A NEW FOSSIL ALGA FROM THE ENGLISH SILURIAN

by GRAHAM F. ELLIOTT

ABSTRACT. A new fossil alga, *Inopinatella lawsoni* gen. et sp. nov., is described from the Upper Bringewood Beds (Aymestry Limestone), Upper Silurian. It is reminiscent of an early growth stage of the modern green alga *Neomeris* (Chlorophyta, order Dasycladales), and it may be a primitive adult non-calcified dasycladalean, with a simple structure now only seen in the early ontogeny of dasycladaceans.

THE alga which forms the subject of this paper was collected by Dr. J. D. Lawson during his investigation of the Aymestrey area and was entrusted to me for study. Although a new genus and represented by numerous examples, the material was at first sight unpromising, by reason of the simplicity of the structures preserved. However, consideration of the correct taxonomic reference of this alga has led to a surprising estimate of its possible relationships.

SYSTEMATIC PALAEONTOLOGY

Algae INCERTA SEDIS (? Order DASYCLADALES; CHLOROPHYTA)
Genus INOPINATELLA gen. nov.

Diagnosis. Non-calcified alga with long thin main stem showing regularly spaced slightly thickened levels from each of which diverge much thinner primary branches, usually four at each level. Primary branches slightly swollen immediately beyond point of junction with main stem, then thinning and extending for some distance before dividing into two or more thinner secondary branches. Reproductive structures not seen.

Type species. I. lawsoni sp. nov. Upper Silurian, Upper Bringewood Beds (Aymestry Limestone); England.

Inopinatella lawsoni sp. nov.

Plates 120, 121; text-fig. 1

Diagnosis. Inopinatella with primary and secondary branches about equal in length.

Description. The remains of this alga lie flattened on planes of parting in the rock, much as an assemblage of Recent sea-weeds might be pressed for the herbarium, but without definite orientation. The original thallus is represented by a black carbonaceous residue, cracked and friable; where this has fallen away, the smooth-surfaced impressions of stems and branches are seen in the granular rock. In an account by Ruedemann (1909, p. 201) of a somewhat similar genus similarly preserved in the American Lower Palaeozoic, *Callithamnopsis*, the longitudinal cracking of the carbonaceous filling was considered to indicate flattening of an originally hollow stem. This has not been seen

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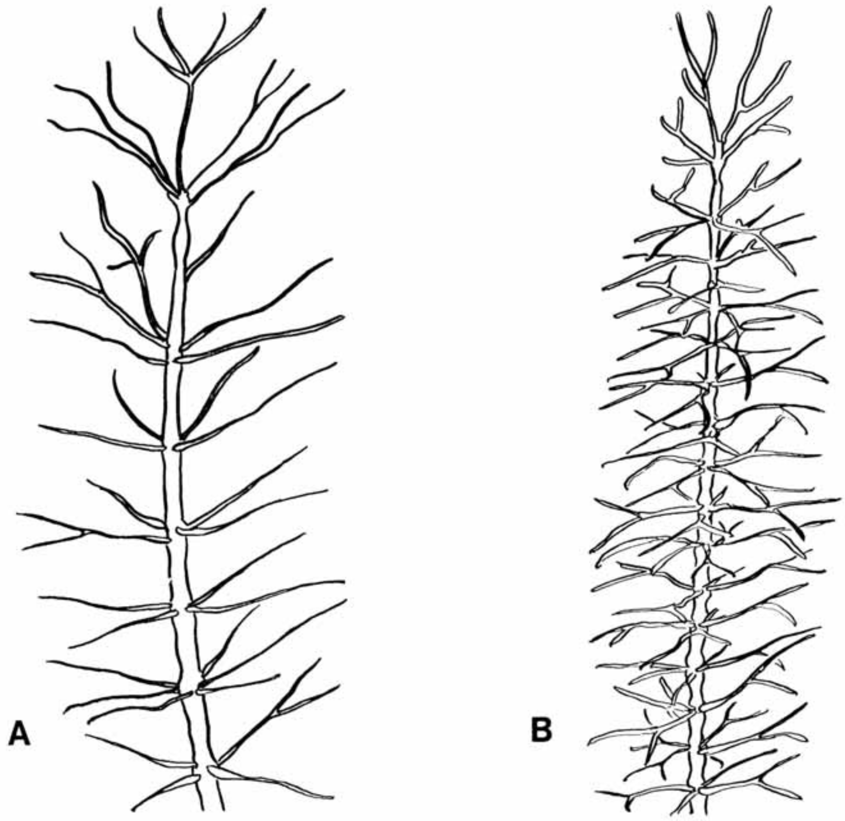
in *Inopinatella*, but one example was noted of a thin black carbonaceous-walled circular cross-section at right angles (vertical) to the plane of parting, interpreted as a cross-section of an uncrushed hollow stem. For this reason the diameters given below are probably slightly greater than those of the living plant.



