situations they constitute the principal source of propagation.

The Highlanders and other northern peoples employ this plant, instead of alum, as a mordant to fix their colours in dyeing: with Brazil-wood especially it is said to produce a beautiful and permanent blue; *L. clavatum* and other species are sometimes used with a similar effect. They likewise prepare from it an irritating ointment, and occasionally administer the decoction or infusion internally as an emetic and cathartic: Linnæus refers to a similar use of its emetic quality in Sweden, where it is sold by many of the medicine venders, under the name of *Muscus catharticus*; but he adds, on the authority of Rothmann, that it is violent in its operation, and apt to induce vertigo and convulsions, unless given in very small doses. The same decoction, he informs us, is used by the country people, as a detergent wash to destroy the vermin that infest their swine and cattle.

The specific name *Selago*, according to De Theis, is derived from the Celtic *sel*, sight, and *jach*, salutary, it being once held a valuable remedy in diseases of the eye, for which purpose the ointment is stated to be still employed in the Highlands of Scotland, producing an effect somewhat similar to that prepared from Savin (*Juniperus Sabina*).

The geographical range of the normal form of *Lycopodium Selago* seems to be limited to the Eastern Hemisphere, where it is very common in northern Europe and the adjoining parts of Asia. In

North America, *L. lucidulum* of Pursh, *L. reflexum* of Schkuhr, resembles it very nearly in habit, in the axillary position of the thecæ, in the frequent development of deciduous buds or bulbs, and in the octoserial disposition of the leaves, and, with the exception of the latter being reflexed instead of densely imbricated, I am unable to discover any decisive feature of distinction; the toothed character of the margin is not constant in Canadian specimens and is sometimes present in the European species, the leaves of which, though never so widely divaricated or spreading as those of the American plant, occasionally display, the lower ones especially, a tendency to become reflexed. The moister habitats affected by *L. lucidulum*, "low sphagnous grounds and on the banks of shady rivulets," would be alone sufficient to produce a more important alteration in general character. These remarks apply equally to objections respecting the identity of other species of *Lycopodium* regarded as common to the two hemispheres.

Lycopodium inundatum. Marsh Club-Moss. Tab. XIX.

Stem creeping, short: branches few, simple, short, erect. Leaves scattered, linear, entire, acute, curved upwards. Spikes terminating the short erect branches.

Lycopodium inundatum, *Linnæus*. *E. B.* 239. Generally adopted.

Occasionally found on moist boggy heaths in different parts of the kingdom, but it is a local rather than a common species, and more frequent in the southern counties of England than elsewhere; in alpine districts especially its occurrence is rare. It seems to have a very slight attachment to the soil, a circumstance that accounts for its preference for places from which the turf has been recently pared off, leaving little or no other vegetation to contend with; in such situations it is frequently so abundant as to cover the dark peaty soil, which is essential to its more luxuriant state of growth, with a verdure of the brightest green. The specific name refers to its preference to spots upon which water accumulates occasionally during the winter rather than to any tendency to aqueous habitats, as it will be generally met with in situations so well drained as to be perfectly dry during the heats of summer, and over a subsoil of sand or gravel. The stem creeps closely pressed to the ground, rooting at intervals by strong fibres that scarcely reach half an inch below the surface; it is very rarely branched, on account of its peculiar habit of dying away annually, leaving only the extreme growing point, from which a new extension takes place the following year; hence a specimen producing two or more prostrate branches during one summer, as is occasionally the case, would, in the succeeding one, form as many distinct plants. The leaves are narrow-

linear and acute, curving upwards, and of a bright yellowish-green hue. The erect branches described in the above specific character are not always present, especially where the prostrate stem itself becomes branched, their elevation being associated with the production of fruit: they are usually single, from one to three inches in height, and terminate in a solitary spike occupying about half or one-third of their length, whose leaves, bearing the thecæ in their axils, are broader towards the base than those of the stem, and are occasionally furnished with a tooth-like projection on each side. The thecæ are nearly globular, and ripen about the end of August or the beginning of September.

For cultivation, the turf containing the plants should be cut off without interfering with the roots, taking with the mass a sufficient surface to admit of the following annual extension. The failure, which is complained of by most persons, of their efforts to grow this interesting, though not showy species, appears to be owing to want of management in this respect and to the planting in loose soil; the latter error very slight observation of its natural habitats would teach us to avoid, as the ground that bears it always has the appearance of having been beaten and washed, so as to leave no shifting particles upon the surface. Its very short roots are ill adapted to fix it in the artificial compost employed for growing Ferns and many of its more deeply rooting congeners.

LYCOPODIUM SELAGINOIDES. Lesser Alpine Club-Moss. TAB. XX.

Stem creeping, much branched, sinuous. Leaves scattered, lanceolate, ciliato-dentate. Spikes solitary, sessile at the extremity of short erect leafy branches.

Lycopodium Selaginoides, *Linnæus*. *E. B.* 1148. Generally adopted by English botanists. Selaginella spinulosa, *Koch*.

In boggy ground, on the sides of hills, and especially about rills and waterfalls, in the rocky districts of the north of England, Wales, Scotland, and Ireland, this is not unfrequent. The numerously branched prostrate stems root at intervals like those of the other procumbent species, but appear to take very slight hold of the soil; they are slender, leafy throughout, and spread by their somewhat sinuous branches much in the manner of those of *L. clavatum*; the plant is, however, of comparatively very small size, and otherwise totally different in habit. The leaves are grass-green, shining, lanceolate, and rather spreading; and are remarkable among the species of this genus for their deeply serrated margins, the serratures terminating in fine cilia-like points, whence the English name Prickly Club-Moss, bestowed upon it by some writers. The fructification is developed upon the older branches,

two or three of which in the course of the summer become elongated and, at first assuming an ascending position, eventually grow erect, varying from one to three inches in height, according to situation and soil. The extremity of the branch gradually assumes a different character from that which it had in the procumbent state, becoming thicker and club-shaped, with leaves larger and broader at the base, in the axils of which two kinds of thecæ are developed, those toward the upper part of the spike opening with two valves and discharging an impalpable powder, those of the lower part separating with three divisions and discovering three or four large grains nearly the size of poppy seed. This is the only British Lycopodium in which the two forms of the reproductive apparatus mentioned in the generic character are uniformly to be met with; in the others the occurrence of the granule-bearing thecæ is either rare or they are but sparingly distributed; I have found them on three species, *L. clavatum, alpinum,* and *Selago,* and close examination of these and others may probably lead to the establishment of the fact that their production is less limited than hitherto supposed: their frequent occurrence in the imported powder is not perhaps a circumstance of importance in the question, as, though chiefly the produce of the Common Club-Moss, we know not what other species may be collected with it in those parts of the continent whence the supply is obtained.

With the exception of the smaller size of the specimens, there does not appear to me to be any essential difference between the Canadian plant under this name and our English one.

I have not had *L. Selaginoides* under cultivation. The only plants that have come under my notice in this part of England were kept under a bell-glass, in which state they had existed two years, but no fertile branches had made their appearance last August, and the specimens had not a healthy aspect.

CHARACEÆ.

These are aquatic plants, and always grow submerged, preferring stagnant to running water, though occasionally met with in slow rivers. They are of annual duration only, and but slightly attached to the muddy bottom of the ditches and pools that are their favourite habitats. Their slender, wiry stems are more or less branched in a dichotomous manner, very brittle, and conspicuously jointed, each articulation being surrounded by a whorl of slender branchlets. In the subgenus *Nitella,* the appearance of the stem is that of a single transparent tube divided transversely at intervals. In *Chara,* properly so called, the central tube, or rather succession of tubular cells, is surrounded by a number of smaller ones; and the whole

is generally encrusted by a comparatively thick coating of calcareous matter, carbonate or phosphate of lime, a secretion of the plant itself, and bearing some analogy in its disposition to the siliceous particles in the stems of *Equisetum*, and, according to Sir D. Brewster, exhibiting similar optical phænomena.

The organs of reproduction are of two kinds, axillary to the branchlets and in many instances accompanying each other:—1. *Globules* of a red or orange colour, consisting externally of eight triangular valves, enclosing a mucilaginous fluid, investing spiral filaments, and cells containing minute reddish granules. 2. *Nucules* of an oval form, composed externally of two envelopes, the outer very thin and transparent, the inner formed of five or more spirally twisted filaments, enclosing a cavity containing minute granules which appear eventually to combine into a single seed. The extremities of the spiral filaments often form a crest on the summit of the nucule.

These curious bodies have been variously described by different observers, a circumstance attributable, perhaps, rather to the different periods of incipient or matured growth under which such examinations have been made, than to error in the appreciation of their results. For more detailed accounts of the complicated structures of both *globules* and *nucules*, the reader is referred to the succeeding descriptions of those of *Chara flexilis* and *C. aspera*.

Young plants may be freely raised from the *nucules* of all the species, which, however, certainly partake more of the character of deciduous buds than of seeds; the spiral filaments of the envelope representing a whorl of branchlets. The notion that the *globules* are stamens, or that they fulfil an analogous function, is no longer tenable: the remark by Wallroth of having witnessed their germination, I have myself seen attested by the growth of those of *C. aspera* in several successive years; the plants produced were always clustered, two or more together, and presented a striking contrast to those springing solitarily from the nucules of the same.

