

Leaves

On Rhizocarps in the Palaeozoic Period.

(Read before the American Association (1875.)
I.W. Dawson of Montreal

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One year ago my attention was directed by the late Sir W. E. Logan to a shale from the Erian formation at Kettle Point - Lake Huron, supposed to be on the horizon of the Marcellus shale of New York, and which was filled with minute brownish discs, scarcely more than an hundredth of an inch in diameter, and which I recognized as probably Spore-cases or macrospores of some terrogenous plant. They were described in some detail in a

paper on Spore Cases in Coal published²
in the American Journal of Science for
April 1841 and reprinted in the
Canadian Naturalist New
Series, Vol. V.

They were described as
a flattened disc-like bodies, slightly
papillate externally, and with a
minute point of attachment at one
side and ^{Sometimes a} slit more or less gaping
at the other. Viewed under the
microscope as transparent objects they
appear yellow like amber, and
show little structure except that
the walls can be distinguished

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from the internal ^{cavity} ~~matter~~ and the
latter is seen in places to contain
patches of granular or flocculent
matter." They occur in a
brown bituminous shale, which
burns with much flame. This
bed is stated in the Reports of the
Geological Survey of Canada to be
12 to 14 feet in thickness; but
whether the fossils are equally abun-
dant throughout its thickness
is uncertain. The shale also con-
tains least numbers of rounded
transparent granules which may
be escaped spores or Microspores

Among other fossils found in this bed are stems of a species of Calamites, (C. imbricatus) and a Sepidodendron almost preserved, but not improbably the S. pinnaculum of Rupper. My impression at the time when these specimens were first examined was that they might have been produced by a Sepidodendron or other lycosporic acorn plant.

In July 1882 my attention was again directed to the subject of Prof. Ostrom of Columbus, Ohio, who mentioned to me

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The occurrence of similar bodies
in vast numbers in the Euan
and Lower Carboniferous shales
of Ohio, known as the Huron
Cleveland and Berea shales,
Prof. Otter regarded these bodies as
Macropores, and was disposed
to consider them as a main source
of the bituminous matter so abundant
in these formations in Ohio.
He subsequently described his specimens
at the meeting of the American
Association at Montreal and referred
to certain thread-like branching
filaments found with these bodies as

We had found similar bodies in the
Hamilton Shales of New York, and
that they were associated with the
curious pinnately leaved plant
Ptilophyton Vermeeri, an obs-
ervation to which I subsequently
referred in discussing the affinities
of this plant in a report on the
Lower plants of Canada pub-
lished in 1882.* Prof Williams was
~~subsequently~~ kind enough to send
me specimens, in which however
the round spire-like bodies
were much less distinct than
in the specimens from Ohio.

* Report on Lower Plants of Canada, Pt II.

and Lake Huron, In the report⁸
already referred to I have also
noticed the occurrence of rounded
spine-like bodies in association
with the stems of Trochophyllum
of Sequereux from the Lower
Carboniferous of Pennsylvania,
and of which specimens were
~~kindly~~ submitted to me by the
Lacoe of Pittston and Prof
Sequereux. Trochophyllum I
regard as closely allied to a per-
haps Cuscutine with Phyllophora,
and in the report already referred
to have argued that these

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plants were probably aquatic. *actinopus*
Still more recently Prof J. M.
Clarke of Northampton, Mass., was
so kind as to send me two
fragments of rock containing *Sphaerites*
similar to those above mentioned,
one from the Senessee shale
of Canandaigua Co., and
another from the Cirripeds
Sandstone. In the latter these
bodies retain their globular
form, though some are partially
crushed in such a manner
as to show their membranous
character. In pieces prepared by

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Prof Clarke the wall is seen to
be thin and carbonaceous with
indications of a dense cellular
structure, and some of the
specimens show ^{a projecting} ~~an~~ aperture or
point of attachment at one
side, giving them a somewhat
pear-shaped appearance. The
size of all these spores is
macrospores from the *Spirium*
of New York is nearly the
same with that of the
L. Huron specimens. They found
with *Trichophyllum* in the Lower
Carboniferous are used together.

