Morphological Notes.

BY

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With Plate XL.

X. A PROLIFEROUS PINUS CONE.

THE specimen described in this note has perhaps a little more than a scientific interest. It was brought from Spain by the late H. R. H. the Comte de Paris in 1894 and sent by him to me not many months before his death, which took place on September 8 of that year.

Its history is given in the following letters:—

PALACIO DE VILLAMANRIQUE,
PROVINCIA DE SEVILLA (ESPAÑA),
April 27, 1894.

SIR,

I have in my possession what I consider as a very curious botanical phenomenon, and I would gladly present it to the Kew Museum, or send it to you for inspection, if you thought it worth of it.

It is a frondiferous cone of the *Pinus Pinea*, out of the upper end of which has grown a young tree just as a pine-apple grows out of the crown of this fruit. Generally these cones fall only after having thrown away their seeds. This one fell on the ground (how I do not know) with the seeds or almonds still encased in it. It was picked up in a large *Pinar* or pine forest which I own in this neighbourhood, by

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one of my keepers a day I was out shooting. The young tree was then about six inches long. The woodmen of this country say they never saw anything like it.

I took the cone home and left it alone on a table, about the middle of February. It went on growing for a month, made a stem more than a foot long with three branches, and even threw out new shoots. About the end of March, although it was watered, it ceased to grow and dried, although the needles did not fall and preserve their colour.

Will you kindly send your answer to Stowe House, Buckingham, where I shall be in a few weeks, as a letter sent to Spain would be too late to reach me.

Believe me, &c.,

PHILIPPE COMTE DE PARIS.

STOWE HOUSE, BUCKINGHAM,
May 19, 1894.

DEAR SIR,

I have just received your letter of yesterday, and I hasten to thank you for it.

I send you at once the curious growth out of the cone of *Pinus Pinea* which I mentioned to you in my first letter. If it can be of any interest I shall be glad to present it to the Kew Museum.

As I wrote to you, this cone was found on the ground in the Pinar de los Lobos on my estate of the Coto del Rey near Seville, by one of my keepers a day I was out shooting in February, 1894. The growth then was only six inches long and single, and quite fresh. I took it home and put it on a shelf in my study where it went on growing and dividing in branches for about a month. Then it suddenly stopped, dried up, and nothing could induce it to start again: very likely the stock of sap which the cone contained was exhausted.

Believe me, &c.,

PHILIPPE COMTE DE PARIS.

STOWE HOUSE, BUCKINGHAM,
June 11, 1894.

DEAR SIR,

I learn from your letter, with the greatest pleasure, that the botanical specimen which I had sent you a fortnight ago has been most fortunately discovered, and the foolish idea of the

railway expeditor in Buckingham who labelled the parcel containing this specimen as an empty box, has had no serious consequences. I only regret very much the trouble which this absurd mistake has caused you, and I beg to apologize for it. It would indeed have been very unfortunate if this curious and anomalous growth had been lost for ever under a heap of old empty boxes.

I thank you very much for the interesting lecture given in your letter upon the physiological characters of pine-cones. What struck me most in that specimen is the following fact: when it was picked up it must not have been lying on the ground more than two or three weeks, perhaps less. The young single shoot was not six inches long. It went on growing very rapidly, throwing off branches and showing all the appearances of an ordinary strong and healthy branch, without being ever fed in any way. After about six weeks it had attained its present size, and then the growth suddenly stopped and the needles, losing their dark green appearance, began to wither. It was in vain that I put the cone in a wet cloth, nothing could restore life in it. This shows evidently that there was a certain quantity of sap in the cone sufficient to insure this anomalous growth up to a given size, and that when this store of food was exhausted the autonomous life of this cone became extinct.

Excuse me for making this remark, and believe me, &c.,

PHILIPPE COMTE DE PARIS.

The total length of the specimen is 19½ inches. The figure is therefore reduced to rather more than a third.

