BISPORANGIATE CONES OF PINUS LONGIFOLIA AND PICEA MORINDA

BY

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Several cones of *Pinus longifolia* (Salis) were collected by the writer during April, 1929, at Ootacamnud (8,000 ft.) from a single tree. Being aware of the importance of such hermaphrodite cones and also the value attached to such peculiarities in interpreting the morphology of the female cone of *Pinus*, the writer approached Dr. B. Sahni, Sc. D, for guidance in working ont this paper. The response was very unck. Dr. Sahni with his usual kindness not only furnished me with the required references to the literature on the subject but was also kind enough to send me a bisporangiate cone of *Picea morinda* (Link) (which he collected at Gulmarg, Kashmir and described in 1929) with permission to include the same in this paper along with the above *Pinus* cones.

Bisporangiate cones have been recorded in Pinus maritima Goebel (1903) and Pinus excelsa, but so far as the author is aware no such instance has been recorded in P. longifolia. In P. montana however, similar bisexual cones were collected and described by W. N. Steil (1918). and according to this author nearly all the cones of such clusters bore both macro- and micro-sporophylls, the latter being in every case on the lower portion of the cone. The macrosporophylls were borne in most cases on only the upper portion of the cones. As far back as 1883, an androgynous cone Pinus Thunbergu was recorded by Dr. Masters in which the base of the cone was occupied by the 'stamens". The bud scales passed by gradual tran. sitions into stamens and then again into bracts supporting the seedscales. However, in quite a number of other gymnosperms such cones have been recorded as in Picca excelsa by Dickson (1860). P. Alcockiana by Wieland (1916), in Sequora by Shah (1896), in Pseudotsuga Douglassi by Hill and DeFraine (1908), and in Fitzroya patagonica by Henry John Elwes (1912) According to this last author, monoecious flowers of Fitzroya occur in Chilean specimens as well as on cultivated trees at Hewell Grange (England). The bisexual fowers of the latter have several whorls of scales, the scales in three lowermost whorls bear anthers and those in the upper two whorls bear ovules. The axis ends in the normal three glard like processes. Certain abnormalities are mentioned in *Picea excelsa* Link, observed both by Stenzel and Willkomm (1900). The former describes the androgynous cones in which the male organ usually occupied the base and the female the upper part of the cone. More rarely were the males scattered among the female organs. Still more rarely did the male organ form a middle zone with the female above and below.

It is evident that in all the instances above quoted and thus far reported the relative position of the micro- and the mega-sporophylls was the same, i.e., the micro-sporophylls occupying the lower portion of the cone and the mega-sporophylls the upper part. The bisexual cones of *Picea morinda* (Link) and *Pinus longifolia* (Salis) that are described in this paper possess some additional peculiar points which are believed to be of value in understanding the female cone of *Pinus*.

The bisexual cone of *Picea morinda* (Link) was collected by Dr. Sahni in July, 1928, at Gulmarg, 8,500 ft. above the sca-level, cn a large tree from which several insect galls were also collected—a fact suggesting that the abnormality may possibly have something to do with an insect attack on the incipient male or female cone. There is, however, no visible puncture or any other apparent sign of association with an insect.

The basal part of the cone bears a number of scales of exactly the same type as the transitional basal scales of a normal female cone. These are followed by a well-defined zone of microsporophyl's most of which are well formed and apparently normal. The distal half of the cone is again female, also normal in every respect (Figs. 1, 2). Thus the male zone has been intercalated between the basal and an apical female zone. In this case the cone appears to have altered its normal, probably female nature, through a disturbance caused by an insect.

Several bisporangiate cones of *Pinus longifolia* (Salis) were collected by the author during April, 1929, at Octacamund (8,000 ft. above the sea-level) from a single tree. The same tree bore several female cones, all normal and at various stages of development, and clusters of male cones at the shedding stage. The bisexual cones that were collected from this plant could not be distinguished as such at the outset; but were mistaken to be normal female cones situated amidst the needles. On careful examination, their bisexual nature was made out. All the cones were apparently normal measuring from 2.0 cms. to 2.5 cms. in length. At the base of the cones are the usual scales similar to those found on the long branches and those bearing clusters of male cones of the same species Coulter and Chamberlain, (1925). Higher up, in the axils of such scaly bracts are

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found, forming a girdle, several axiliary male cones varying in number from 10 to 14, of different sizes but very much smaller than the normal male cone of the same age. The smallest male cone being 3 mm. long and the biggest being 8 mm. long (Fig. 3). These cones seem to have developed normally with the full compliments of a typical male cone, the pollen grains being quite normal in size and structure. Above this girdle of small male cones there is a distinct zone of microsporophylls. The gradation between the two zones is sudden. The microsporophylls also are normal with well-developed microsporangia and microspores. As stated above, the pollen grains are just at the shedding stage (Fig. 7). The length of the male zone