No certain clue seemed to be
afforded by all these observations as
to the precise affinities of these
widely distributed forms; but in
March last Mr Orville Derby of
the Geological Survey of Brazil
sent me specimens ^{found along with fossils of Spirifer} from the
Creek of that County ~~found in~~
~~beds containing Spirifer~~ which
seemed to ~~throw~~ throw a new
light on the whole subject. Mr
Derby's specimens recalled to
remembrance certain fossils which
had been sent to me several
years ago by the late Prof. Harte

Flemingites* Calenthes specimens were from
 the same shale, and were found in
 shales associated with beds of coal and
 believed to be of Carboniferous age,
 though the fossils found with
 them and attributed to Naeggerathia
 and Odontopterus would, if interpreted
 by North American analogies, be sup-
 posed to be older than the true coal
 formation. The present specimens
 are also labelled as Carboniferous,
 but the occurrence in them of
 abundant bands of Spirophyton

* See Magna Vol VI p 157.

rather points to a Devonian date,"

Mr Darbys specimens contain
Spirophyton and also minute rounded
Sporangites like those obtained by
Prof Hartt. But they differ in
showing the remarkable fact
that these rounded bodies are
enclosed in conducell tubes,
in ^{spherical} rounded and oval sacs,
the walls of which are composed
of a type of hexagonal
cells, and which resemble
in every respect the involucres
of ~~Sporangites~~ ^{the minute group of Aetoporus known as}
of modern Rhizocapsa
and living in shallow water,

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More especially they resemble the *Sporocarpia*.
~~and~~ especially of the genus *Caloinia*.
This fact throws an entirely new
light on the whole question, and I
would now proceed to describe these
interesting specimens, & inquire as
to their probable affinities with modern
plants and their probable relations
to early palaeozoic forms of vegetation
found with them.

Mr Darby's specimens are
labelled as from Rio Trombetas and
Rio Curuá. They occur in two kinds
of matrix. One is a thin, laminated
sandy shale, tinged red with
peroxide of iron, and with occasional

Ferruginous laminae. In this the spores
 Sacs are flattened and black, and
 show the structure of the walls under
 the microscope. The contained spore
 & Utricles, when visible appear as
 minute depressions or tubercles or sometimes
 as round light spots according to their
 state of preservation (Fig 1 a) The other
 kind of matrix is a gray dense
 shale in which the spore sacs
 appear less flattened and destitute
 of carbonaceous matter.

The very numerous spore sacs
 contained in these shales are
 extremely variable in size and form,

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and may have belonged to several species of plants. They resolve themselves however into two leading types, which may be named Sporangites Brasiliensis, and S. biloba; and which may be described as follows:-

(Fig 1a) Sporangites Brasiliensis, ^{S.N.} + Sporangia
thin, cartilagenous, having a structure
x dense of hexagonal cells and enclosing walls
spores which vary in number from three
to four to as many as 25. Form circular
oval or reniform. Largest diameter from
3 millimetres to 6 millimetres. Some of the
sacs which do not show included round bodies may have held
^{microspores.}

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S. biloba, n (Fig 1. b) Sporocaps
oval or reniform, 3 millimetres to 6 millim-
etres in diameter, each showing
two rounded prominences at the
ends, with a depression in the
middle, and sometimes a raised
neck ^{or isthmus} at one side connecting the
prominences. At first sight it would
be easy to mistake these bodies
for valves of Bezirichia.

The geological relations of the
beds containing these interesting remains
are thus stated by Mr Derby *

* Proceedings Am. Phil. Socy Dec 21, 1879

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I have not seen specimens of the
black shales referred to in this de-
scription, but should think it likely
that on careful examination they
might be found to owe their
Carbonaceous or bituminous matter
to the partial decay of Sporangites.
They also deserve careful examination
with the view to the discovery of
the vegetation appertaining to the
Sporocarps.