The Characeæ are widely distributed, inhabiting stagnant waters, both fresh and salt, in almost every part of the world. The species are all of a dull greenish hue, and generally give out a disagreeable fetid odour. Their œconomical value is to be sought in the ministry of nature, under which, in common with many other aquatic vegetables lower in the scale of organization, they constitute an important series. They tend to maintain a healthy condition of the water in which they grow, and at the same time assist, by their annual development and subsidence, in elevating the bottoms of pools and lakes, until they are brought sufficiently near the surface to be further solidified by the successive vegetation of the numerous species of Rush, Carex, Equisetum, &c.; and subsequently thus aid in forming a soil endued with the essence of fertility, and requiring

only modification by the art and industry of man to convert it to his immediate use and benefit. The quantity of calcareous matter elaborated by some of the Charas—so great as to have acquired for them the vulgar name of Stoneworts—is an admirable adaptation for this purpose, like the siliceous deposits, before alluded to, of the Equisetums. The share indeed that such plants have had, even from a distant geological epoch, in increasing the solid surface of our present lands, is evinced by the abundance of their fossil remains in the freshwater strata overlying the chalk in the Isle of Wight, about Paris, and elsewhere. These remains consist both of the stems and nucules, but chiefly the latter, called by Lamarck, *Gyrogonites*, under the impression that they were the shells of a testaceous animal: their identification, together with the important fact, that those of *Chara hispida* abound in the calcareous marls of Forfarshire, while the same species exists profusely in a living state in the lakes that still cover portions of their surface, may be regarded as among the most beautiful and interesting discoveries of modern science. Dr. Lindley remarks that "the fetid effluvium arising from them is regarded as very unhealthy, and one of the sources of the malaria of the Campagna of Rome." The salubrity of this or any corresponding odour is questionable; but whether the atmosphere of that renowned region of sickness and death, or that of our English swamps and fens, would be improved by the absence of plants that subsist upon the impurities of their waters, is doubtful; we expect neither the sweep nor the scavenger to exhale Eau de Cologne, but the value of their services as ministers of cleanliness is not less certain, nor their efforts for the abatement of nuisances less desirable and praiseworthy.

In consequence of the exceeding tenuity of the cellular membrane constituting the organic structure of these plants, and its all but perfect transparency in *Nitella*, as likewise in *Chara* itself, when the calcareous incrustation is removed, the movement of the vital fluid contained in their tubes or cells may be distinctly seen by the assistance of a microscope. The public attention was first directed to this curious phenomenon by Professor Amici of Modena, and similar movements have been since traced in the cells of a variety of other plants, but not in any affording equal facility for examination. The fluid contents of each elongated cell or tube form a rotating current always in the same direction, ascending on the outer side, or on that farthest from the axis of the plant, and descending on the inner, although no partition exists between the two courses, as is evinced by the fact, that of the granules or molecules floating in this fluid, one or more, pursuing a course upward or downward with one side of the current, will be occasionally attracted into the other and forcibly carried away in the opposite direction. It is by the presence of these molecules, which are

more opaque than the medium in which they float, that the circulation, or *rotation* as it is technically termed, of the containing fluid is distinguishable: they vary considerably in dimensions, but the largest cannot be distinctly traced with a lens whose focus is more than $\frac{1}{13}$ of an inch, and to follow their movements successfully in the aggregate, the higher powers of the modern achromatic microscope are required. The velocity of the motion has been variously stated as estimated by different observers; but it is dependent upon the time of year, and, more especially, upon the surrounding temperature; below 50° Fahr. the movement is either so slow as to be scarcely perceptible, or it ceases altogether.

The claim of this order of plants to rank among the "Fern Allies," however incongruous that assemblage undoubtedly is, must be considered as more vague and uncertain than that of any of the preceding. Its place in any arrangement has never been satisfactorily determined. Linnæus commenced by placing the genus *Chara* among the flowerless plants of his class *Cryptogamia*; and afterwards, regarding the *globules* as *stamens*, and the *nucules* as *pistils*, removed it to the Phanerogamous or flowering series. Later botanists have been equally divided as to its real affinities, and, after having been successively transferred from one group of aquatic plants to another, and eventually established as a distinct natural order, it still remains an anomaly in botanical classification. In certain points of general structure it approaches that of the Confervoid Algaceæ, but the nature of its reproductive organs is too complicated to admit of its being placed so near the bottom of the structural scale; and, though Dr. Lindley in his "Vegetable Kingdom" has adopted this allotment of Characeæ for convenience sake, he does not fail to point to its other affinities. In the second edition of "English Botany" I placed Characeæ after Equisetaceæ, remarking that there is sufficient resemblance between the nucules of *Chara* and the sporules of *Equisetum*, independent of many peculiarities in mutual habit and organization, to warrant its temporary position as a reduced form of that order. The resemblances in question are very striking, if we set aside the fact that the Charas are destitute of any true vascular or woody tissue—in both orders we shall then have stems interrupted at intervals by articulations, and having the central cavities or internodes encompassed by a series of smaller ones; earthy secretions constituting an integral portion of the organic structure; the absence of true leaves; the whorled branchlets; and, lastly, the reproductive organs so evidently formed by modification of such whorls at the base of an embryo stem, as exemplified in the spirals covering the nucules of *Chara*, and the spirally curved stamen-like processes investing the sporules of *Equisetum*. Critically considered, these analogies may be rather specious than real; but it is to be lamented that a similar

objection may apply, and with equal force, to many other items of vegetable classification, founded upon so-called natural affinities which have no firmer foundation than such resemblances.

The globules and nucules being in some species developed upon the same, and in others upon different plants, these latter are described as being *monœcious* or *diœcious*.

CHARA.

Gen. Char. The same as that of the Order, of which it is probably the only genus extant.

The name *Chara* is of uncertain derivation; it was applied by the ancients to some aquatic plant with edible roots, memorable as being resorted to, under a scarcity of provisions, by Cæsar's soldiers, during the war in Spain against Pompey. Linnæus adopted it for the genus before us without any reference to its former signification beyond that of corresponding habitat. The species are now usually arranged under two subgenera.

1. NITELLA.

Plants more or less pellucid; not striated; joints simply tubular.

Chara flexilis. Flaccid Nitella. Tab. XXI.

Plant monœcious. Stems slender, smooth, flexible, pellucid. Branchlets pointed, nearly equally forked, or trifid. Nucules and globules approximate in the forks of the branchlets, ebracteate.

Chara flexilis, *Linnæus. E. B.* 1070. C. nidifica, *some authors.*
Nitella flexilis, *Agardh, Syst. Alg. E. B.* ed. 2.

A very weak, slender plant, far from unfrequent in ditches and other stagnant waters. The whorled branchlets are generally forked or trifid at the extremity, but occasionally simple, and sometimes so much divided as to give them a clustered appearance; which latter state has probably occasioned it to be confounded with another species, as *C. nidifica*. The nucules and globules are produced in the forks of the branchlets of the upper whorls, and are, for the most part, unaccompanied by the short bracteal appendages or modification of secondary whorls which characterize those of *C. Smithii* and some others: they are sometimes found side by side, but seem to be most frequently solitary. Mr. Babington describes the nucules as having six striæ, which is perhaps generally the case; but the spirals of these curious organs are too liable

to vary in number to be depended upon as features of much value in specific distinction.

The following remarks upon the structure of the globules in this species are extracted from the description given of them by the Rev. M. J. Berkeley, under his notice of *Chara Hedwigii* in E. B. Supp. 2762, and are valuable as conveying a general idea of their complicated development:—

"The globules are not perfectly globose, but slightly obovate, with a very short pedicel: beneath the transparent external membrane, the surface is divided into eight equilateral triangles by one horizontal and two vertical great circles: in the centre of each of these triangles is a subrotund area, from which lines radiate regularly, so as to form obovate oblong cells,—the line which radiates from one triangle running to the middle of the outer boundary of the corresponding cell in the adjacent triangle. The globules are filled with a mass of transparent, colourless, flexuose, confervoid filaments, with articulations about equal in length and breadth; and minute orange spherules, whose diameter is less than that of the filaments, are contained in the radiating cells of the triangles, which are raised on the inner side. These spherules are immersed in gelatine, as the green spherules of the stems are. In the centre of each of the spherical triangles into which the surface is divided, on the under side, arises perpendicularly an orange-coloured cylinder which bears on the top a bell-shaped cup, which is at first orange, being filled with the same granules as the cells, afterwards pellucid and striate or plicate at the margin. At the place where the cup is attached to its pedestal, the confervoid filaments originate.—It appears that the orange matter contained in the radiating cells has access, by means of the hollow pedestal and bell, to the curved filaments. The pedestal is certainly hollow, as, when dry, the orange mass contracts exactly as the colouring matter does in the joint of a *Conferva*." Such appears, with slight variation, to be the general structure of the globules throughout this genus; and that they, as well as the nucules, are modifications of the primary organs of the plant, viz. of the stem and branchlets, will be readily admitted by the attentive examiner; but, beyond this, our knowledge of their relative functions is at present little more than speculative. The globules attain maturity and fall off, generally, long before the nucules, the parts composing them separating more or less at that period: but the fact, that young plants spring from them, at once decides against the supposition that they fulfil the office of anthers.

The structure above described is well illustrated by Mr. Berkeley's magnified figures of the parts mentioned. Figure *a* represents the divided extremity of one of the branchlets bearing a globule; *b*, a globule separated; *c*, the same greatly magnified;

d, one of the triangles seen from within, with its pedestal and radiating cells; *e*, the pedestal when dry; *f*, one of the cups, with a portion of its pedestal and accompanying confervoid filaments; *g*, the same cup and filaments as they appear at an earlier stage, without the pedestal; *h*, the filaments and granules.

CHARA SYNCARPA. Twin-fruited Nitella. TAB. XXII.

Plant diœcious. Stems slender, equal, smooth, flexible, pellucid. Branchlets bluntish, apiculate, nearly equally forked or trifid. Nucules or globules in the forks of the branchlets, ebracteate.

Chara syncarpa, *Thuillier*. *Babington, Man. Brit. Bot.*

The striking difference between this and *C. flexilis*, as shown on our plates, must not be depended upon, as the two forms present every intermediate gradation. I have not found them together, but am informed that they not unfrequently occupy the same waters. The distribution of submerged aquatic plants is at all times a subject difficult to be ascertained, and although that of the present is apparently limited, it is probably not more so than others which are regarded as common. To previous habitats in Sussex, Cambridgeshire, Caernarvonshire and Galway, we may add the pool on Wandsworth Common, Surrey, in which *Stratiotes aloides* abounds, and a ditch in the meadows near Dulwich College, where it grows in company with *Ranunculus pantothrix*, as well as other stagnant waters in the same county. If a distinct species, which is very doubtful, the leading characteristic must be sought in the peculiar bluntness of the branchlets, so dissimilar to those of *C. flexilis*, and their apiculate termination, both of which are exhibited in the magnified views on the right side of our plate. The diœcious disposition of the nucules and globules, though usual, is not constant; they attain their maturity in June.

CHARA TRANSLUCENS. Translucent Nitella. TAB. XXIII.

