ART. X.—*Accelerated Cone Growth in Pinus*; by G. R. WIELAND.

THE rare but suggestive instance of multiseriate production of ovulate cones in *Pinus rigida*, illustrated in the accompanying figure, has been recently brought to my notice by one of my colleagues.* This conspicuous group of cones appears to have been derived from some New England source many years ago, having been found with a series of geological specimens collected or left in the Peabody Museum by Professor Benjamin Silliman and probably not examined since his day.

As appears in the figure, the individual cones, of which there are fifty-three in all, are nearly all of normal or approximately normal development and so regularly crowded together on their common axis as to simulate, taken *en masse*, some such single huge cone as that of *Pinus Coulteri*. It is clear enough, however, that the entire growth of cones is not in any complete sense an abnormality; for each cone must appear normally in the axil of a bract, just as do the several up to half a dozen cones in the usual ovulate clusters [or whorls], and exactly as in the case of the far more numerous cones of the corresponding staminate groups.

* At the time this note was first written it seemed to me that its interest was somewhat lessened by the fact that after diligent search and inquiry I failed to learn of additional examples of clustered *Pinus* cones. Since then, however, I have seen three large and even finer clusters in the collections of the *Jardin des Plantes*, Paris. No label accompanied these specimens, which represent at least two more species of *Pinus* exhibiting accelerated cone growth.

Also, similarly to both ovulate and staminate cone-bearing axes, as well as to occasional single ovulate cones, the main or vegetative axis was prolonged; although, having been broken away, this feature does not appear in the figure. The present very unusual or even unique group of cones has therefore been produced in the simplest possible manner, namely, by increase in number and crowding to the extent of about a dozen of the ordinary ovulate clusters.

Moreover, it is from its very simplicity of origin that this fine example of accelerated proliferation appears to me to derive an instructive interest; for of late there have been accumulating various significant facts pointing toward a derivation of all existing spermatophytes from primitive ferns by way of pteridospermous types. Indeed, it now appears quite probable that the production of ferns may well have been Nature's fundamentally greatest achievement in vegetal evolution, and that following this great step, perhaps thoroughly accomplished in Silurian time, advance in reproductive structures was largely along lines of lesser resistance rather than by sheer forward movement. That is, broadly as well as theoretically speaking, the hiatus between monœcious fern prothalli and the seeds of pteridosperms and finally of gymnosperms and angiosperms; or, more definitely still, the hiatus between asexual fertile fern fronds, and the microsporophyll and carpellary leaf, the stamen and carpel, as seen in their thousand-and-one combinations in strobili flowers and inflorescences, was bridged not so much by the outright evolution of new organs as by more roundabout methods. Such, for instance, are, following the development of either generalized types or organs, extreme reductions, the secondary requisition of organs not originally evolved for the specific purpose or use finally assumed, and especially rearrangements or regroupings of fertile axes with sporophyll changes sequent to accelerated branching.

Now, if such conceptions of the descent of the higher types of existing plants from the ferns can in any sense approximate the truth, then the question as to the extent to which sporophyll reduction entered into the evolution of primitive types of cones from a main terminal strobilus like that of *Cycas* at once arises. And directly corollary to this inquiry there immediately comes up for discussion the further possibility of accelerated branching with marked increase in number of partially reduced fertile axes. Such, whenever assuming a more or less compacted order constituting in reality primitive types of inflorescences, would, if once coming to appear habitually, readily undergo still other subsequent mutations of form. For example, how else than by some such course of evolution as that here briefly suggested, has the male cone (inflorescence)

of *Welwitschia* arisen? It is certainly thinkable that an initial period of sporophyll reduction and accelerated branching in some ancient pteridospermous ancestor characterized by large bractlike leaves, could result in a *growth* of fertile axes in compacted groups more or less analogous to that before us, and that a secondary course of reductions may then have intervened and produced the condition we now see. In other words, we imagine that in the diœcious *Welwitschia* single flowers originally derived from fertile terminal buds of vegetative form have, following increase in number, undergone extreme reduction and modification into "cones," the ovulate forms of which have lost their microsporophylls. Furthermore, if each cone of a group more essentially like that illustrated were to be reduced so as to produce but a single seed, another interesting type of conoid inflorescence would be outlined; though such a form could scarcely be as capable of wide variation as a still more primitive series of spirally inserted multiovulate sporophylls.*

It is thus of decided interest to have clearly brought home to us by such a simple form of accelerated branching as that of *Pinus*, the very interesting fact that by reason of new *emplacements* wholly new series of modifications in organs of reproduction may take place. These hypothetical *en masse* changes following the earlier evolutionary stages of primitive sporophylls pointedly suggest how the endless variety of angiospermous fructifications can have arisen from plant types not very remote from but still more primitive than the Cycadeoideæ; while contrariwise in races with few ovules to the carpel and little phytologic plasticity like the conifers, such realignments and modifications have in post-Triassic time seldom appeared or become habitual with a resultant displacement of the plastic stock by its better equipped descendants.

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* The gymnosperm cone itself, both simple and compound, is throughout derived by branching from a primitive main axis. The sporophylls of both sexes are of course all derivatives of pteridospermous fronds; and dorsal, ventral, or lateral insertion of sporangia is of purely secondary import, since resulting in the simplest possible manner during the process of extreme reduction in which all circinnate prefloration was displaced by obscured conduplicate, or direct forms, with formation of various types of appression faces. Finally, in the Coniferales, sclerotization into regularly interlocking spirally inserted prismoids resulted in the nearly aplastic bracts and carpels, which have changed but little since the Jura. Appositely it is hypothesized that a diminution in the number of primitive sporophylls, followed only secondarily by spore decrease in number, would conserve the requirements of carpellary plasticity.