PSEUDOLYCOPSIDS FROM THE ROCKY MOUNTAINS OF CANADA

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The material studied by the author belongs to the Geological Survey of Canada (Calgary, Alberta), and it was entrusted to him for description after the congress in Montreal in 1972. It is not large but surprisingly multiform, dominated with specimens, which in one way or other resemble true Lycopsids, and with those the study of the material started. These specimens have all of them more or less distinct rhombs arranged in quincunx, a pattern that seems to have been considered an infallible indicator of Lycopsids. But when the first specimen was closely examined no further lycopsidean characters could be discovered. The only openings within the rhombs were single ones situated near the upper corner of each rhomb, and around these openings a thin film of coal with a striation of rows of very small cells comes up, and they are stuffed with crystals of calcite.

Where an opening is damaged, part of a tube leading inwards from it is exposed (Fig. 10). By and by more extensive portions of tubes were discovered at spots where the surface of the specimen was damaged, and a reconstitution could be made of a system with main, straight tubes, width c. 1 mm, running through the entire length of the specimen, and diagonal secondary tubes, strongly winding, raising the covering epithelium so that ridges delimiting the rhombs were formed (schematized in the stripe above the measurement (in Fig. 8). Gradually finer tubes were formed through branching, the finest ones capillaries, 100 to the millimetre – or even more – across. Such fine tubes also had walls composed of minute cells, and they were in the interior of the plant so densely packed that a coal resembling anthracite was formed (Figs. 4 & 5).

Epithelia were formed from the same material in such a way that the ends of tubes did swell to bulbs of a size according to the width of the tube, and from the equator of those bulbs fine circular lamellae expanded – the result resembling wheels with the primary bulb as a hub. These 'wheels' crowded and joined to form a continuous surface, as 'epithelium' without a cuticle and without stromata. Tubes may dive up into such an epithelium, and they may have been responsible for the exchange of gases (CO_2 O_2). The lack of a cuticle and of strands of supporting tissues may suggest that the plants were aquatic.

The histology described above is common to the entire Canadian material, whatever shape the representatives of the flora may have taken on, but it is unknown among what we are used to regard as 'higher plants'. There are very deceiving imitations of lycopsids, and even more perfect ones of fern-like pinnulae, but the plants may also take on a general habit and architecture totally alien to Tracheophytes. What looks like branches of 'higher plants' is very often in the Canadian material even as a rule – connected between themselves by thin sheets of tissues. These are now seen as impressions over large surfaces of the slabs, the more obvious parts (the 'branches') forming ribs expanding the 'web' formed by these surrounding tissues; and there is no doubt, that the more substantial coaly parts and the impressions belong to the same specimen, as components along the boundary between the two is fairly regularly combined of one part in coal and one as an impression (Fig. 11). And, further, there are strands of tissues

