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II. Observations on some Bisexual Cones occurring in the Spruce Fir, (*Abies excelsa*)

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us in detail as such. But if we are to look for such ends in every individual object in nature and in every organ, we are only preparing ourselves for frequent disappointment; for utility is not the point of view which ought *to rule* in our regards. In the natural as in the moral world, there is a higher principle than particular expediency or individual interest. There is a call all through nature, which is ever for order, universal order, the wellbeing of the whole. And accordingly there is in natural science a doctrine of *general homology* as well as of *special utility*. And truly wonderful it is to observe to what an extent, in the natural as in the moral world, multitudes of special uses and individual advantages in detail are secured as often as supreme law is obeyed. Hence the grand aim at once of science and philosophy ought to be, the discovery of supreme laws; and to this theme the preceding pages have been devoted in the delightful field of the vegetable kingdom.

II. *Observations on some Bisexual Cones occurring in the Spruce Fir, (Abies excelsa).* By ALEXANDER DICKSON, M.D., Edin.

When in Peeblesshire, in the beginning of last month, I met with an interesting, although apparently not a very uncommon abnormality in the shape of what may be termed bisexual cones, occurring in some young spruce firs. The abnormality consisted in the lower portion of the cone being covered with stamens, while the upper or terminal portion produced bracts and scales like an ordinary female cone.

The staminiferous portion varied in extent from about $\frac{1}{2}$ to $\frac{3}{4}$, or even more, of the whole cone, and differed in no respect from the normal male cone, except perhaps that it was rather thicker, in consequence of the axis being a little stouter than usual.

The remaining upper part of the cone, on the other hand, bore small, narrow, more or less acute, bracts, with large pinkish or rose-coloured scales in their axils, and in fact resembled the normal female cone.

On closer examination, I found the stamens at the upper

limits of the male portion of the cone somewhat altered in shape. The indurated scale-like crest of the anther became more elongated, whilst the anther cells at its base were diminished in size. The stamen now closely resembled one of the bracts of the female cone; indeed, some of these taper-crested stamens contained the lowermost scales of the female portion in their axils.

In these specimens, therefore, *the stamens in the lower part of the cone are serially continuous with the bracts of the terminal portion.*

Schleiden mentions, that "in *Abies alba* it not unfrequently happens that a portion of the lower leaves of the female inflorescence becomes converted directly into stamens; but then no axillary buds [scales] are developed." * The abnormality to which Schleiden refers must have been precisely similar to that which I have exhibited; and I cannot but think, that if he had looked at them closely enough, he would have found some of the lowermost scales in the axils of stamens as I have done.

Richard, in his *Mémoires sur les Conifères*, &c., plate xiv., has given a somewhat indifferent representation of an "*amentum androgynum*" in *Abies*, of which the lower portion is staminiferous; but without any commentary, beyond the mere indication of stamens in one portion and scales in another.

Dr Lindley, in his "Vegetable Kingdom," thus refers to the morphological constitution of the male cone. "It is obvious, that in the larch, the cedar of Lebanon, the spruce, and the like, each anther is formed of a partially converted scale, analogous to the indurated carpellary scale of the females; and therefore each amentum consists of a number of monandrous naked male flowers, collected about a common axis" (p. 227).

That the above is an erroneous view of the homologies of the male and female flowers in the coniferæ, I am fully persuaded, and I am the more impressed with the necessity of attempting its refutation, when I reflect on the consideration which is justly accorded to Dr Lindley's opinions.

1. There is no reason why the stamens in a male cone should not be regarded as foliar structures belonging to one

* Schleiden's Principles of Botany (Lankester's translation), Note to p. 299.

and the same axis, viz., that of the cone, since they are not placed in leaf axils, nor do they, so far as I know, present any articulation, or any other evidence of their being possibly other than what they seem,—viz., simple stamens arranged spirally upon one common axis, thus constituting a single male flower.

That such a view of the male cone is well founded, appears from the abnormality under consideration, which proves the stamens of the male cone to correspond to the “bracts” of the female. That the bracts of a female cone are the leaves proper to its main axis, is at once proved by examination of the larch cone, where there is a gradual and beautiful transition from the “bracts” to the ordinary green leaves surrounding the base of the cone, with which leaves the bracts are serially continuous. From these considerations it follows that the stamens in a male cone represent the leaves proper to its main axis, that, in fact, they collectively constitute a single male flower as I before mentioned.