Plant monœcious. Stems thick, equal, smooth, flexible, pellucid. Sterile branchlets spreading, simple, not articulated. Fertile whorls of small bi- or tri-furcate branchlets. Nucules small, oblong, two or three together, just below the bract-like branchlets that surround the solitary terminal globule.

Chara translucens, Persoon. *E. B.* 1855. Nitella translucens, *Agardh, Syst. Alg.* 124. *E. B.* ed. 2. 1467.

Found in deep stagnant water only, and, though widely distributed, far from frequent. The thickness of the stems and branchlets

varies in different situations, but is usually very striking compared with that of the other species of the subgenus *Nitella*. The branchlets of the fertile whorls, being small, closely placed, and tending to an erect position, have the appearance of being capitate. The number of spirals composing the nucules is from five to seven; the relative situation of these organs to the solitary globule is shown in our magnified figure. The whole plant is very smooth and glossy, and the greater size and transparency of its long continuous cells render it the most valuable of all the species for microscopical examination of the rotating fluid. It may be found in fructification from July to September.

CHARA MUCRONATA. Mucronate Nitella.

"Plant monœcious. Stems slender, equal, flexible, transparent. Branchlets strongly mucronate, nearly equally forked or trifid. Nucules and globules together at the forks of the branchlets, without bracts."

Chara mucronata, *Braun. Babington, Man. Brit. Bot.*

Found by Mr. Borrer in a marsh-ditch at West Grinstead, Sussex. I have not seen this plant. Mr. Babington describes it as being "rather thick;" the secondary branchlets once or twice forked, and the terminal subdivisions rather shorter than the others. The nucules have four or five spirals, and mature in July.

As a species distinct from *C. translucens*, the above description is not very satisfactory. The apiculate termination of the forks of the fertile branchlets is shown in our figure of the latter plant, and the term *mucronate*, though nearly synonymous, is scarcely applicable to any such appendage to the extremities of the branchlets of this family; the point in question being generally formed by an abortive or contracted cell. The absence of bracts affords a character of greater apparent value, but even this is equivocal, as the organs so called, in other species or varieties, are only modifications of branchlets.

CHARA GRACILIS. Slender Nitella. TAB. XXIV.

Plant monœcious. Stems very slender, equal, smooth, flexible, pellucid. Branchlets in loose whorls, repeatedly divided; terminal segments apiculate, shorter than the others. Nucules and globules produced together, one of each, at the subdivisions of the branchlets, ebracteate.

Chara gracilis, *Smith. E. B.* 2140. Nitella gracilis, *Agardh, Syst. Alg.* 125. *E. B.* ed. 2. 1470.

Found by Mr. Borrer in boggy pools in St. Leonard's Forest, Sussex. By others in Llyn Idwel, North Wales, and in Jersey.

There is a peculiarity in the general aspect of this plant, especially when viewed in water, that would induce the observer to regard it as a perfectly distinct species. The comparatively small size, and the almost hair-like tenuity of the whorled barren branchlets, that spread out diverging so much from the stem as often to become deflexed, added to the compact, almost capitate appearance of the fertile ones, render it the most elegant of its kind. It is of a pale green hue, glossy, and almost transparent. The fructification is axillary to the subdivisions of the upper branchlets, and unaccompanied by short bracteal appendages. A single nucule and globule generally grow side by side, but they are often solitary, and sometimes, as observed by Mr. Wilson, to whom we are indebted for its Llyn Idwel habitat, occur on separate plants, thus departing from the monœcious character. The nucules are subglobose, proportionally large, with from four to six spirals, and, with the globules, are perfected in August.

The different size and more complicated division of the branchlets, both exceedingly arbitrary features of distinction, alone separate this from *C. flexilis*.

CHARA TENUISSIMA.

"Plant monœcious. Stems slender, equal, flexible, transparent. Branchlets short, in dense, compact, subglobose whorls, repeatedly divided into from three to seven segments; terminal segments mucronate, longer than the others. Globules and nucules each solitary, but together at the subdivisions of the branchlets, without bracts."

Chara tenuissima, *Desvaux. Babington, Man. Brit. Bot.*

Found by Mr. C. C. Babington in peaty ditches in Cambridgeshire. I have only seen this in the dried state, in which it is scarcely possible to trace any material difference between it and *C. gracilis*. It must, however, be admitted, that preserved specimens of these slender aquatics afford little foundation for inquiry into specific distinction. Mr. Babington's description presents some apparently important characteristics at variance with such a conclusion: "Very small and slender. Branchlets very much divided, forming little globose compact masses, which are often much incrusted. Nucules subglobose, with from six to eight striæ, minute, but three times the diameter of the branchlets, and placed outside of them. Globules much larger than the nucules." Fructification matures in July and August.

CHARA SMITHII. Smith's Nitella. TAB. XXV.

Plant diœcious. Stems slender, equal, smooth, flexible, pellucid. Branchlets blunt: those of the primary whorls simple, elon-

gated, sterile; those of the axillary branches numerous, densely crowded, bearing three secondary branchlets (bracts) at the articulation of the terminal joint. Globules stalked, subtended by the three bracts. (Nucules unknown?)

Chara Smithii, *Babington*. C. nidifica, *Smith*. *E. B.* 1703. Nitella nidifica, *E. B.* ed. 2. 1469.

The plant figured in 'English Botany,' Tab. 1703, under the name of *Chara nidifica*, as a native of salt-water ditches in some of the southern and eastern shores of England, is involved in some obscurity: that it is not that so called by some continental botanists, seems probable at least, though not altogether decided. The simple, much elongated branchlets of the primary whorls, and the crowded and divided characters of those bearing the fructification, though sufficient to hold it distinct from *C. flexilis* and its near allies, are equally characteristic of the two following, *C. prolifera* and *C. Borreri*, as is likewise the presence of the three bracts, so called. The stalked condition of the globules may or may not be constant, but as it occasionally occurs in others where that curious organ is generally sessile, it can assuredly not be regarded of much importance in the present instance.

The figure and description refer to specimens found by Mr. Borrer in a ditch at Lancing, Sussex.

CHARA PROLIFERA. Proliferous Nitella. TAB. XXVI.

Plant monœcious. Stems slender, equal, flexible, pellucid. Branchlets blunt: those of the primary whorls simple, elongated, sterile, usually of three or four joints; those of the axillary branches numerous, densely crowded, bearing three secondary branchlets (bracts) at the articulation of the terminal joint. Globules sessile, accompanied by one or more nucules, subtended by the three bracts.

Chara prolifera, *Braun*. *Babington, Man. Brit. Bot.*

First noticed by Mr. Borrer, growing in ditches, at Cley, Norfolk, in 1806, and afterwards in Hayling Island, Hants, in May 1853. The following is his description of it in the latter habitat:—

"The plants grow erect in dense clusters, a few inches high. Root of very slender, colourless, transparent fibres, with whorled finer fibres at the knots. Stems at about an inch from the base beset with a whorl of longish, blunt, pointed, barren branchlets, and divided into several primary branches, similarly whorled with branchlets, from the axils of which again grow short branches, and much crowded, shorter whorled branchlets. These last are curved upward and inward a little above the base, and at the point of curvature produce, on the upper side, a cluster of sessile globules and

nucules intermixed, subtended by three, sometimes four, bracts shorter than the continuation of the branchlet; one of which bracts diverges at right angles from the under side of the branchlet, while the others are curved upward, clasping the fructification. Clusters of nucules are sometimes produced at the base of the branchlets likewise."

Mr. Borrer observes that the incrusted state of all his specimens was such as to render the three or four joints existing in each of the whorled branchlets with difficulty discernible, and this is not an uncommon circumstance with other species or varieties of *Nitella*, though apparently dependent in a great degree upon the character of the water in which they vegetate.

CHARA BORRERI. Borrer's Nitella.

"Plant monœcious. Stems slender, equal, flexible, pellucid. Branchlets strongly mucronate: those of the primary whorls simple, sterile, long, jointed; others on axillary branches, many densely crowded, bearing three short and one long bract at their first and sometimes second joining. Globules stalked or sessile, in company with several nucules, and subtended by the three shorter bracts."

Chara Borreri, *Babington, Man. Brit. Bot.* C. nidifica, *Borrer, E. B. Supp.* 2762, note.

The indefatigable botanist whose name this plant bears, found it in a marsh-ditch at Henfield, Sussex, about seven miles from the sea in a direct line, but occasionally affected by the tide, in July 1827. At the time, he seems to have regarded it as identical with that since named *C. prolifera*, found by him at Cley, in 1806, differing only in being of a larger size. Mr. Babington, while bestowing upon it the rank of a species, remarks upon its near resemblance to both the latter and *C. Smithii*, "but larger;" the "one long bract," in his specific description, above quoted, according with our terminal joint in those of the plants in question. The inconstancy in the development of the globules, either stalked or sessile, reduces its distinctive character to one simple feature, viz. the termination of the blunt branchlets in an apiculus.

CHARA POLYSPERMA. Many-seeded Nitella.

"Plant monœcious. Stems slender, equal, flexible, transparent. Barren and fertile branchlets of the primary whorls once or twice unequally branched, middle branch longest: branchlets of axillary branches many, densely crowded, much subdivided into short joints, mostly finely pointed. Nucules and globules placed at the joinings of the branchlets between the lateral rays."

Chara polysperma, *Braun. Babington, Man. Brit. Bot.*

Found in running water, near Bury St. Edmunds, and Cambridge. Mr. Babington remarks that this species is distinguished from the three preceding by the absence of true bracts. Wanting recent specimens, his farther description is here adopted :—

" Small. Branches with two or three ascending branchlets, often again branched at their first joining; often, but not always, there is a simple branchlet beneath, and at right angles to the main branch at that point. Globules stalked, directed downwards. Nucules clustered, sessile, directed upwards."

There is much in the general aspect of this plant in favour of its claim to be considered a distinct species, which is more than can be said of many of the preceding. It is, indeed, the only one of those unfigured in our work, of which I regret that the incapability of obtaining living specimens at the required time, prevented us from illustrating by careful drawing and *bonâ-fide* description.

2. CHARA.

Plants more or less opaque, generally brittle; striated; joints compound, the central tube being surrounded by smaller ones, except toward the termination of the branches and branchlets.

Chara crinita. Bearded Chara.