TEXT-FIG. 1. A. Diagrammatic sketch of abnormal early growth-stage of living *Neomeris* sp., showing whorls with small number of unusually long side-branches, ×50 approx. Based on Valet (1968). B. Reconstruction of the Silurian *Inopinatella* as in life, for comparison with (A). Upper portion of a plant, ×10 approx.

EXPLANATION OF PLATE 120

Figs. 1–3. *Inopinatella lawsoni* gen. et sp. nov., from the Silurian Upper Bringewood Beds (Aymestry Limestone), Aymestrey, Shropshire. 1, 2. Holotype, showing main stem and primary branches ×12·5, and the basal portion enlarged ×30. Brit. Mus. (Nat. Hist.), Dept. Palaeont., Reg. no. V.31268. 3. Paratype, ×12·5. Reg. no. V.31263.

The main central stem of the plant is remarkably uniform. Examples lie straight, curved, or flexuous, and were originally several cm long: up to 30 mm (incomplete at both ends) has been traced. Over this length the diameter diminishes only from 0·286 mm to 0·195 mm: in another incomplete specimen of 15 mm the diminution is from 0·260 mm to 0·234 mm. The stem shows a regular swelling or slight increase of diameter at the levels from which the branches spring; these are spaced apart very regularly along most of the length at 0·390 mm apart, though closer in the terminal (distal) part of the stem. In the 15 mm example quoted the diameter of 0·260 mm increases to 0·312 mm at branch level, and the diameter of 0·234 mm similarly to 0·260 mm.

The black carbonaceous filling of the stem impressions is shrunken and cracked. Where these cracks are regularly and equidistantly transverse they give the appearance of an original plant structure, but this is an illusion as longitudinal, diagonal, and irregular cracking may also be found. In *Callithamnopsis* Ruedemann (1909) recorded transverse lines suggesting segmentation of the main stem at branch level: this has not been seen in *Inopinatella*. The point is further discussed below.

The branches lie in some confusion on the planes of parting of the rock, particularly where several individual thalli are tangled together. When their junction with the main stem can be distinguished clearly at any separate branch level, they are seen to originate in fours. Damage or tangling obscures this with many junctions, and it may be that occasionally there were more than this, but four appears to be normal. Each typical primary branch swells quickly from a small insertion on the stem-cell to a diameter of 0·156 mm and thins to 0·104 mm: at a length of about 0·7 mm they divide into two secondaries of about the same length and 0·104–0·078 or less diameter. There may sometimes have been more than two secondaries to a primary and also short tertiary branching, but I have not been able to distinguish this clearly on primaries visibly attached to a main stem.

The main stems appear to end in a terminal bunch of shorter finer branches: this is probably due to the closer spacing of branch levels with their young growing branches at the distal, growing point of the plant. In *Callithamnopsis* Whitfield (1894) considered that one specimen probably showed a terminal growing point: I have not seen this in *Inopinatella*.

No reproductive structures were found, and no recognizable holdfast was seen.

I have pleasure in dedicating this species to its discoverer, Dr. J. D. Lawson. The generic name refers to the unexpected possible relationships of the plant: *inopinatus, a, um*; that happens contrary to expectations, unexpected.

Holotype. The specimen figured in Pl. 120, figs. 1, 2, from the Upper Silurian, Upper Bringewood Beds (Aymestry Limestone), shale band several feet below *Dayia*-beds. Small quarry above road, *c*. 594 m W. 40 N. of Aymestrey Church, Shropshire, England (Map. ref. 32/421655); J. D. Lawson Coll. Brit. Mus. (Nat. Hist.), Dept. Palaeontology, Reg. no. V.31268.

Paratypes. The specimens figured in Pl. 120, fig. 3 and Pl. 121, figs. 1–3 same locality and horizon, Reg. nos. V.31256, 31262, 31263, 31278; also V.31253 not figured.

Other material. Numerous examples on rock fragments from the same sample.