2. In these bisexual cones, the “bracts” at the upper part are serially continuous with the stamens below. From this it is evident that the stamens in a male cone must be represented, morphologically at least, by the bracts in a female, and not by the scales, as Dr Lindley believes.

The question, however, remains—What is the nature of these scales?

As the bracts of the female cone are the leaves of its main axis, it is manifest that the scales which originate in their axils must belong to secondary or lateral axes, whether they are viewed as foliar or as axial structures.

The opinion generally entertained by botanists, that the scale is a foliar structure, analogous to a carpellary leaf, has been ably combated by Schleiden, who asserts that “throughout the whole vegetable kingdom, no simple leaf is ever formed in the axil of another leaf.”* From this, among other reasons, he draws the conclusion that the scale cannot be considered as a leaf, but must be regarded as an axial organ.

Dr Lindley has attempted to negative the objection by asking “what the fruit of *Salix* is but *folium in axilla folii?*”

* Schleiden's Principles of Botany (Lankester's translation), p. 385.

This question, however, regarding the fruit of *Salix*, seems irrelevant, since there is not merely a simple leaf contained in the axil of each bract in the amentum of *Salix*, but a floral axis with receptacular scales, carpels (probably two), and a placenta with ovules.

At the same time, Dr Lindley does not seem to consider the content of the bract in the cone as consisting *absolutely* of a simple leaf, since he says that the scales "occupy the same position with respect to the bracts as the leaves [I presume of *Pinus*] do to their membranous sheaths." The fascicled leaves, however, which occur in the axils of the membranous leaves in *Pinus* are, as he himself holds, the product of secondary or lateral axes; and the occurrence, indeed, of these short and more or less abortive shoots in the axils of membranous or bract-like leaves in *Pinus* affords a good argument in favour of Schleiden's determination of the scales of the cone as shoots, abortive so far as longitudinal extension is concerned, and comparable to the flattened leaf-like shoots of *Ruscus* and *Phyllanthus*, or to the curiously expanded shoots in *Phyllocladus*,* which, as being a gymnosperm, possesses a peculiar interest in this respect.

On the whole, as there is no evidence that the bract in the cone contains other than a simple structure—viz. the scale—and as we cannot consider this latter as a *simple leaf* ("*folium in axillâ folii*" being, strictly speaking, without a parallel), we are obliged for the present to accept, as more probable, the other alternative, and view the scale as a *simple flattened shoot*.†

* With these last must not be confounded the somewhat similar expansions in *Salisburia*, which, however, are true leaves, producing shoots in their axils.

† I must not omit to mention, that Dr Lindley (Vegetable Kingdom, p. 227) refers to a figure in plate xii. of Richard's *Mémoires sur les Conifères, &c.*, where he says that there is represented a monstrous cone of *Abies*, in which the scales have assumed the common appearance of leaves. I am rather at a loss to account for Dr Lindley's reference, because the abnormality figured in plate xii. is not a cone, but what Richard terms "*monstruosité strobiliforme*," and consists in a hypertrophy at the bases of the leaves, resulting from irritation or morbid stimulus induced by the attacks of an insect.

In plate xiii. of Richard's work, there is a figure of a larch-cone, to which, more probably, Dr Lindley may have intended to refer; but in this, as in all

I do not intend at present to enter at length upon the homological relations of the female flowers in gymnosperms to those in the other Phanerogamia. The remarkable similarity which various observers have shown to exist between the *corpuscula* in the coniferous "ovule," and the *archegonia* upon the *prothallus* in the large spore of Lycopods and Rhizocarps, would seem to indicate analogies very different from those which have been sought for in the Phanerogamic sub-kingdom, and would even lead us to doubt if the so-called "ovule" in Gymnosperms be really equivalent to the ovule in the other Phanerogamia. In reference to this point, it would be of great importance to determine whether the ovular envelopes of Gymnosperms (in those cases where there is more than one coat) follow the same order of development as those in the other Phanerogamia. The discovery by Griffith, that the third and most internal envelope of the "ovule" in *Gnetum* is developed *after* the appearance of the two outer coats, seems to point towards an important distinction between these and the ordinary Phanerogamic ovules, where, as is well known, the coats are developed in order from within outwards.