There can be no question of the close resemblance of the Brazilian species of Sporangites with the Spore-envelopes of modern Rhizocarps. Since individuals of the S. Brasiliensis are scarcely distinguishable in form & contained macrospores from the Spores of Salvinia natans of the rivers of Europe. * It is true that the analogy of Salvinia would lead us to expect other sacs containing microspores; but in ordinary circumstances the latter could not be preserved in a visible state, and on the

(Fig. 1d.)

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Brachian slabs there are many specimens not showing macrospores, and which might have been filled with microspores, which have been flattened into an undistinguishable mass.

If ~~we~~ we compare the separate macrospores of the Brachian Spor. Caps, and especially those which are found detached from their envelopes, with Sporangites Aurumensis, we see a remarkable similarity in size, form and texture, sufficient to justify us in supposing that the latter may be of the same

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nature with the former but deformed
of their ^{either by dehiscence or by decay} vital cases, and this is
the view which I am now dis-
posed to take of their nature,
and which better accords with
their wide distribution in aqueous
deposits and with their asso-
ciations than any other
supposition. I may add that
Prof. Cotton and Prof. Clarke,
in letters to the author, refer
to grouping of the little rounded
bodies and traces of enveloping
membrane. In this connection
I would also mention the Sues

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Containing rounded bodies known
as Purka, and which have been
Met with in the Erian beds
both in Scotland and in Gaspe,
and have been supposed to be
ova of Crustaceans. It is true
that these are much larger than
the Sporecarps above referred
to, but on examination of Gaspé
specimens in my collection, I am
disposed to suspect that they
also may prove to be ~~Spore~~
the fructification of Rhizocarps.

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It remains to enquire — are there any Liliac plants known to us in their stems and foliage, & which such organs of fructification as those above described ~~are~~ referable to? might have belonged?

A preliminary question would naturally be as to the vegetative organs of modern Nivoseae. In reference to the description, and to a somewhat extensive collection of specimens placed at my disposal by Mr. Poe Watt of Montreal, I find that there may be referred to these leading types,

Some like Pilularia have simple linear leaves. Others like Marsilea have leaves in verticils and cuneate in form, while others like Asolla and Salvinia have pinnate leaves multiple pinnate in their arrangement. The first type presents little that is characteristic, but there are in the Permian Sandstones and shales great quantities of filamentous & linear objects which it has been impossible to refer to any genus, and which might have belonged to plants of the type of Pilularia. It is quite possible

Bliss

also that such plants as Phyllophylon
glabrum and Cordales angustifolia,
 of which the fructification is quite
 unknown, may have been
 allied to Alisocarps. With re-
 gard to the verticillate type, we
 are at once reminded of Sphenoz-
phyllum, which many Palaeozo-
 botanists have referred to the
Marsiliaceae,^{*} S. pinnatum of Deshayes
 is found in the Hudson River group,
 and my S. antiquum in the
 Middle Erian. Besides these
 there are in the Silurian and
 Erian ^{beds} plants with verticillate.

* though
 like other
 Palaeozoic
 Charophytes
 it presents
 complexities
 not seen
 in its modern
 representatives,

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The two best known species of Bilophyton (B. princeps and B. robustum), which allied to Lycopods by the structure of the stem and such rudimentary foliage as they possess, are ^{also} allied to the Rhizocarps by the form of their fructification, and not to Ferns as some palaeobotanists have incorrectly supposed.*

I do not suppose that the facts above stated ~~establish~~ ^{furnish} any positive proof that the abundant Sprangites of the Missisippian Period were the fructification of Rhizocarps.

* See my Report on Missisippian Plants of Canada, 1882.

... here group.