" Plant diœcious. Stems slender, coarsely striated, thickly beset with setaceous spreading clustered spines. Branchlets abbreviated. Bracts whorled, slender, equal. Nucules narrowly oblong, shorter than the bracts."

Chara crinita, *Wallroth. Ann. Bot.* tab. 3. *Babington, Man. Brit. Bot.*

A native of stagnant brackish pools. Discovered by the Rev. W. L. P. Garnons, in Burdoch Pool, Falmouth, Cornwall. Stems erect, slender, smoothish, and rather flexible, slightly branched, pale green; coated with as many tubes as there are branchlets in each whorl. Whorls of eight or ten short branchlets, each of seven joints, with six bracts at each articulation. Nucules solitary, with about twelve spirals and a prominent crown.

I do not find either the number of spirals, or the prominence of the nucule crown formed by their extremities, at all constant in the present or in other species of this subgenus.

Chara vulgaris. Common Chara. Tab. XXVII.

Plant monœcious. Stems opaque, scabrous, brittle, obscurely striated. Whorled branchlets slender subulate: the fertile ones

with many clusters of short ramuli or bracts on the upper or inner side, each numbering about four, two or more of which are much longer than the single nucule and globule which they accompany.

Chara vulgaris, *Linnæus*? *Agardh, Syst. Alg.* 128. *E. B.* 336.
Chara fœtida, *Braun.*

Common in ponds, ditches, and slow streams. The whole plant is of a yellowish or reddish-green hue, and usually so much incrusted as to render its structure very obscure. The stems vary with the depth of the water from a few inches to a foot in length; the apparently simple branchlets being about the length of the joints from the articulations of which they proceed. The upper whorls only are fertile. The nucules present twelve or thirteen spirals, and are terminated generally, but not always, by a short crown. In most instances, a single nucule and a single globule accompany each other in each little tuft of the bracts so called: they may be found throughout the summer.

It is generally spoken of as being the most fœtid of the British species of *Chara*, but this character seems much dependent upon the condition of the water in which it vegetates.

CHARA HISPIDA. Bristly Chara. TAB. XXVIII.

Plant monœcious. Stems opaque, thickened upwards, brittle, striated, bristly or spinulose. Branchlets elongate; the fertile ones especially with many whorls of short ramuli or bracts, the innermost of which are longer than the solitary nucule and globule they accompany.

Chara hispida, *Linnæus. Agardh, Syst. Alg.* 128. *E. B.* 463.

Not uncommon in ditches and turf-pools. The earthy incrustation is often so dense as to give the plant the appearance of a petrifaction, though in some habitats it is nearly wanting. The surface of the stems is minutely tuberculate, and more or less deeply and spirally grooved, in consequence of the arrangement of the small outer tubes. The bristles or spines vary in abundance in different localities. The branchlets are simple, subulate, pointed toward the extremity, and composed of about seven joints, with a whorl of from four to seven short bracts at each articulation. The ovate nucules occupy singly, with a globule, the upper side of the whorl of bracts, those to which they are axillary being longer than the others. The odour is very fœtid.

CHARA TOMENTOSA. Tomentose Chara.

Plants "diœcious? Stems thickened upwards, spirally sulcate, rough, brittle, with scattered obtuse papillæ. Branchlets incurved.

Bracts unilateral, ovate-oblong, mucronate-acute. Nucule shorter than the bract on each side of it, longer than the three in front."

Chara tomentosa, *Linnæus. Babington, Man. Brit. Bot.* C. latifolia, *Willdenow. Hooker, Icon.* 532.

Found in Belvidere Lake, Westmeath, Ireland. "Opake, whitish-green. Stems covered with minute tubercles; papillæ distinct, rather whorled, short, blunt on the prominent primary tubes." I am unacquainted with this species.

CHARA ASPERA. Rough Chara. TAB. XXIX.

Plants dicœcious. Stems very slender, nearly flexible, finely striated, beset with scattered, spreading or deflexed bristles. Branchlets of the whorls short, subulate; the fertile ones with numerous whorls of short slender ramuli or bracts, the two innermost of which are longer than the others, and accompany the solitary globule or nucule.

Chara aspera, *Willdenow. E. B. Supp.* 2738. *Agardh, Syst. Alg.* 130.

Not unfrequent in bog-pits and other stagnant waters in the North of England, in Wales, and Scotland. Stems one or two feet in length, varying with the depth of water, densely crowded; beset with slender, acute, straight, spreading or deflexed bristles, which seem to be scattered without order, or perhaps very irregularly whorled. At the base of each whorl of branchlets is a row of long appressed bristles, connected in pairs, of which one points upwards and the other downwards. Between the outer tubes and the central one, in both the stems and branches, is a green cellular substance, arranged in lines alternating with the striæ, and separated, or broken transversely at intervals, giving them a spotted appearance. The branchlets, from six to nine in a whorl, consist of about seven joints, each bearing at its articulation five or six slender spine-like bracts. I have never met with nucules and globules on the same plant, and they are uniformly solitary. The spirals of the former are about twelve or thirteen, and terminate in a rather prominent crown. The smaller magnified figures on our plate illustrate the structure of the globules, which does not materially differ from that already described under *C. flexilis*. Mr. Wilson, who discovered this species in Anglesea, and from whose specimens the figure in the E. B. Supp. was drawn, observed, that a coloured column, continuous with the short pedicel of the globule, extends to its centre, whence are given off the pedicels of the eight triangular facets that form the surface.

I have had this species under cultivation in a glass jar for several years, and, although no nucules appeared at any time upon it, young plants were copiously produced every spring.

CHARA HEDWIGII. Hedwig's Chara. TAB. XXX.

Plant monœcious. Stems opaque, smooth, slender, equal, somewhat brittle, striated. Branchlets elongated; the fertile ones with many whorls of short ramuli or bracts, of which the longest are shorter than the nucules. Nucules ovate.

Chara Hedwigii, *Agardh, Syst. Alg.* 129. *E. B. Supp.* 2762.
Chara fragilis, *Babington, Man. Brit. Bot.*

Forms dense masses in stagnant water. Stems from six inches to a foot in length, slender, rather brittle; sometimes partially incrusted, but generally clear and of a bright green colour. Each joint appears, as shown in our magnified figure, to be divided about the middle, in consequence of the smaller surrounding tubes being articulated midway, as well as at the divisions of the central one. The branchlets consist of about eight joints, the three or four lower ones each bearing on the upper side an ovate nucule, much larger than the accompanying globules beneath it, supported by four slender bristle-like bracts, generally shorter than itself, while two or more, either rudimentary or very small ones, complete the whorl.

CHARA PULCHELLA. Beautiful Chara. TAB. XXXI.

Plant monœcious. Stems smooth, slender, equal, flexible, striated. Fertile branches with many tufts of short ramuli or bracts, of which the longest are about the length of the nucules. Nucules oblong.

Chara pulchella, *Wallroth. Borrer in E. B. Supp.* 2824. C. fragilis, *Babington.*

Found by Mr. Borrer in Sussex. Chiefly distinguished from *C. Hedwigii* by its flexible stems, and the oblong rather than ovate form of the nucules. The bracts are not so distinctly whorled. In publishing the figure, we are desirous of directing attention to these circumstances, not with a view of establishing it as a species, although its claim to be regarded as such is fully equal to that of some of the preceding, but to mark more strongly the very slender foundation upon which such distinctions are occasionally based. Mr. Babington is doubtless correct, in referring *C. Hedwigii* and *C. pulchella* of the English Botany to the same type; but, admitting this, the question must occur to every careful student in vegetable morphology, whether the sixteen or more acknowledged British species may not be capable of condensation, the greater number being mere accidental varieties of four or five primary forms.

INDEX.

Synonyms and names incidentally mentioned are printed in italics.

THE END.

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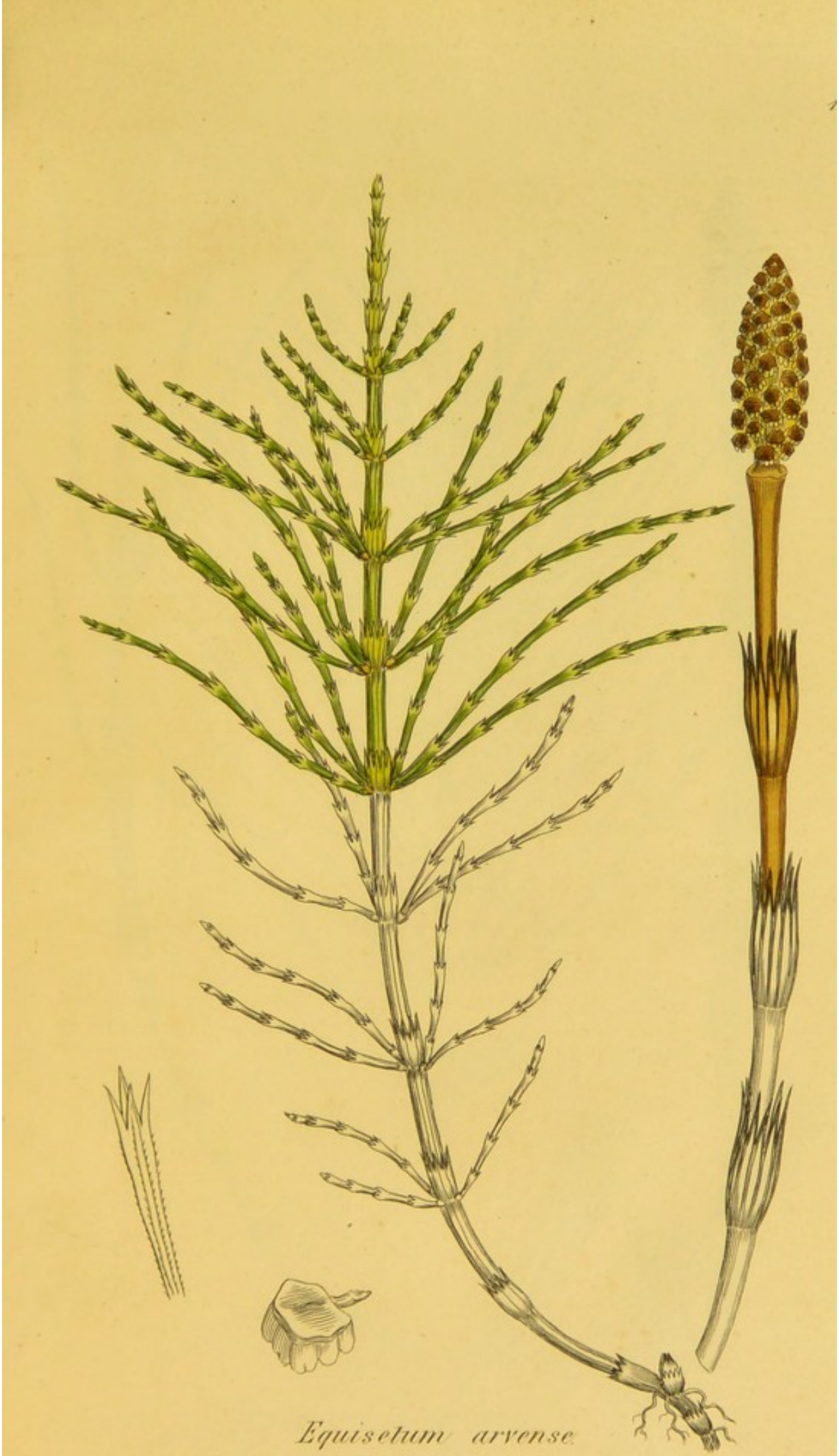