The cone belongs to the 'Stone Pine' (*Pinus Pinea*, L.). As is well known the seeds are edible, hence the Comte de Paris writes of them as 'almonds': strung together they are sold in the market at Lisbon. Examples may be seen in the Kew Museum, where the specimen is also preserved.

I have failed to find any record of terminal prolification in a *Pinus* cone, and Dr. Masters, F.R.S., who is an accepted authority on the *Coniferae*, kindly informs me that he knows of none.

Normal cones of *Pinus Pinea* are usually about 6 inches long. That now described is only 3½ inches. It is therefore a small cone. But as the apex of the largest scales

measures an inch across, which is the normal size, the smallness of the cone is due to its having fewer scales and not to its being immature.

The morphological interpretation of the female cone in the *Abietineae* is a subject upon which the most divergent views have been held. As is well known a cone is composed of seminiferous scales (which become greatly enlarged in *Pinus*) and these are apparently axillary structures subtended by the primary reduced leaves of the axis of the cone, the so-called bract-scales.

In *Larix* proliferation of the female cones is not uncommon. But the passage from cone to shoot is not, as in the present case, abrupt, but gradual. Masters has shown conclusively (Gardeners' Chronicle, N.S., xvii. pp. 112, 113) that in such cases the bract-scales pass into ordinary foliage leaves with which they are serially continuous. The fact admits of no dispute and the interpretation is generally accepted.

So far we seem to be on solid ground: whatever be the explanation of the seminiferous scale it is at any rate 'subtended' by the bract-scale, which is undoubtedly a modified foliar organ and is not seminiferous.

This state of things is in sharp contrast to that which obtains in the *Cycadeae*. In a former note (Annals, xv. pp. 548–550) I have shown from the study of a proliferous *Encephalartos*, that the carpophylls or seminiferous scales are homologous with the ordinary foliage leaves and therefore with the bract-scales in the *Coniferae*, as both belong to the primary axis.

No one would I suppose now deny that the Gymnosperms stand in an intermediate position between the Phanerogams and the Cryptogams. Few things in vegetable morphology are more remarkable than the reluctance with which this has been admitted.

Nothing can of course be simpler than the fundamental generalization which is applied to both. An *Anther* is a modified leaf which produces microsporangia: a *Carpel* is a modified leaf which produces macrosporangia. Of the latter

the carpophyll of *Cycas* is the simplest we know: we fold it like a sheet of note-paper, and we get an arrangement which does not differ essentially from a pea-pod. But in the majority of Phanerogams, a carpel of this simple type is lost sight of in the complexity of adaptive arrangements, and a subsidiary structure—the placenta—is called into existence to bear the ovules.

It seems to me that the Gymnosperms having assisted us to grasp the generalized structure underlying the complex arrangements of the Phanerogams, we must use great caution in the attempt to find in the former the specialized structures developed in the latter. Nevertheless the history of Gymnospermous morphology shows a constant attempt to bring it forcibly into line with that of Phanerogams.

The most recent view as to the nature of the seminiferous scale in *Abietineae* proper is that of Goebel (Outlines of Classification and Special Morphology, p. 328). He lays stress on the fact that in *Abies* 'the seminiferous scale arises as a protuberance on the base of the so-called bract-scale and therefore is not axillary.' I must confess, however, that vegetable morphology presents us with so many cases of similar dislocations that the mere fact taken alone does not strike me as of great importance. I am disposed to agree with Van Tieghem that it merely depends on 'intercalary growth' such as 'separates a dialypetalous corolla from a gamopetalous one.' If this is the correct view, as I believe it to be, Goebel's theory that 'the seminiferous scale' must 'be regarded as a *placenta* of large dimensions growing out of a carpellary leaf' seems to be without a valid argument to support it. And in *Pinus*, where the seminiferous scale is truly axillary, Goebel admits that it cannot be considered an outgrowth, though he still thinks it may be considered a placental growth.

