quantum number push each other away from their normal positions and alter each other's transition probability. A calculation of the amounts of these shifts and intensity changes by means of the quantum formulas yields magnetic patterns in close agreement with those observed. The g-values that we have derived for the N I and O I energy levels conform, within observational error, to those required for LS-coupling, despite the fact that the term-intervals, except those of $3p\,^4D^o$ of N I, do not conform to the Landé ratios.

Multicellular Hairs in *Gossypium*[1]

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The seed hairs of cultivated cotton (*Gossypium* spp.) are of two types: long fibers, which constitute the lint of commerce and which are removed in the ginning process, and short hairs, closely adherent to the seed, which are known as fuzz or "linters." The seeds of wild species of *Gossypium* differ from those of cultivated types in that they bear only one type of hair which varies considerably in length from species to species.

The developmental histology of lint and fuzz hairs in cultivated varieties has been studied by several workers.

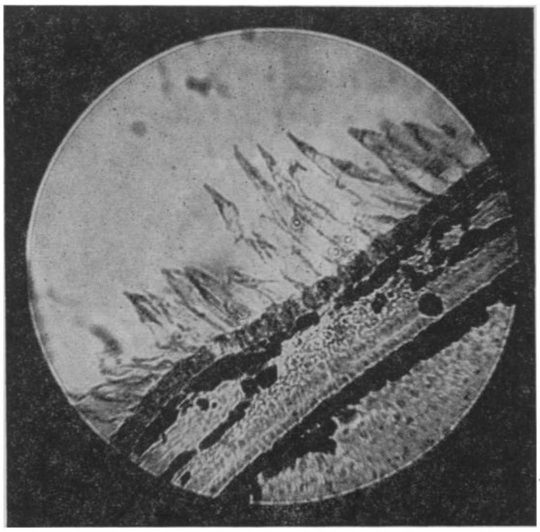

FIG. 1. Binuclear elongated epidermal cells of *G. hirsutum* ovules, fixed at 60 hrs after the flower opened (× 675).

In 1881 Bowman reported that lint hairs were multicellular. Later, he (*2*) and all subsequent workers have indicated that both lint and fuzz hairs are unicellular outgrowths of the seed coat epidermis. Since the comparative morphology of lint, fuzz, and wild type seed

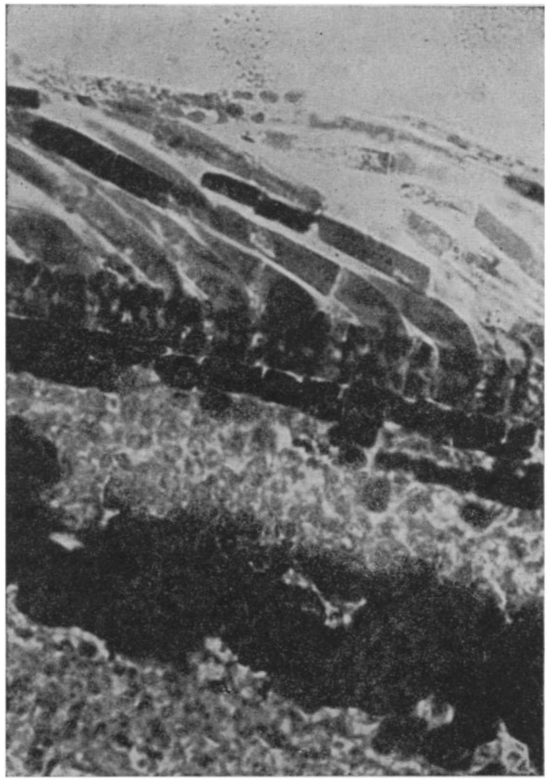

FIG. 2. Multicellular elongated epidermal cells of *G. klotzschianum* var. *davidsonii* ovules, fixed at 48 hrs after the flower opened (× 1,050).

hairs is of considerable evolutionary and technical significance (*3–5*), a comprehensive study of the *Gossypium* genus as a whole has been begun at the Texas Agricultural Experiment Station.

This study was initiated during the summer of 1947 on upland (*G. hirsutum*) ovules taken every 2 hrs, beginning 16 hrs before the opening of the flower. Ovules were fixed in Navashin's solution as modified by Longlet (*6*) and embedded in paraffin. Microtome sections, 12 μ in thickness, were stained with iron gentian violet and mounted in Canada balsam. Studies were continued in the greenhouse during the winter of 1948 on 4 different species, samples being taken every 12 hrs. The results, which will be published in detail elsewhere, suggest a new interpretation of structure and development of seed hairs in *Gossypium*. They may be summarized briefly as follows:

(1) Both lint and fuzz originate at the same time and are distributed at random over the surface of the ovule, their initiation being independent of both pollination and fertilization (cf. *1*).

(2) Differentiation between fuzz and lint, based upon the diameter of the epidermal cell (*3*), general shape of the hair, and number of nuclei present, can be made as early as the time of flower opening.

