A PRELIMINARY NOTE ON THE EMBRYO-SAC OF CERTAIN PENAEACEAE.—The Penaeaceae form a small and rather isolated group of shrubby xerophytes, of doubtful affinities, entirely confined to the south-western region of Cape Colony. The Order has not yet been thoroughly investigated; there are apparently five genera—*Sarcocolla*, *Penaea*, *Brachysiphon*, *Endonema*, *Geissoloma*, the last being placed by Engler in a separate Natural Order. Of these, I have investigated five species, representing the first three genera, and, as careful examination and comparison have revealed an exact similarity in the structure and development of their gametophytes and embryo, the following account may be taken as applicable to all three.

The macrospore mother-cell appears to form a row of three (?) macrospores, of which only the lowest persists, becoming the embryo-sac. This enlarges, and its nucleus divides to form four daughter-nuclei, which are arranged peripherally like the spores of a tetrad; an arrangement exactly the same as that described for the corresponding stage in *Peperomia*.³ As the embryo-sac enlarges, a central vacuole is formed, and these four nuclei migrate to the parietal layer of protoplasm. Here, as in *Peperomia*, they show none of the polarity so characteristic of the usual type of Angiospermous embryo-sac, being irregularly distributed around the periphery of the embryo-sac. Usually, however, as the sac elongates two of the nuclei take up their position, one at or near each end, and the other two about its equator; but even this slight degree of polarity is often lacking, and the nuclei, or the cell-groups resulting from their division, may be arranged in any manner around the embryo-sac.

From this point the resemblance to *Peperomia* ceases, and here it may be noted that, while their embryos agree in the absence of a suspensor and in the formation of a spherical pro-embryo, the male gametophyte differs from that of any known Angiospermous type, while in *Peperomia* it is quite typical.

Each of these four nuclei now divides, and the two resultant daughter-nuclei again divide, so that four groups, each consisting of four nuclei, are formed, one group from each of the four original daughter-nuclei of the embryo-sac. Protoplasm now aggregates around three of the nuclei in each group, and a definite limiting layer—'Hautschicht'—appears about each of the cells thus formed, while the fourth nucleus remains free—so that in each group there are now three cells with definite membrane-boundaries, and one free nucleus. Either during or after the formation of the 'Hautschicht' round the cells, the free nucleus of each of the four groups migrates to the centre of the embryo-sac. There they meet, and gradually fuse to form the single large definitive nucleus.

While these nuclei are fusing, the four parietal cell-groups have each assumed the appearance of a typical egg-apparatus, and it would seem probable that this may be their true nature. The discussion of the evidence in support of this hypothesis is, however, better postponed until the phenomena accompanying fertilization have been more completely investigated.

¹ Annals of Botany, vol. xxi, p. 467; vol. xxii, p. 91.

² Lang, On the Sporogonium of *Notothylas*. Ann. of Bot., vol. xxi, April, 1907.

³ Campbell, D. H., The Embryo-sac of *Peperomia*. Ann. of Bot., xv, pp. 103-17, 1901.

Johnson, D. S., On the Endosperm and Embryo of *Peperomia pellucida*. Bot. Gaz., xxx, pp. 1-11, 1900.

Whether anything corresponding to 'double fertilization' (a term here obviously inappropriate) occurs is not certain, though the evidence points to it. The definitive nucleus begins to divide before the fertilized egg. Its divisions are rapid and simultaneous, and, as might be expected from its multinuclear origin, the endosperm nuclei are large, with a great number of chromosomes and several nucleoli. They are distributed in the parietal layer of protoplasm, and walls appear only at a very late stage, forming a loose tissue in the lower part of the embryo-sac, which is entirely used up by the growing embryo.

These investigations were carried out in the Botanical Laboratory of the South African College, Cape Town, at the suggestion and under the supervision of Professor Pearson; they are being continued at the Botany School, Cambridge.

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THE EMBRYO-SAC OF PANDANUS. PRELIMINARY NOTE.—A preliminary study of the embryo-sac of *Pandanus* which I have recently made shows that it differs decidedly from the usual Angiospermous type, and to some extent resembles more nearly that of *Peperomia*. Two species of *Pandanus* have been examined—*P. odoratissimus* and *P. Artocarpus*—which agree very closely in the structure of the embryo-sac. Up to the second nuclear division in the young sac, *Pandanus* agrees with most of the Angiosperms, and at this stage the embryo-sac shows the usual two nuclei at the micropylar and chalazal ends. The two micropylar nuclei undergo no further division, but the chalazal nuclei divide until there may be twelve of these, and this seems to be the normal number, to judge from an examination of a number of the largest sacs that were studied. These always showed two nuclei at the micropylar end, surrounded by a relatively small amount of granular cytoplasm, while the large chalazal nuclei were scattered, apparently without any definite order, in a large mass of granular, more or less vacuolated, cytoplasm, which filled nearly one-third of the sac. The differentiation of antipodal cells was visible, and there was no certain evidence of nuclear fusions.

Whether any further differentiation of the embryo-sac structures occurs before fertilization remains to be seen.

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STANFORD UNIVERSITY,
Feb., 1908.

SUPPLEMENTARY NOTE TO 'STUDIES ON SOME JAVANESE ANTHOCEROTACEAE'.¹—Since this paper was written, Dr. Lang² has published an account of the sporogonium of *Notothydas Breutelii*, which closely agrees with that given in my paper for *N. javanicus*. The most marked difference is the greater development of sporogenous tissue from the endothecium in *N. Breutelii*.

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Stephens, Edith L . 1908. "A preliminary note on the embryo-sac of certain Penaeaceae." *Annals of botany* 22, 329–330.

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