If the seminiferous scale is not a placenta or outgrowth from the bract-scale, which in that case would be a carpel, it must be some kind of foliar organ. Lindley was satisfied 'that the scales of the cones really are metamorphosed leaves'

(Vegetable Kingdom, 3rd ed. 227). And this view seemed to him conclusively supported by a monstrous cone of *Picea excelsa* figured by Richard (Mémoire sur les Conifères et Cycadées, t. 12, f. 3). Unfortunately this was not a cone at all, but a 'false cone' or gall. Schleiden, whose boisterous criticisms may still be studied with advantage, insisted that the seminiferous scale was the equivalent of an axillary bud:—'l'écaille, considerée par R. Brown comme un ovaire ouvert, n'est autre chose que le bourgeon axillaire de la feuille carpellaire, placé sous l'écaille, et, par cette raison seule, ne saurait être un organe foliaire, parce que *folium in axilla folii* est chose sans exemple dans tout le monde végétal (Ann. d. sc. nat., 2^{e} sér., xii. 374). Schleiden's theory was developed by Braun, Caspary, and at first Eichler: they regarded the seminiferous scale as a short axis which has coalesced with its two carpels; Von Mohl as 'a coherent structure formed of the leaves of an undeveloped branch.'

The latter view derives some support from the ingenious argument which Masters has founded on a proliferous cone of *Sciadopitys*, first figured in Veitch's Manual of Coniferae (Gardeners' Chronicle, l. c.). According to a note by Van Volxem in the same volume (p. 155) this is 'the most common form . . . . . in the neighbourhood of Yokohama.' Masters finds that in this case the bract-scale remains unchanged, while the seminiferous scale is replaced by a normal 'leaf.' He remarks that 'whatever be the nature of the so-called 'leaf' of *Sciadopitys* it must be essentially the same as that of the seed-scale of the *Abietineae*.' The argument is, however, doubtful. *Sciadopitys* does not belong to the *Abietineae* proper, and its 'leaf' has itself been regarded as a shoot formed by the coalescence of a pair of leaves such as occur in *Abietineae*.

Van Tieghem has adopted a view of which I have given an account in a note to Sachs' Textbook (1st ed. pp. 453–4). He regards the seminiferous scale 'as the first and only leaf of an axis which undergoes no further development.' This reconciles the views of Schleiden and Lindley.

The position, however, becomes more complicated when we consider the remarkable case of a monstrous cone of *Pinus lemoniana* (P. Pinaster), described by Parlatore, from the Gardens of the Royal Horticultural Society at Chiswick (Ann. d. R. Mus. di St. nat. di Firenze, 1884). In this the seminiferous scale is replaced by a limited branch or fascicle of ordinary foliage leaves. The facts:—'dimostrano chiaramente come ne conviene lo stesso Signor Eichler, che nell' organo squamoso o squama interna, secondo ch' egli lo chiama, delle Abietinee, debba scorgersi non un asse soltanto secondo l'opinione di Schleiden, nè un carpello come comunemente si crede, ma un ramo raccorciato con gli organi fogliacei.'

An important paper by Stenzel (Nova Acta, xxxviii, 1876) I have not had the opportunity of seeing. But it has been carefully summarized by the late Professor McNab (Journ. Bot. 1877, pp. 26–7). It was based on abnormal scales of the spruce (*Picea excelsa*, Lk.) in which the seminiferous scale was replaced by an axillary bud. 'The two lateral bud-scales . . . are well developed, hard, brown, with the margin irregular and quite of the texture of the scales of the cone. By further tracing these abnormal buds it is found that at last all trace of the bud except the two lateral bud-scales disappears, and these become soldered more or less completely. . . . Farther down, the scales show no trace of a suture, and pass into the ordinary bifid scales of the cone.'

The conclusion arrived at was that the fruit-scale of the spruce, and also of the other true *Abietineae*, consists of the first two leaves of a suppressed bud developed in the axil of a bract. This is in agreement with the view of Von Mohl (1871).