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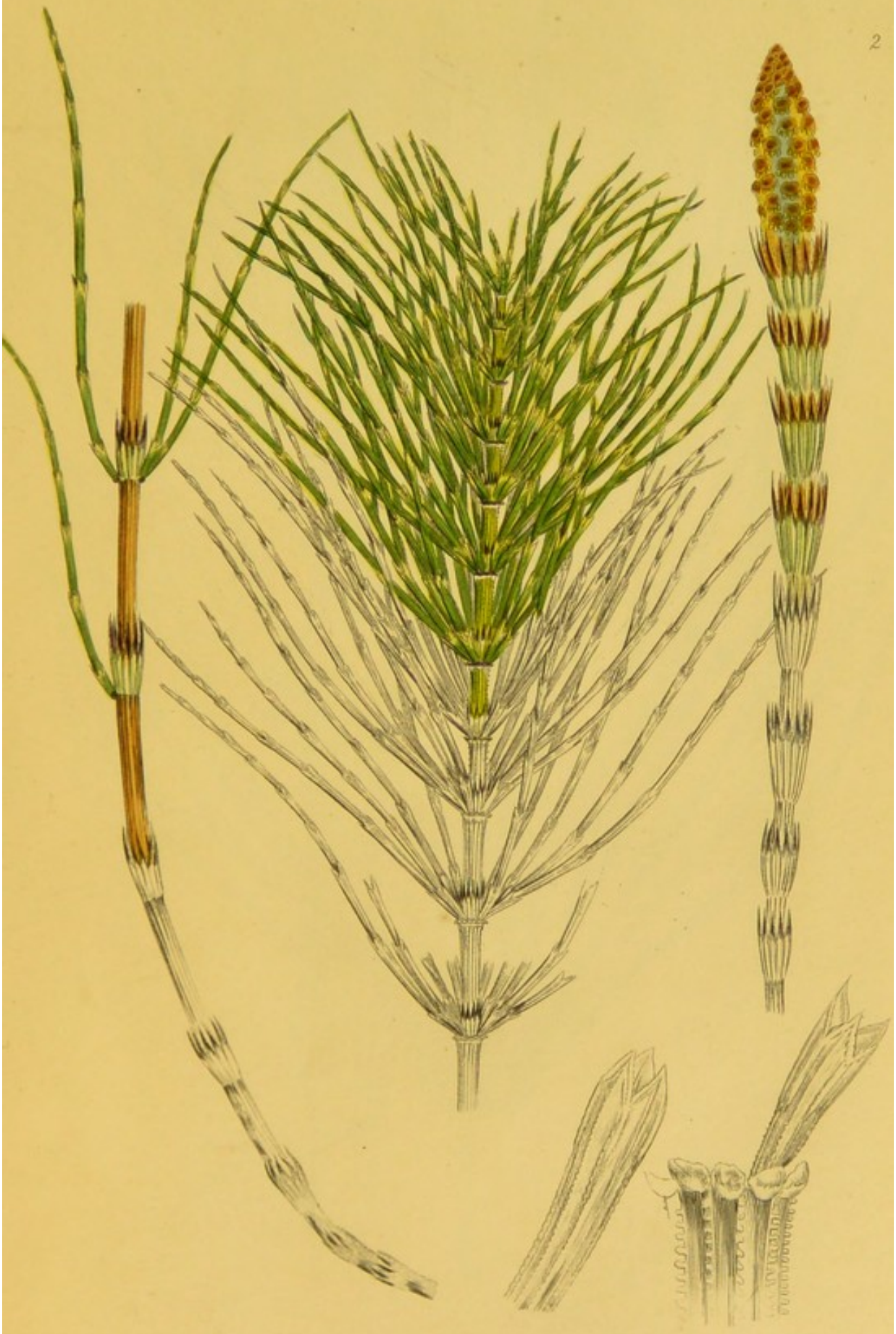

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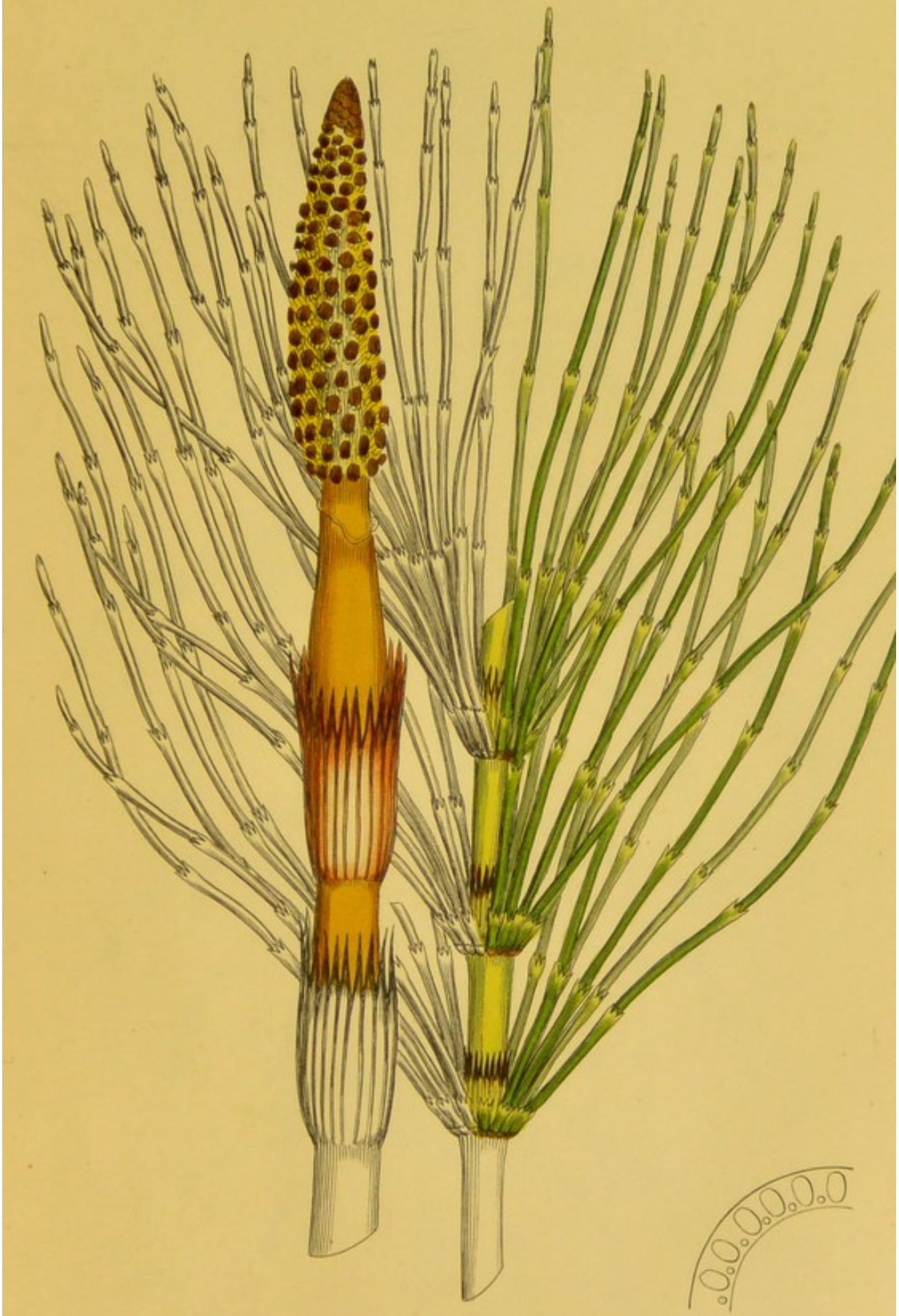

Equisetum Telmateia.

J. E. S. Fecit

Equisetum sylvaticum.