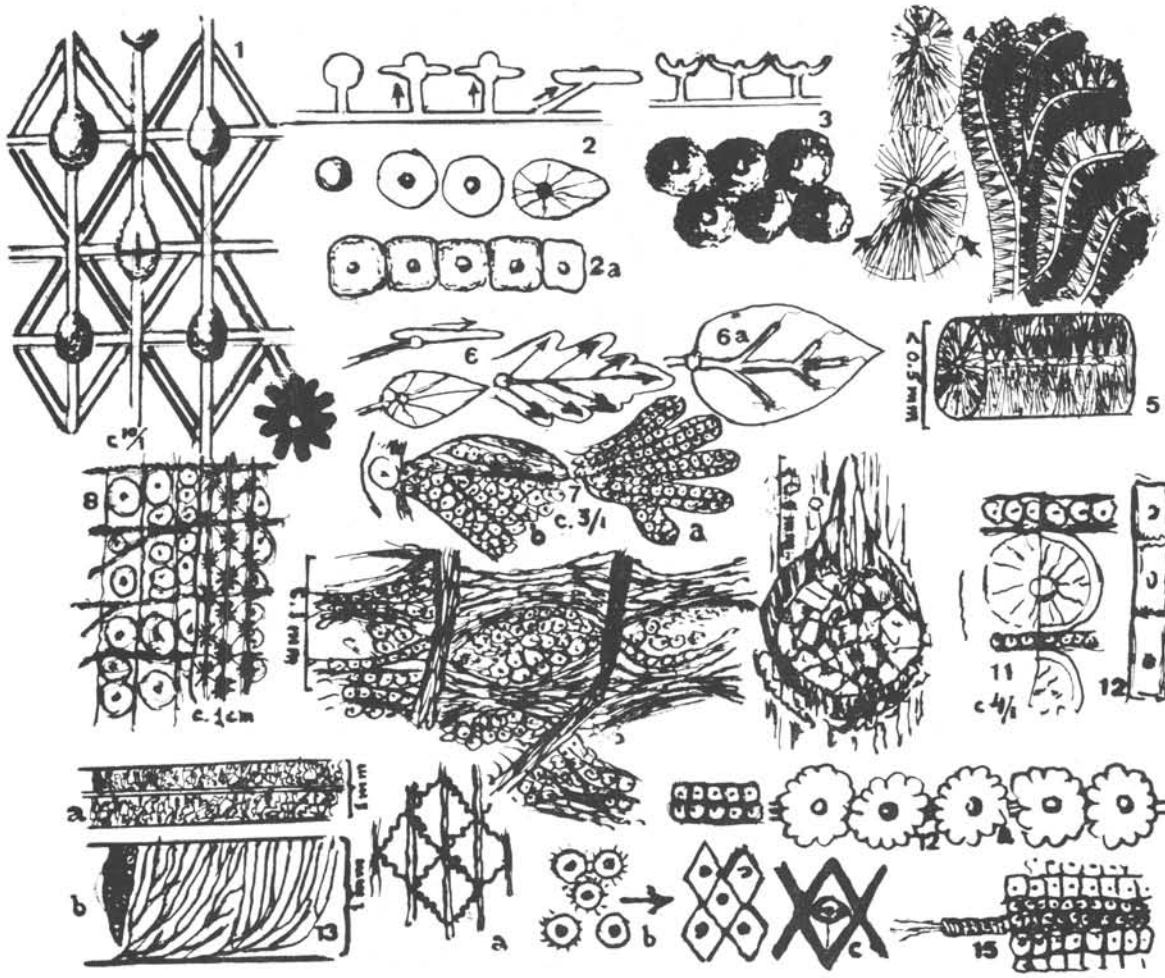

Fig. 1 — Rhombs formed from expanding wheels, and their relation to longitudinal and transverse tubes. The bulb in their centre secondarily filled with compact coal, presumably formed through ingrowth of fine tubes.

Fig. 2 and 2*a* — Genesis of the components of an epithelium, sections and views from above. 2*a*. Leaves deformed into squares after having come into contact.

Fig. 3 — Crowded wheels deformed into cups. Section and surface view. Stripes of such an epithelium traverse the upper corner of the rhombs in the 'type specimen' (the specimen first studied, and the one that opened the way to the interpretation of structure characteristic of the group).

Figs. 4 and 5 — The structures of compact coal network, within the group.

Fig. 5 — Cylinders composed of bunches of very fine tubes issuing from a mother tube in their centre. The coal consists of packs of such cylinders, and it gives at fracturing an appearance as in Fig. 4; the ridges have the mother tube on their summit (Cf. Fig. 4a: the way of splitting indicated by the arrows).

Fig. 6 — Development of structures, where a tube hits the surface obliquely — 6*a*. Fillings of calcite coming out at the end of the branches.

Fig. 7 — Two 'leaves', in *a* with the lamina composed of a single layer of tubes and wheels; the upper lobe in *b* consists of compact coal with surface structures transient to the impressions.

Fig. 8 — Schema of the 'type specimen'. The 'c. 1 cm' marks the width of the coaly part. To the left of this three of wheels, and the whole is crossed by transverse bands at fairly regular distances. — 8*a*. A large deeply dissected 'wheel' at the upper corner of a rhomb (small dark stars in Fig. 8). See also the text.

Fig. 9 — See the text

Fig. 10 — Scheme of an opening at the upper angle of a rhomb (basic to the understanding of the entire histology of the group). *C* Film of coal forming the wall of the tube. — *Ca* crystals of calcite. See also the text.