Latterly Eichler changed his views, according to a note in the Gardeners' Chronicle (l.c. pp. 264–6). 'In his opinion the seed-scale is only an excrescence from the outer scale or bract, so that the two really constitute one leaf, and the bud or branch in the axil of the bracts in proliferous cones are not to be considered as transformed seed-scales, but as axillary buds to the composite leaf.' If this were the true explana-

tion one would expect to find some trace of the seminiferous scale persisting, even in the presence of an axillary bud. But it is clear that this is not the case. In the *Abietineae* with membranous cone-scales (possibly also in *Sciadopitys*) it seems to me that the view of Von Mohl, supported by the researches of Stenzel, is probably correct, and that the seminiferous scale is complex in its origin. But I am not clear that this is the case when the cone is woody, as in *Pinus*. It does not follow because the seminiferous scale is replaceable by a fascicle of leaves that all potentially take part in its development. The general resemblance of a cone of *Pinus* to one, say, of *Encephalartos* is obvious at a glance. In each case we have a 'carpophyll' enlarged above into an hexagonal apophysis with an 'umbo' on its external surface. However violent may seem the transformation, I have clearly demonstrated that the carpophyll in *Encephalartos* is a modified leaf belonging to the primary axis: in the *Abietineae* it appears to me equally demonstrable that it belongs to a secondary one. As Van Tieghem has remarked:—'This establishes a fundamental distinction between *Cycadeae* and *Coniferae*.' But, as in *Encephalartos*, the umbo seems to me clearly the dilatation of the atrophied apex of a foliar organ.

Returning to the specimen now described, I have already noticed that, unlike what takes place in the proliferous shoots of *Larix*, there is an abrupt discontinuity between the reproductive and vegetative regions of the axis. This reminds one in fact of *Callistemon*, where the same axis serves alternately one or the other purpose: an even closer analogy would be found in *Cycas* if the carpophylls were persistent.

The explanation of the fact that a cone is not proliferous is to be found in physiological necessity. The upward stream of food is diverted and absorbed by the developing carpophylls, and the growing point of the cone is arrested in its further development practically by starvation. The upper seminiferous scales share the same fate and become mere woody rudiments. Meanwhile the growth of the cone in diameter sets up a passive tension which would, by mechanical pressure,

in ordinary cases effectually suppress any extension of the growing point. It is, however, to be remarked that in *Pinus Pinea* the cone is often not quite symmetrical; there is a sort of apical appendix, as if terminal growth were not relinquished without a struggle.

I have already noticed that the cone now described is below the normal size. It may be supposed that the food-supply directed towards it was in excess of its needs. The growing point was therefore started into activity. That this was not, however, accomplished without a struggle is proved by the deep constriction between the shoot and the cone. The passive tension of the apex of the cone prevented any increase in the diameter of the shoot till it was entirely free from it.

The age at which the specimen came into my hands had obliterated any trace of external morphological continuity between its two parts. But it seems impossible to shut one's eyes to the fact that the fascicles of leaves in the upper part must correspond to the carpophylls or seminiferous leaves in the lower.

One or two other points remain to be mentioned. Why the cone was shed, seeing that it was actively vigorous, is difficult even to conjecture. When first found the shoot was six inches long; it is now sixteen: it therefore grew at least ten inches after separation from the parent tree. The cone is probably figured in about its normal position: the strong curvature of the shoot is no doubt due to geotropism.

The shoot was entirely dependent on the cone for its supply of both constructive material and water. It is a striking illustration of the power possessed by rapidly-growing tissues of not merely diverting nutriment from others which are less active, but of actually robbing them. But in the absence of roots the supply was bound sooner or later to come to an end. Probably the actual cause of death was, notwithstanding the pains of the Comte de Paris, the failure of a water supply to maintain the transpiration current.

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