THE ANTHERS OF CLETHRA.—To all eastern botanists our common *Clethra*, *C. alnifolia*, L., is certainly familiar, yet as far as I know no one has noticed the striking peculiarities of the anthers. In the more southern species, *C. acuminata*, Mx., these are even more marked. During the past summer I had opportunity to make a careful study of both species in all stages except fruit. According to Bentham and Hooker (Gen Plant II, 603) the genus *Clethra* is a waif as far as the suborders of Ericaceæ are concerned—"genus anomalum," they call it—but Dr. Gray (Syn. Fl. N. A. II, 17) places it among the *Pyrolineæ*.

There is nothing peculiar in the development of the flowers. In *C. alnifolia* there is a marked difference between the outer and inner whorl of stamens while young, the latter being noticeably shorter. From the very beginning the anthers are *extrorse* and when young very decidedly epipetalous. They begin as mere knobs at the base of the petals but soon become sharply sagittate, which shape they retain. As long as the anthers are enclosed in the bud the filaments are bent upon themselves, but differently in the two species. In *C. alnifolia* they are shaped like a fish hook bearing the anther at the point corresponding to the barb, while the filament is represented by the shank. In *C. acuminata* the filament resembles an interrogation point (?) except that the first bend (counting from below upwards) is almost a right angle instead of a gradual curve. In all species these bends are more or less marked as may be seen in various figures.*

But in none of the figures referred to is to be seen anything peculiar about the anther or connective, though several figure the enlarged stamens. Not in any of the descriptions of foreign species is there notice of anything in the structure of the anthers to provide for their retroversion at anthesis common to the whole genus.†

As soon as the flower begins to open, the growth of the filaments, which is extremely rapid at this time, pushes the anther beyond the corolla, and it, relieved of the compression of the petals, immediately springs to a horizontal position. The completion of obversion until the anther becomes *introrse* then proceeds more slowly though it is accomplished in a few minutes after the first spring has taken place. There seem to be two causes for this freak. The straightening of the filament both lengthens the stamen and continues the somersault begun by a special device, viz.: a cushion of turgid cells on the back of the connective. This cushion is continuous with the filament, but is not joined to the connective throughout its whole extent, being arched away from it about the middle of the anther. The cushion divides into two tongues, which taper to slender points as they pass down the thecæ. Under the microscope the cells of the upper part of the filament and of this cushion are seen to be turgid while the anther is still held by the corolla, but soon after it escapes these become shriveled and the cushion withers first. The outside cells are shown by a

*Vide Meissn. in Mart. Fl. Bras. VII, t. 64, 65, 66.—Lam. Illustr. t. 369.—Bot. Mag. t. 1057, 3743.—Lindl. Bot. Reg. 1842, t. 23.

†Vide DC. Prod. VII, 589.—Walp. Rep. II, 726; VI, 417; Ann. I, 479.—Miq. Fl. Ind. Bat. II, 1056.—Griseb. Fl. Brit. W. Ind. 141.

cross section to be thinner-walled and larger than the inside ones and all are filled with oil globules of various sizes in addition to the protoplasmic contents. This cushion is about 1-60th of an inch in width and one-half that in thickness. Near the center, as also of the connective, runs a fibro-vascular bundle.

Between our two species there is a difference in the time of dehiscence of the anthers—those of *C. alnifolia* not breaking until complete anthesis, while in *C. acuminata* they break just as the petals separate at the top. Both are proterandrous. Both also are very fragrant, but the fragrance is earlier perceptible in *C. acuminata*, correlated with the earlier dehiscence of the anthers. In this species the nectaries are very large and double, one on each side of the filament at the base of the petals. In *C. alnifolia* they are smaller and apparently single, situated between the filament and the petal.

Fertilization is effected almost altogether by honey bees. They alight on the outspread petals and thrust the head down by the side of the style frequently touching the stigmas. In crawling around over the spike of flowers almost every part of the body comes in contact with the stigmas. Cross-pollination is thus abundantly provided for as usual both by proterandry and the visits of insects.