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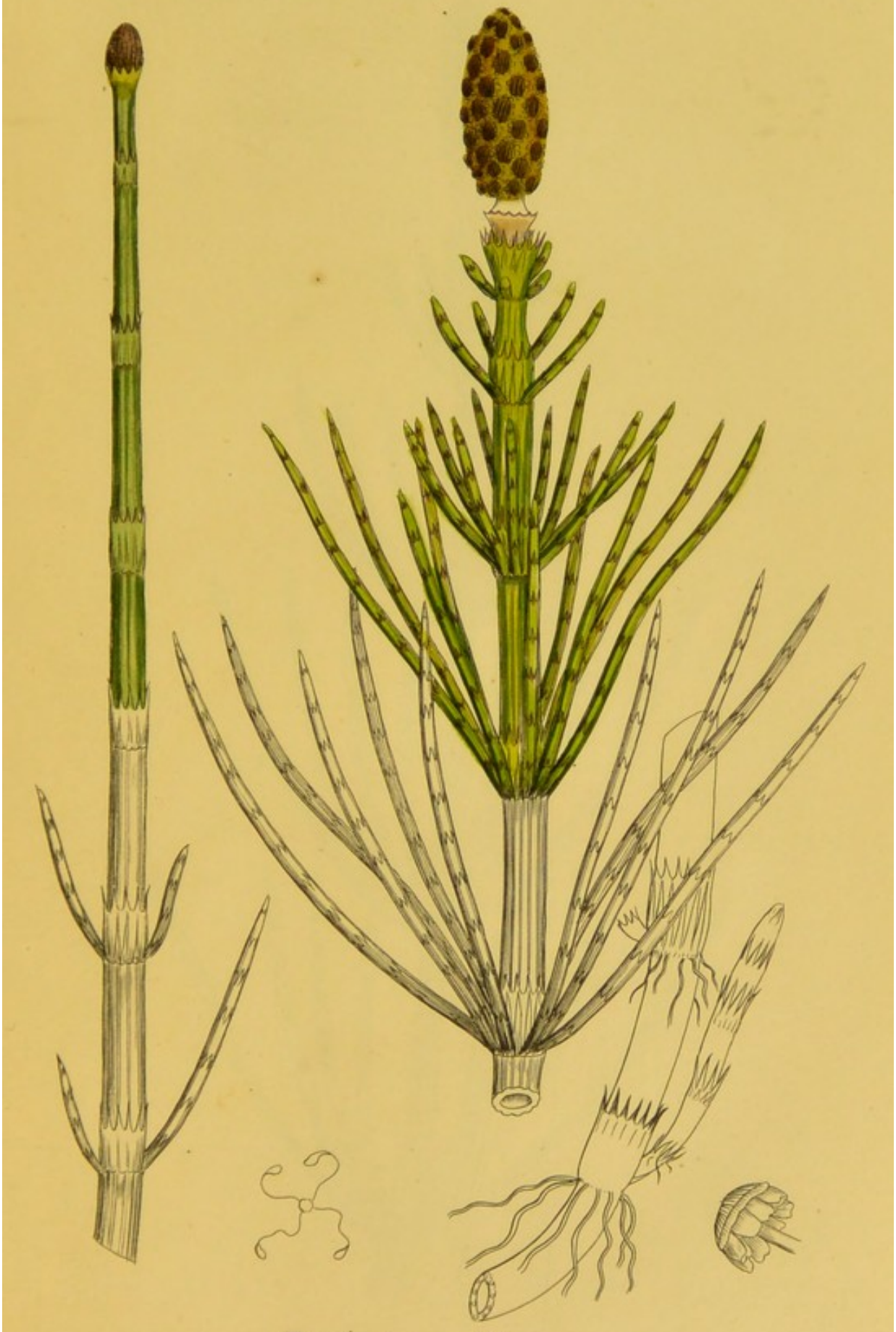

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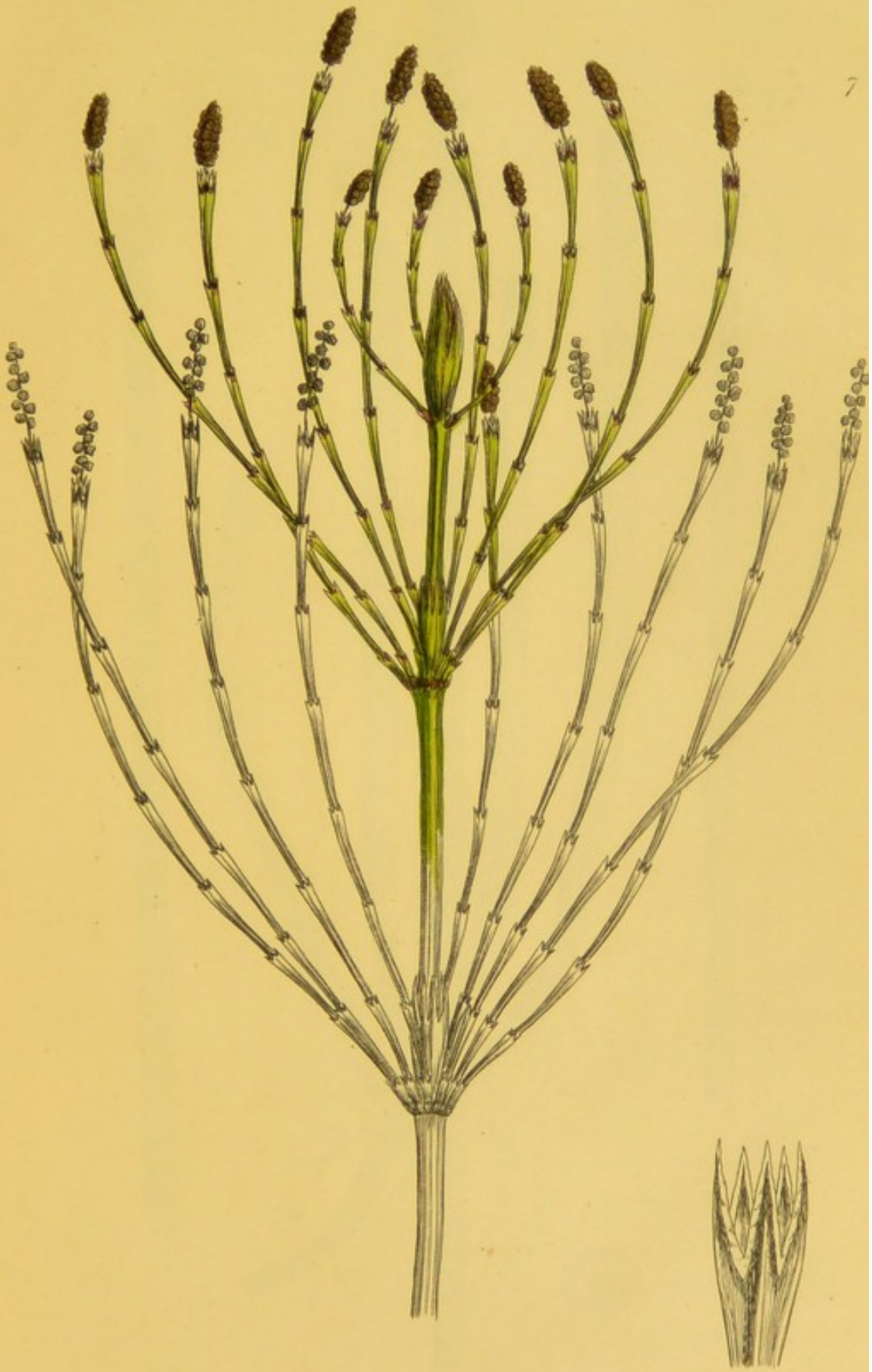
J. E. S. Fecit.

Equisetum palustre.
J. E. S. Fecit.