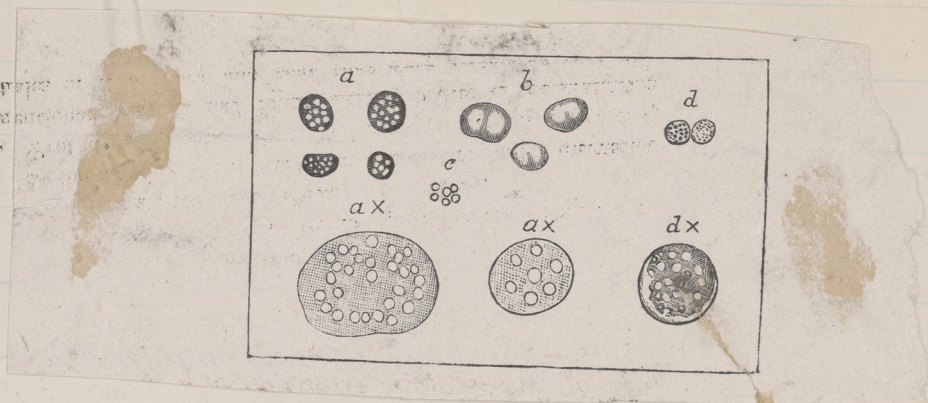
“(The third or Curuá group consists almost exclusively of black and red shales, passing at times into shaly sandstone. These beds form low cliffs along the rivers Maecurú and Curuá for a considerable distance, lying almost horizontal, except where disturbed by eruptions of diorite. On the Trombetas the black shale forms two short cliffs on the river bank, and the red shale is badly exposed on a lake near by. At Ereré these rocks are exposed in the eastern part of the plain, and in the base of the serras, particularly that of Tajurí, the front of which is composed almost entirely of these shales. The black shale forms the lowest bed, the thickness of which, on the Curuá, is estimated by Mr. Smith at 300 feet. It is well laminated, almost slaty in structure, and in the lower part contains numerous large, calcareous and arenaceous concretions. The first are bluish black in color, have well developed cone-in-cone structure and emit, when struck with a hammer, a strong odor of petroleum. ¶

“(The reddish shale lies above the black, having more or less the same thickness. It is generally chocolate-colored, mottled with spots of a darker hue and banded, parallel with the stratification, with white, yellow or

... proportion of
finely-divided mica and sand, the last often forming independent layers, a few inches thick. The only fossils found in these shales were Fucoids, of the genus *Spirophyton*, and small fruit-like bodies, resembling very much a flattened currant, consisting apparently of a thin pellicle enclosing two to six small grains. The *Spirophytons* are apparently identical with those described by Prof. Hall, from the Hamilton group of New York. They occur abundantly in all the localities, in both the black and red shale, near the junction of the two. ¶

“(On the Curuá and Maecurú the red shale, which is undoubtedly Devonian, is followed by beds of coarse sandstone which, according to Mr. Smith, are at least fifty feet thick on the Curuá. This is followed by fossiliferous Carboniferous beds. The red shale is also overlaid by coarse sandstone, in the mountains of Ereré, but it is not certain that this sandstone is of the same formation as that of the Curuá. ¶

“(As regards the extension of the Devonian series, it has been recognized as far west as the river Uatumá, a small river between the Trombetas and the Rio Negro. On the southern side of the valley, there are, on the Tapajos, shales containing *Spirophyton* and calcareous concretions, which were referred provisionally to the Carboniferous by Prof. Hartt, but which seem to me to be Devonian, and I refer to the same age the black shale found by Sñr. Penna on the Xingú. ¶



- (a) Sporangites Brasilensis, not sure (ax) same magnified
- (b) Sp. biloba, not sure
- (c) Detached Macrospores
- (d) Spore cases of Sulvinia natans, (dx) same magnified
 In dx the spore macrospores are ~~not~~
 as large as represented well. They showed
 the layers and were globular.