Fig. 11 — See the text (*I* impression, *C* coal).

Fig. 12, 12*a* Rows of 'wheels', respectively derivatives of 'wheels' produced by a tube still connecting them. Those in Fig. 12 of compact coal, thick, forming the axis of the branches in one of the specimens referred to the Pseudolycopsids; no rhombs distinguishable in that specimen.

Fig. 13 *a,b* – From the walls of major tubes in two species. The walls strong mother tube with a maze of equivalent, strongly winding secondary tubes on each. – *b* a system of successively branching tubes. In both cases the intervals between the branches of the tubes are occupied by wheels.

Fig. 14 *a, c* – See the text.

Fig. 15 – The epithelium covering the tube is composed of wheels smaller than those in the surroundings. The tube still with its wall of coal, to the left a tuft of calcite threads coming out.

The enlargements given on some of the figures are approximate. Most the other figures are schemata and not draw to scale. The wheels are rarely exceeding a diametre of 0.5cm, and they are mostly small or dwindling small.

– tubes bordered by rows of 'wheels' and usually quite narrow – which connect a set of 'branches' in such a way that one might have to assume, that were two systems of tubes for the transport of fluids within the plant body, crossing each other at right angles. And it is not the question of superimposed fragments, as the crossing-points of the two systems fit very well in with the internal structures of the respective intercrossing parts (schematic in Fig. 8). Fig. 9 is from a small fragment, which distinctly shows stumps of branches (width one or two millimetres) suspended in a network of strands of transverse tubes.

Thus, tubes and bulbs (usually expanded to wheels) are the primary components (there are with certainty no true veins). After embedding, solutions circulating within the rock have deposited calcite in the interior of the plant fragments, and the tubes were clogged up. When the rock is split, such fillings often appear, sometimes abundantly, as fine bristles. Ocassionally they appear on the surface still wrapped in their sheath of coal (i.e. the wall of the tube in which they were formed), the calcite peeping out at the ends (Fig. 15).

The description above applies, without any reservation, to the Canadian material. And after a scanning of illustrations in several papers on *Lepidodendropsis*, and similar forms, the author is convinced that the histology dealt with above must be present also in fossil plants from localities outside Canada. So, for instance, in a paper by JONGMANS, "The Carboniferous Flora of Peru" (Bulletin of the British Museum/Nat. Hist.) Vol. 2, nº 5, is said on p. 211: "The space between the cushions is finely granulated (chagrinate) and almost smooth (Pl. 23, fig. 28*c*)". In that figure there is a distinct fine, longitudinal striation, and the "granulation" is evidently due to something very much like what has above been called 'wheels', circular disks with a small knob in their centre, best seen on a small stripe, o.5mm wide, extending from a point 7cm from the border of the fig. and 4cm from the top, downwards c. 2.5cm.

The Canadian material shows some resemblance with material from Siberia and Mongolia and also with material from Brazil; these two latter are, however, much more similar between themselves. The part of the Siberian-Mongolian material, that is of special interest here, is said to be of Lower Carboniferous age, that from Brazil Upper Permian, which seems to leave the Canadian material in complete uncertainty.

It may be of some importance to make clear that a pattern of rhombs can be formed in different ways, with the only feature in common, that they are all due to a rhythm of growth and a general tendency in the kingdom of plants to arrange similar details in quincunx. Fig. 14*a* shows a pattern due to subepithelial tubes, *b* one due to wheels expanding in a surface and finally meeting and adapting themselves to the available space, and *c* real leaf-cushions, being the markings left after the leaves were shed – a type not realised within the Pseudolycopsids, where true leaves and shedding leaves were seemingly unknown conceptions.

Another fact worth noticing is that all structures in the Pseudolycopsids were built up to their definite size adding cell to cell, all cells small and fairly uniform, whereas in the Tracheophytes organs can rapidly attain full development by enlarging available cells, pumping them full of fluids. This is best noticeable, when the leaves appear in the spring; such a phenomenon could hardly have ocurred within the Pseudolycopsids.

A full description of the Canadian material will, as soon as possible appear in the publications of the Canadian Geological Survey.