I have not Bentham and Hooker's Genera Plantarum by me, but if my memory is correct they say "Pollen globosa." I find the pollen of both our species elliptical with three slits, as stated by Edgeworth and only globose after the absorption of water.—C. R. BARNES, *La-Fayette, Ind.*

VESQUE'S DEVELOPMENT OF THE EMBRYO SAC.—In the *Annales des Sciences Naturelles*, 1878, M. Julien Vesque, after discussing the development of the embryo-sac of Angiosperms, draws the following conclusions, which somewhat modify our previous notions concerning the embryo sac. Or rather our text books merely stated that it was an enlarged cell of the nucleus without giving any account of its development.

M. Vesque now fills this hiatus and as his conclusions have been mostly confirmed we feel confidence in printing them in the GAZETTE, urging upon our physiological botanists to test them as far as they are able.

1. In the Angiosperms the embryo sac of Brongniart is not composed, as in the Gymnosperms, of a single cell; it results on the contrary from the blending of at least two cells superposed and originally separated by partitions.

2. The cells which are to compose subsequently the embryo-sac all proceed from a single primordial mother cell. M. Warming, who has discovered them, has with reason given to them the name of special mother cells, comparing them with mother cells of pollen or spores. This bringing together is justified by the physical characters of the partitions.

3. When the evolution of the special mother cells has been completed, each one of them gives rise to four nuclei homologues of the four grains of pollen produced in the same mother cell.

4. The variations which I have observed in the different types of Angiosperms depend on the arrest of development more or less early which seizes the special mother cells.

5. The first cell always forms the sexual preparation. It blends itself with the second cell to thus constitute the greater part of the embryo-sac. When the second cell produces a "*tetrade*," the eight nuclei freed from the embryo sac act as M. Strasburger describes it in *Orchis* and in *Monotropa*. This fact is observed in certain Monocotyledons and dialypetalous Dicotyledons.

6. The other special mother cells (3, 4, 5) may produce some "*tetrades*." Each one of the vesicles is homologous with a grain of pollen, and it is tempting to give to it the name of antipodal. When these mother cells persist in their primitive condition without producing "*tetrades*," they themselves simulate antipodal vesicles superposed, not juxtaposed. They differ from them from a morphological point of view and I have given to them the name of *anticlinal cells*.

This condition has been observed in many Monocotyledons, certain dialypetalous Dicotyledons, and in almost all the Gamopetalæ.

7. The 2d cell appears to undergo at first an arrest of development. In this case, its nucleus becomes directly the nucleus proper of the embryo-sac, and this cell does not produce any antipodal vesicle. This fact, observed in some Monocotyledons and Dialypetalæ, becomes the rule in Gamopetalæ, which are, from this point of view, the plants most removed from Cryptogams.

8. In the Gamopetalæ (with very few exceptions), cell one alone produces a "*tetrade*," complete or incomplete, which is no other thing than the sexual preparation composed of two or three or four vesicles.

The second cell seems to perform the vegetative part of the embryo-sac. Its undivided nucleus becomes the nucleus of the embryo-sac.

The cells 3, 4, 5 (or 3, or 3 and 4, according to the number of the special mother cells) are some anticlinal, or produce the antipodal vesicles by dividing their nucleus.

9. In the greater part of Gamopetalæ, the formation of the endosperm is deferred to subsequent development, by division, of one or several of the special mother cells. These last being homologous with the mother cells of spores, it is legitimate to consider the endosperm of these plants as a sterile female prothallus.

BOTANICAL CONTRIBUTIONS, by Asa Gray. Issued September 1, 1880.—These annual contributions to North American Botany are always greeted with the greatest interest by systematic botanists, and the pages can hardly be cut and run through hastily enough to satisfy their eager curiosity. What new species and genera have come into the world and what have departed this life, are questions that first occur. This paper is largely devoted to recording some of the results of Dr. Gray's elaboration of the vast order Compositæ for his Synoptical Flora. As this portion of the Flora cannot be published at once, botanists are under very great obligations for some of the "ad-