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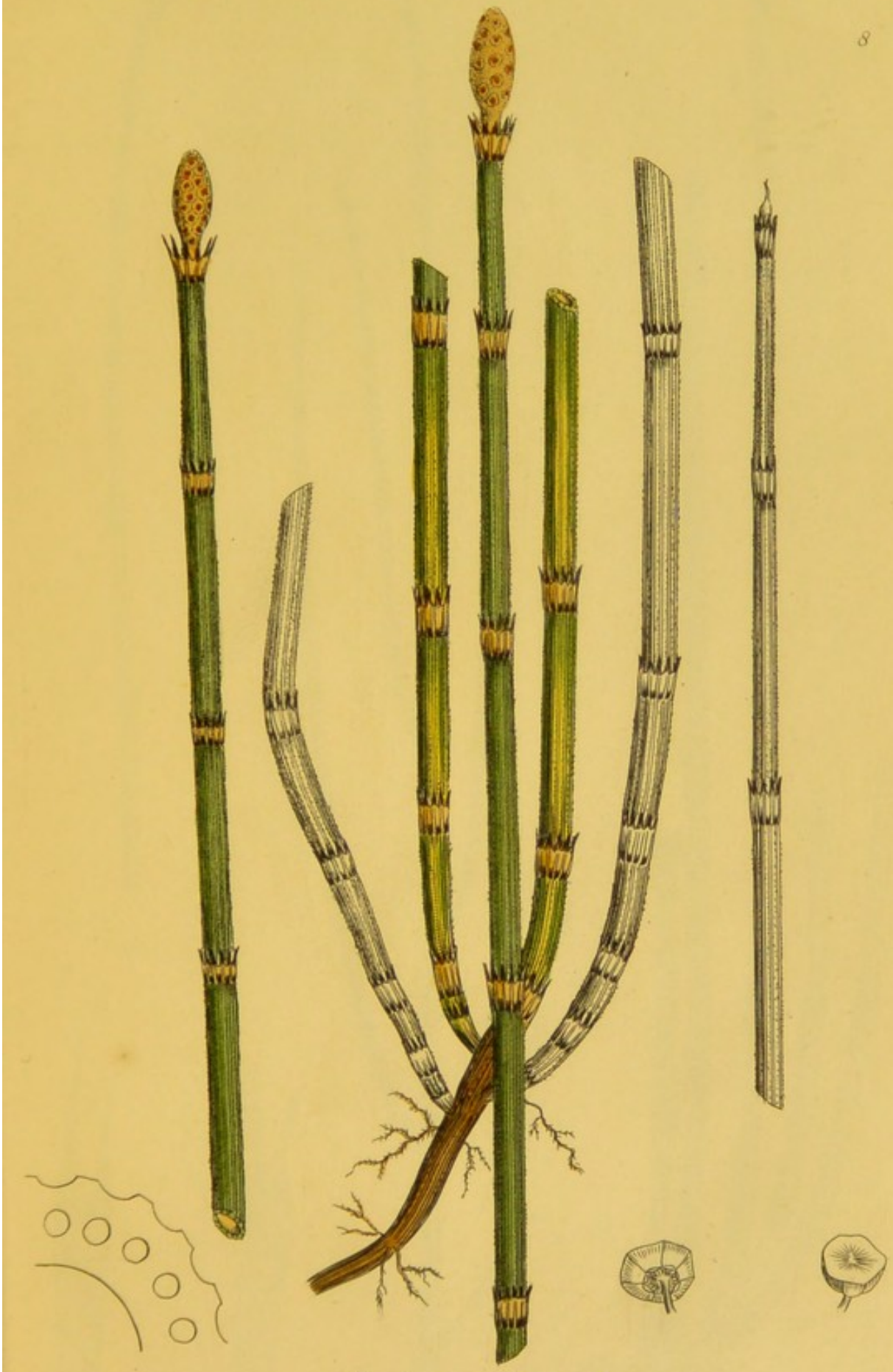
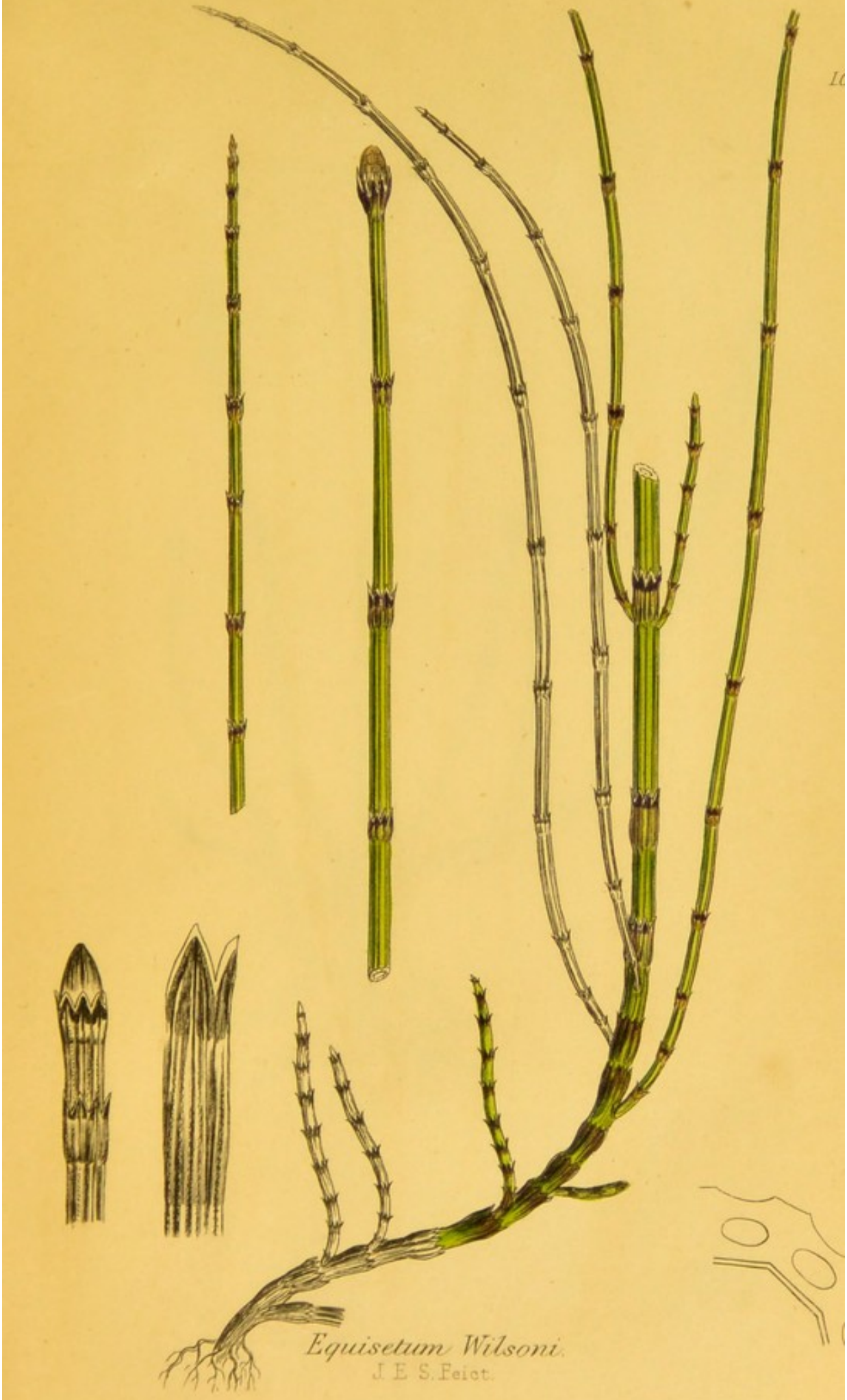
J. E. S. Fecit.

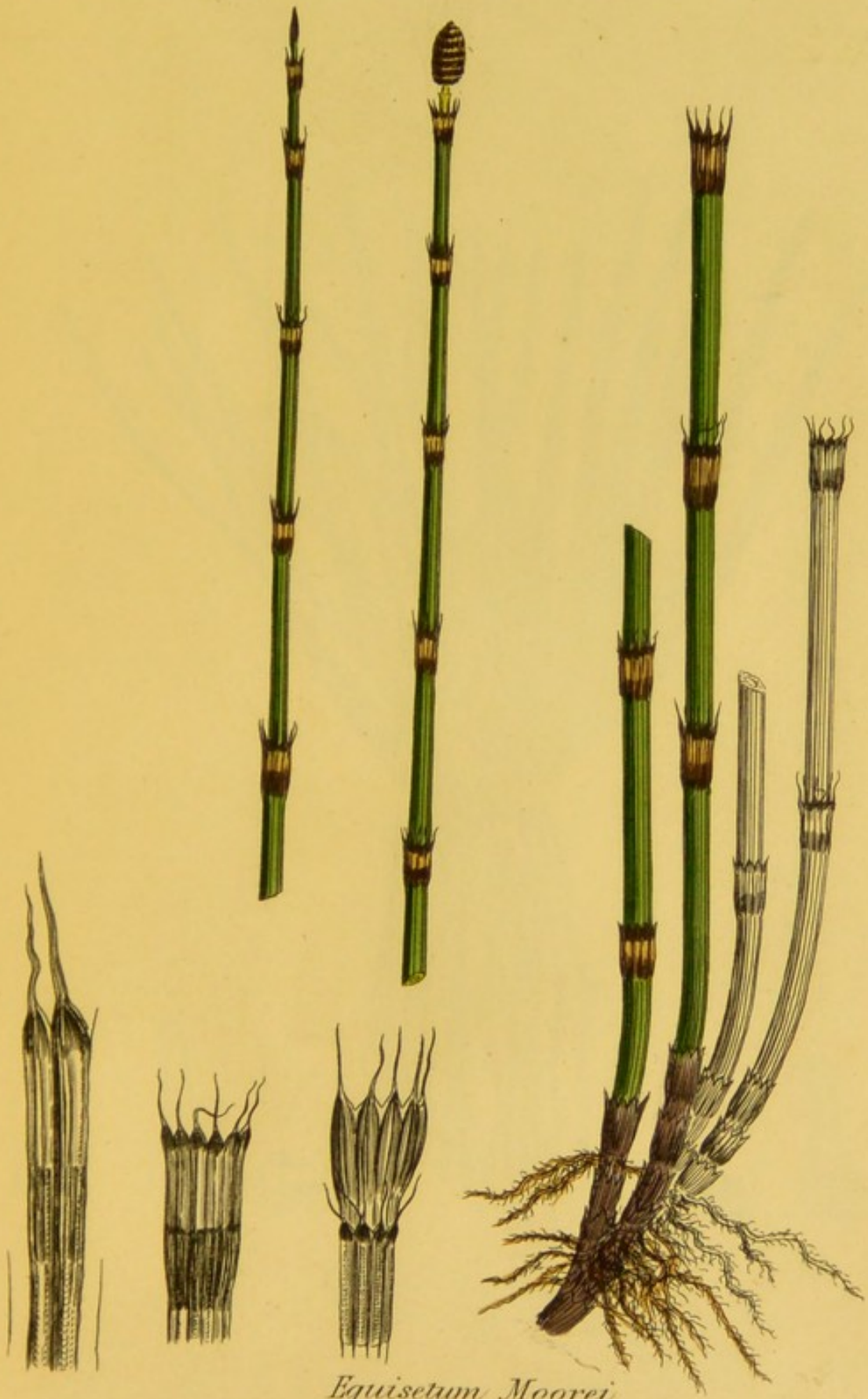


Equisetum hyemale.
J. E. S. Fecit.

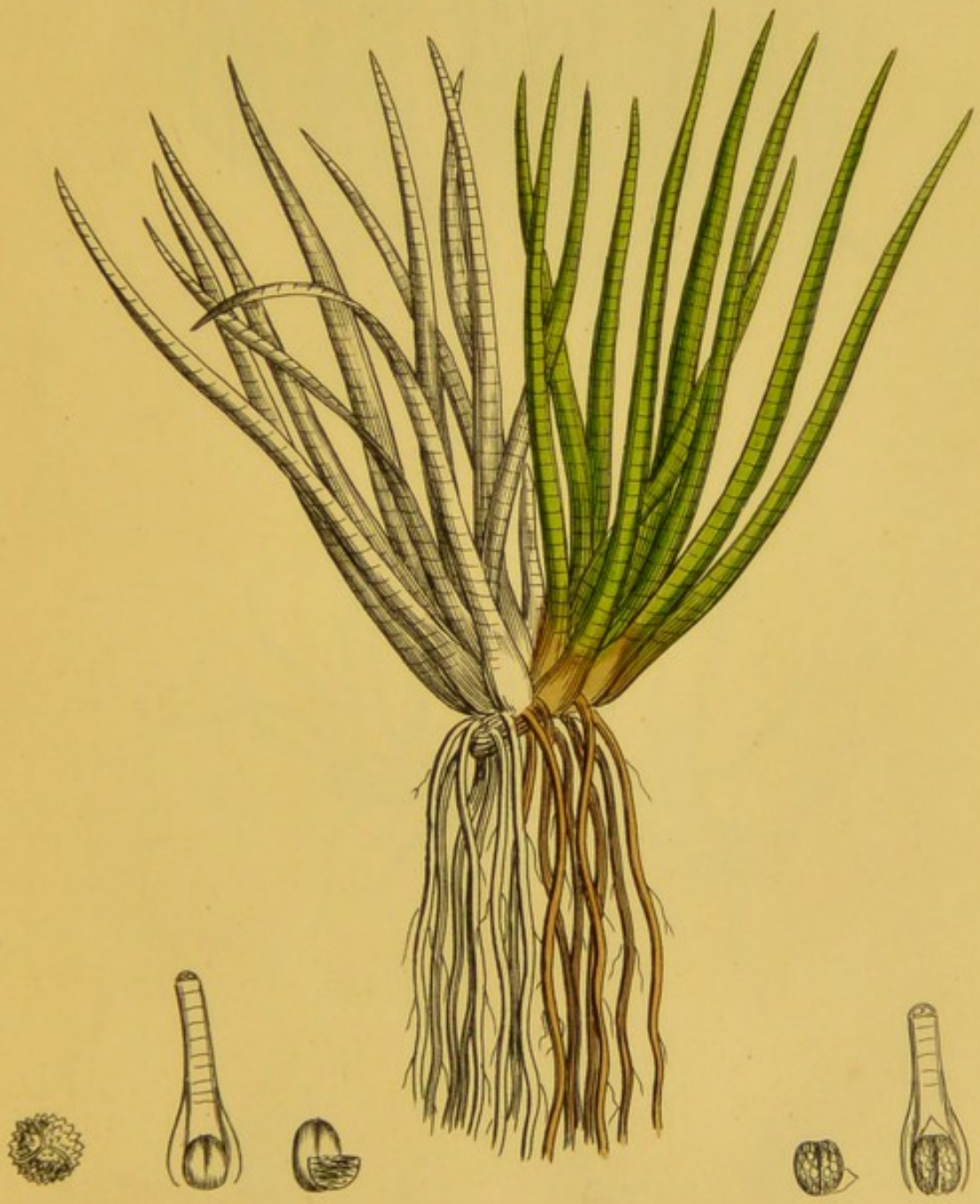

Equisetum Mackaii.
J. E. S. Fecit.