There remains much to be done in elucidation of the morphology of the bractless, or, more probably, *scaleless* cones of the *Cupressineæ*. It is very difficult, indeed, to see how they are to be compared with the cones of our ordinary conifers.

In conclusion, I would state, that although as a general rule it is improper to insist strongly upon any monstrosity as proving a general morphological principle, yet, in the present instance, the abnormality only confirms what may be deduced

ordinary instances where a portion of the axis of a cone becomes leafy, the leaves continue the series of the bracts, whilst the scales are suppressed at that part; and, in reference to this case, Richard makes the following observations (p. 68 of *Mémoires*):—

- "1. Coni axis interdum summitate abit in ramulum foliosum; foliis solitariis distantibus.
2. Squamularum posticarum plurimæ in folii principium desinunt; supremæ etiam nonnullæ in verum folium conversæ. Ergo, non squamæ fructiferæ, sed posticæ tantum in folia mutantur."

This is quite conclusive—"Therefore, *not* the scales (*squamæ fructiferæ*), but only the bracts (*squamæ posticæ*), are converted into leaves."

from a comparison of the normal male and female blossoms in the coniferæ to which I have alluded above.*

III. *On the Movements in the Cells of Anacharis and Vallisneria.* By
S. J. MEINTJES, Jun., Esq.

The author stated that the cells of this plant are brick-shaped, and formed of a single wall. The marginal cells contain less granular matter than those nearer the midrib. These granules, when in motion, line the circumference of the cell, never actually touching the wall. When in a favourable state the granules move regularly round the cells—some in one direction, others in an opposite one. The movement is a slow, rolling motion along the sides of the cell; when the angles of the cells are acute the granules are jerked across, and on regaining the opposite side resume their steady progressive movement. Sometimes a granule is sent out with a jerk from the true course, but it immediately returns, and continues its course. All these phenomena are seen under a power of about 300. When a higher power (650) is used, a thin wave-like line is seen lining the whole of the cell, and in actual contact with the granules when present. This at first seemed an optical delusion, but repeated examinations plainly showed this line to be the free margin of a row of cilia. F. Branson, in a paper published in one of the numbers of the *Microscopical Journal*, pointed out this some time ago, and without being at the time aware of Mr Branson's paper, Mr M. verified all his statements. The conclusion he arrived at is, that the motion of the granules is due to the presence of cilia. The way in which these cilia act is peculiar. Being set at an angle to the cell wall, their action takes place in the direction of their angle; when set in motion they create a strong eddy in the cell. This eddy, by its centrifugal force, drives the granules to the side of the cell, and, coming under the influence of the cilia, they are carried along the side. Owing to the shape of some of the cells, a secondary current is produced in the acute angles, and, when the granules come under the influence of the two currents, they are thus rapidly conveyed across the angle—hence the observed jerk. Another effect of the irregularity of the shape in the cells is, that the eddy can never be perfectly circular, and, this being the case, its force cannot be equally distributed. This inequality causes the outer edge of the eddy to act with greater force on some parts of the cell than on others, and the lighter granules, being sent with a greater force against those parts, rebound. The elasticity of the cilia increases the repulsive power, and also the force of the rebound caused by the action of the eddy.

* Since reading this paper, I have (in July) again visited the locality where I obtained the abnormal cones, and found several similar ones, some of which had withered, while on others the scales had become enlarged, and were approaching maturity. On one cone I found that not only the lowermost scales, but five or six a little higher up, were in the axils of well-developed stamens. Another cone which I examined had a few scales at its base; above this was a stamiferous portion; while further up, and terminating the cone, there were scales again—the whole reminding one somewhat of the inflorescence in *Arum maculatum*.

In another cone (from *Abies nigra*) which I obtained in Perthshire while these pages were in the press, the greater number of the scales upon the lower two-thirds of the cone had their bracts replaced by stamens. The axis of the cone at that part was somewhat elongated, the scales being laxly arranged and not very well developed.