× 300

Fig. 7 a and b, Pollen grains from the microsporangia of P. longifolia. c and d: Pollen grains from the axillary mals cones of the bisporangiate cone of P. longifolia. e. Single pollen grain from the bisexual cone of Piceamorinla. \times 300.

i.e. zone occupied by the microsporophylls varies from 0.6 cms. to 0.8 cms. Above the male zone, the distal end of the cone axis, there is a clear female zone consisting of the mega-sporophylls which are characterised by the woody bracts and the ovuliferous scales clearly seen in the long section of the cone (Fig. 4). The megasporophylls are quite normal and all bear ovules except those at the extreme tip and the base of the female zone.

More recently, October, 1930, the author collected at Kodaikanal, South India, (7,000 ft. above the sea-level) on several plants of *Pinus longifolia*, branches bearing clusters of — both male and female cones. The female cone which is single, always occupies the terminal position of the cluster, with a basal whorl of 4 to 8 male cones (Fig. 5). The cones were quite normal and seem to follow a normal course of development as evidenced by the occurrence of fully developed two and three-years old female cones with the still attached dried male cones at the base (Fig. 6). Thus these branches resemb'e those of *Pinus densiflora* (var. Thanyosho) described by G. R. Wieland (1916).

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Literature Cited.

- 1. COULTER & CHAMBERLAIN, 1915. Morphology of Gymnosperms, 3rd edition, pp. 222, 240.
- DICKSON, A. 1860. Observations on the Hermaphrodite cones of *Abies excelsa*. Trans. Edin. Bot. Society. 6, pp. 418-422.
- 3. ELWES, H. J. 1912. Trees of Great Britain and Irelaud (Private circulation). Edinburgh, pp. 1455.
- 4. GOEBEL, K 1900. Organography of Plants, pp. 153-155. English Edition.
- 5. MASTERS, M. T. 1883. Androgynous cones of *Pinus Thunbergii*. Gardeners Chronicle. June 30, pp. 825.
- SAHNI, B. 19:9. A bisexual cone of *Picea Morinda* Link. Proceedings of the 16th Indian Science Congress, pp. 237.
- 7. STEIL, W. N. 1918. Bisporangiate cone of Pinus montana. Bot. Gaz 66, pp. 68.
- 8. WIELAND, G. R. 1916. American Fosil Cycads. Vol. II.
- WORSDELL, W. C. 1900. The structure of the Female "Flower" in Coniferæ. Annals of Botany, Vol. XIV, pp. 56-57.

Explanation of Plates.

PLATE I.

- Fig. 1. Bisexual cone of *Picea Morinda* (Link) showing the intercalated male zone between an apical and a basal zone of mega-sporophylls. The micro-sporangia are clearly seen in the narrow male zone. \times 3.5.
- Fig. 2. A longitudinal section of the above cone of P. morinda to show the exact nature of the sporophylls and their distribution on the axis. \times 3.5.

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Fig. 3. The bisexual cone of *Pinus longifolia* (Salis) showing the whorl of male cones arising at the axils of the bracts one of which is slightly bent down. Above this whorl is the zone of microsporophylls ultimately the axis terminating in the megasporophylls. \times 3.5.

PLATE II.

- Fig. 4. Micro-photograph of a portion of the bisexual cone of P, longifolia showing the microsporophylls inserted below and the megasporophylls above Note the normal pollen grains in the microsporangia. \times 22.
- Fig. 5. Portion of a branch of *Pinus longifolia* with number of short branches intermixed with male cones, each bearing a single terminal female cone and a basal ring of male cones. Only two such short branches are shown in the fig. $\times 1$.
- Fig. 6. One year-old female cones of *P. longifolia* with the still attached dried male cones at the base. (Slightly reduced)



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PLATE II.



NOTE.

After my little address to the I. B. S at Nagpur¹ had been printed, it was brought to my notice that Shreve in 19:4² and Inamdar and Shrivastava in 1927⁵, had applied Le Chatelier's theorem to biological phenomena. While investigating factors governing seasonal changes in transpiration of Encelin farinosa, Shreve found that the resistance of Encelia to drought was in accord with Le Chatelier's theorem. Later on Inamdar and Shrivastava found that the correlation of variations in the specific conductivity with the needs of transpiration was also in accord with the same principle

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of Encefia farinosa-Bot. Cuz, Vol. 77, p. 432, 1937.

³ Inamdar, R. S. and Shrivastava, A. I. — Seesonal variation in specific conductivity of word in tropical plants with reference to Leaf-fall--Bot. Gaz, Vol. 88. p. 24, 1927

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