Equisetum Wilsoni.
J. E. S. Feict.

Equisetum variegatum
J. E. S. Fecit.



Equisetum Moorei.
J. E. S. Fecit.



Isoetes lacustris.
J. E. S. Fecit.

Pilularia globulifera.

J.E.S. Fecit.

Lycopodium clavatum.

J. E. S. Fecit.

Lycopodium annotinum.
J. E. S Fecit.

Lycopodium alpinum.
J. E. S. Fecit.

Lycopodium Selago.
J. E. S. Fecit.

Lycopodium inundatum.

J. E. S. Fecit

Lycopodium selaginoides.

J. E. S. Fecit.

Chara flexilis.

J. E. S. Fecit.

Chara syncarpa.
J. E. S. Fecit.

Chara translucens.
J. E. S. Fecit.

Chara gracilis.

J. E. S. Fecit

Chara Smithii.
J. E. S. Fecit.

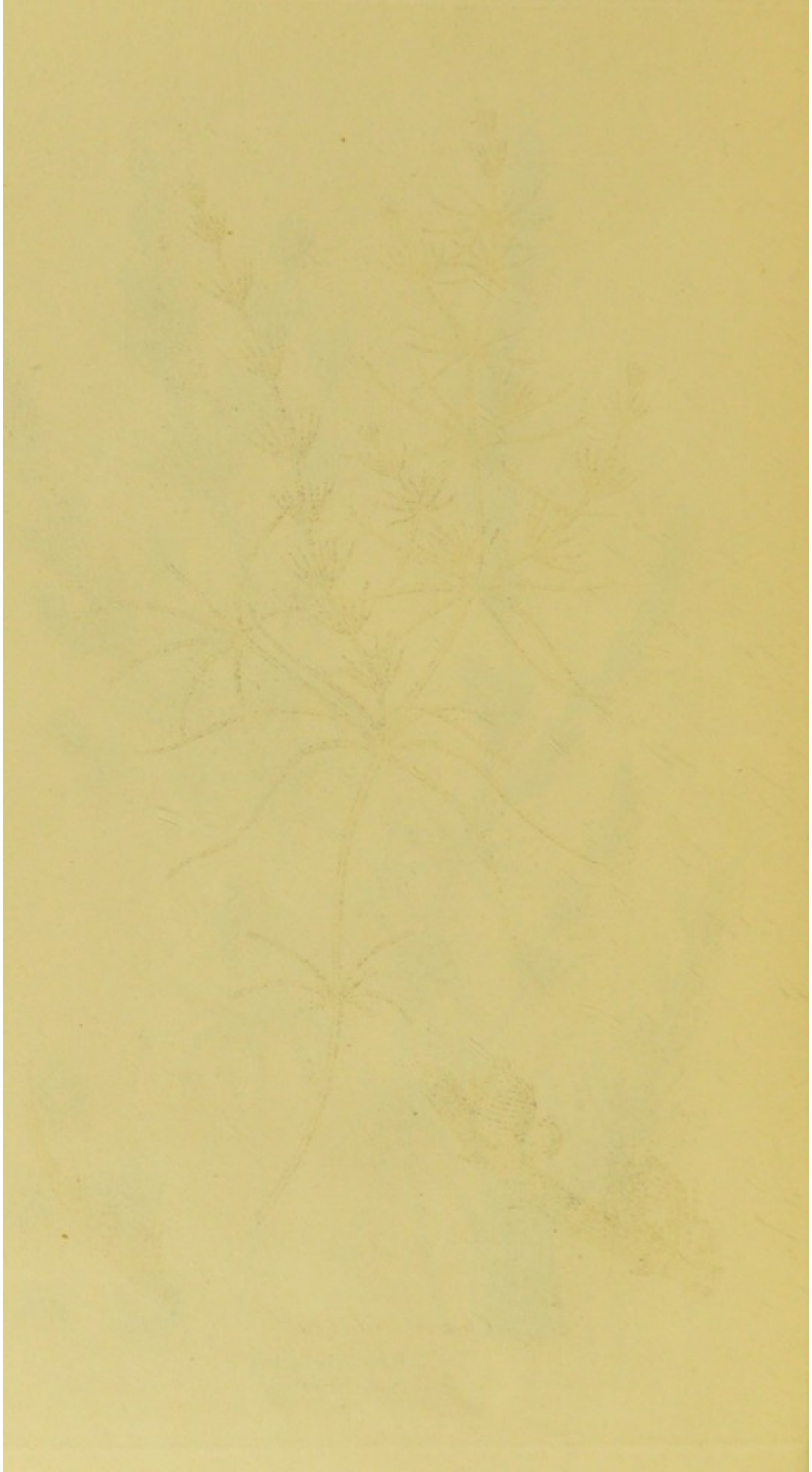
Chara prolifera
J. E. S. Fecit.

Chara vulgaris.
J. E. S. Fecit.

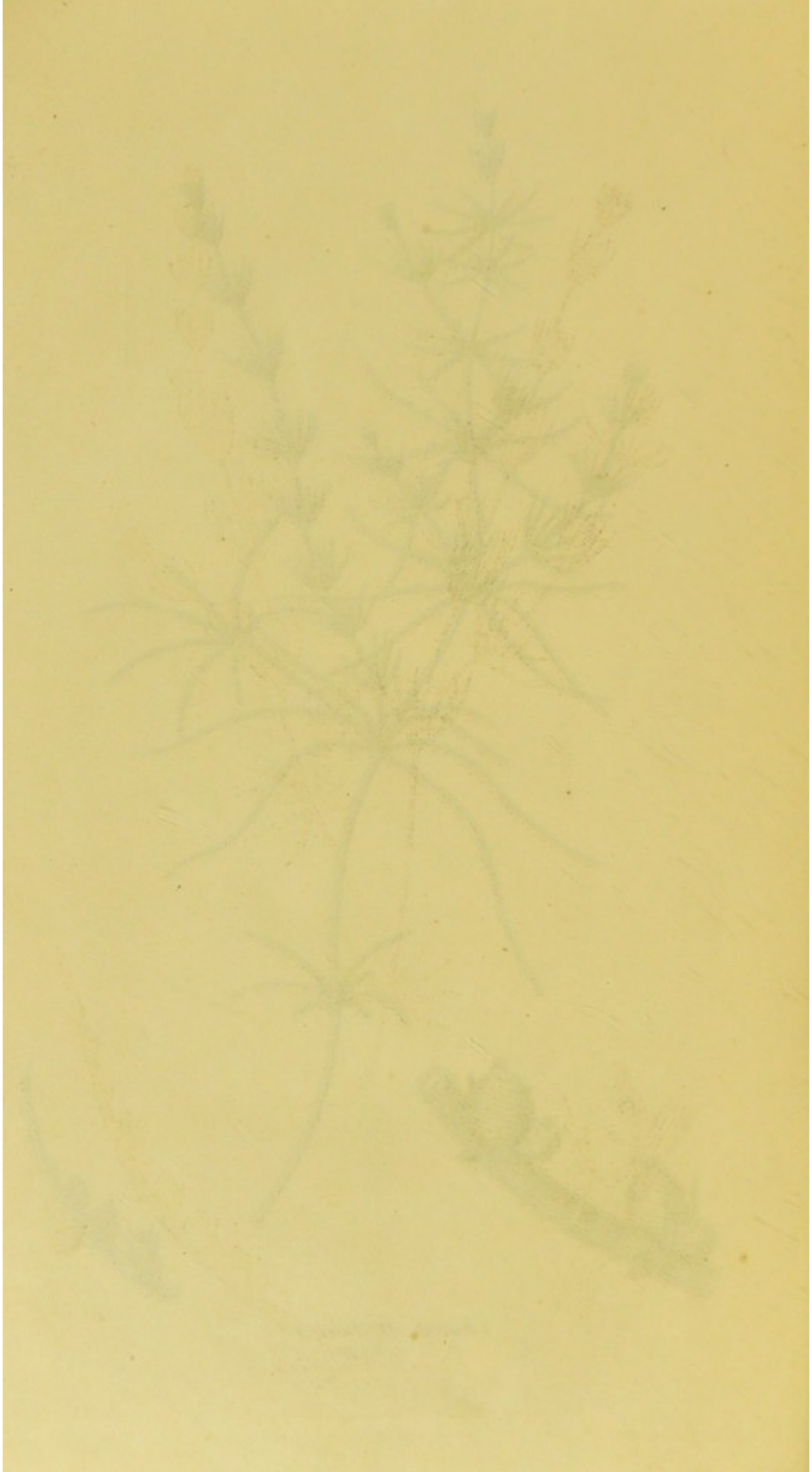
Chara hispida.
J. E. S. Fecit.

Chara aspera.

J. D. C. S. Fecit.



Chara Hedwigii.
J. E. S. Fecit.



Chara fragilis.
J. D. C. S. Fecit.