COMPARISON AND AFFINITIES

Much the closest fossil alga with which *Inopinatella* may be compared is *Callithamnopsis* from the Ordovician (Trenton) of U.S.A. *Callithamnopsis fruticosa* (Hall) Whitfield was described as an alga by Whitfield (1894), and re-examined and a second species (*C. delicatula*) described by Ruedemann (1909), whilst Johnson (1961) has figured photographs of the type-specimens, the earlier accounts being illustrated by line drawings.

Callithamnopsis is similarly preserved to *Inopinatella*, with the same consequent uncertainties of interpretation. Like the latter genus, it shows a long central main stem and numerous side-branches of lesser thickness. Branching of the central stem occurs in *C. delicatula*. The side-branches originate in pairs, one branch opposite the other, up the lower part of the central stem, which is said to be jointed at branch levels. In the upper part the side-branches are said to be verticillate (several originating at the same level). The 'growing tip', distally, is rounded and distinct. Whilst the side-branches agree with those of *Inopinatella* in proximal swelling, the long primaries give rise to four or more very short secondaries, and these to four or more minute tertiaries.

The taxonomic position within the algae of such an extinct form is difficult to decide. The Chlorophyta, Phaeophyta, and Rhodophyta (green, brown, and red algae) are all possible. The living *Callithamnion*, which Whitfield thought his alga resembled, is a rhodophyte. Pia (1927, p. 67) followed by Johnson (1961), referred *Callithamnopsis* very doubtfully to the Dasycladales, a chlorophyte order. The verticillate branching of the upper stem, swollen-based primaries and the nature of the secondary and tertiary branching are dasycladacean characters. The pairs of opposite branches of the lower stem and the jointed stem (if correctly interpreted) are not dasycladacean characters. Some living brown and red algae show paired, alternate branching, or the appearance of branches in a close irregular-spiral order, but none to my knowledge are identical with *Callithamnopsis*.

Inopinatella itself was a slender thin-stemmed alga with simple consecutive whorls of four thin simply-dividing branches. New whorls were formed at the growing tip, and enlarged to uniform spacing as the stem does not show jointing, and there is no trace of calcification, which would have been likely to have been preserved as there are calcareous fossils associated. Presumably each plant was attached by a holdfast, and although flexible each grew vertically, in spreads or thickets on the sea floor. Burial was by rapid muddy sedimentation which entombed them before decay, and prevented immediate subsequent decay so that, whatever the detailed diagenesis to which they have been subjected, they are today preserved as carbonaceous fillings in impressions.

There is not, to my knowledge, any living species of alga like this. But there exists one startlingly similar developmental stage in a living dasycladacean.

Neomeris is a living tropical dasycladacean alga, represented by some seven species. The adult algae are upright cylindrical, rather like little green corn-cobs, with the short branches and branchlets closely adpressed and moderately heavily calcified. But in an early uncalcified developmental stage the appearance is very different: the central stem-cell is thin, with widely-spaced thin branches. In the normal ontogeny of the plant this

EXPLANATION OF PLATE 121

Figs. 1–3. 1, Paratype, portions of two individuals, ×6·5. Reg. no. V.31278. 2, Paratype, area of terminal branches, ×14. Reg. no. V.31262. 3, Paratype, general disposition of algae on slab, ×8. Reg. no. V.31256.

thin stage is impersistent, with one or two such whorls near the apex and only scars of earlier deciduous branches below.

However Valet (1968, pl. 18, fig. 3) figures an abnormal young *Neomeris* sp. at about the 3 mm growth-stage (adult *Neomeris* range from 15 to 30 mm high approximately). In this growth-stage a thin central stem-cell shows regularly-spaced whorls each with a small number of branches, unusually long in the primaries for such a developmental stage of *Neomeris*. Allowing for the difference in size, it is very much as *Inopinatella* must have appeared in life.

Is *Inopinatella*, then, to be regarded as a primitive non-calcified ancestral dasycladacean alga? The apparently flexuous character of the fossil plants could be explained by the conditions of burial. Its stem is not jointed, and this accords with the long central stem-cell of a modern dasycladacean. The co-existence in the older Palaeozoic of highly organized and calcified dasycladaceans, e.g. *Mastopora*, is not an argument against this interpretation, for similar phylogenetic development probably took place in different stocks at different times, as happened in other biological groups. Recapitulation is never an exact record of phylogeny, and it may well be that Valet's exceptional developmental stage of *Neomeris*, abnormal by reference to the usual developmental pattern, mirrored a pattern of thallus long since abandoned in the adult.

This interpretation of the affinities of *Inopinatella* must remain speculative; there seems, however, to be more evidence for it than for a similar correlation with a living brown or red alga.

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