(3) Examination of sections taken before flower opening suggests that the lint hair originates as a binuclear

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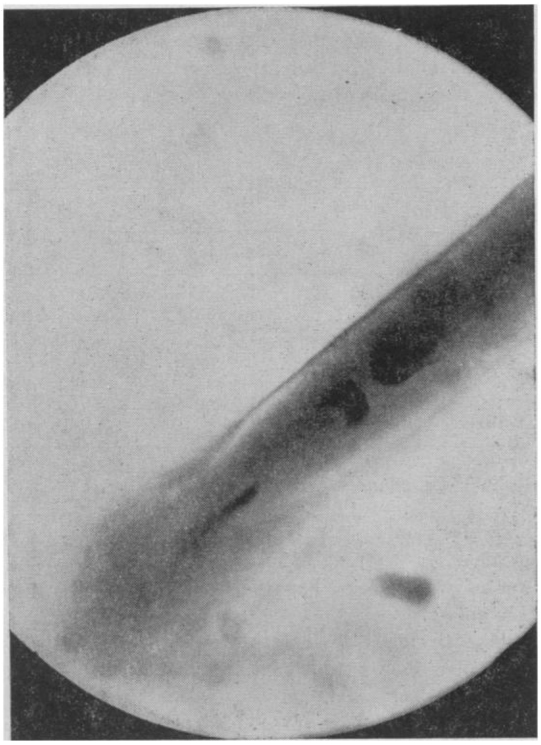

FIG. 3. Mature fiber of *G. klotzschianum* var. *davidsonii* showing a cross wall (× 4,850).

cell. Binuclear epidermal cells and, at a later stage, binuclear lint hairs were seen (Fig. 1). Subsequently, one nucleus degenerates, at a time apparently dependent on the rate of cell growth.

(4) The seed hairs of a wild species, *G. klotzschianum* var. *davidsonii*, are *multicellular* both in young and older stages (Figs. 2 and 3). In mature fibers the cross walls are less thickened than the longitudinal walls, but are clearly visible toward the terminal end of the hair. Previously published illustrations (*5*) of the mature seed hair of another wild species, *G. thurberi*, suggest a similar basic structure in which the cross walls have been thickened to a greater degree. Thus, the lumen appears as a chain of "vacuoles" in an otherwise solid fiber (Fig. 4).

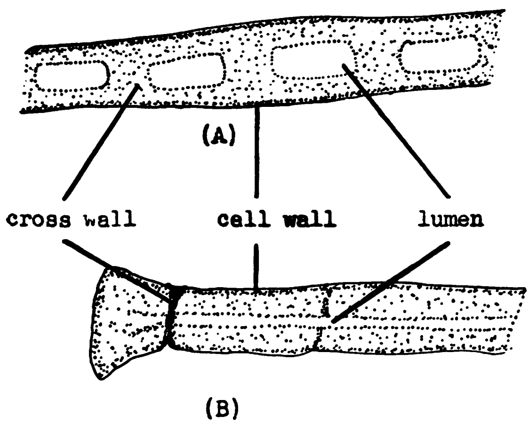

FIG. 4. Diagrammatic illustrations to show the mature fiber of *G. thurberi* (A) and *G. klotzschianum* var. *davidsonii* (B), suggesting the multicellular structure of the fiber.

These results indicate that the unicellular lint hairs of cultivated cottons may be developmentally derived from multicellular wild type seed hairs through an evolutionary process that progressively reduced a primitive, strongly thickened, multicellular structure to a unicellular, partly thickened, long hair (lint) and a unicellular, strongly thickened, short hair (fuzz). From the standpoint of differentiation, the seed hairs of *Gossypium* can therefore be grouped as follows: (1) multicellular type, e.g. the seed hairs of *G. thurberi* and *G. klotzschianum*; (2) binuclear type (one nucleus subsequently degenerating), e.g. the lint hairs of cultivated cottons; and (3) uninucleate type, e.g. the fuzz hairs of cultivated cottons. It is possible that the seed hairs of the wild species, *G. anomalum* and *G. raimondii*, represent an intermediate stage between the multicellular and binuclear types shown above.

References

1. BALLS, W. L. *The development and properties of raw cotton.* London: A. & C. Black, 1915.
2. BOWMAN, F. H. *The structure of cotton fiber in its relation to technical applications.* New York-London: Macmillan, 1908.
3. FARR, WANDA K. *Contr. Boyce Thompson Inst.*, 1931, **3**.
4. GULATI, A. N. *Ind: J. agric. Sci.*, 1934, **4**, 3.
5. HUTCHINSON, J. B., STEPHENS, S. G., and DODDS, K. S. *Ann. Bot.*, 1945, **9**, 361.
6. SKOVSTED, A. *Ann. Bot.*, 1933, **47**, 227.

The Relation of Backscattering to Self-Absorption in Routine Beta-Ray Measurements

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The enhancement of observable activity caused by reflection processes is said to be due to "backscattering." The intrinsic activity of a thin sample is increased by "exterior reflection" from the sample mount; that of a thick sample is further raised by "interior reflection" due to multiple scattering processes taking place within the sample itself. The latter effect is always observed as part of self-absorption, and therefore one compensates for it automatically when self-absorption corrections are derived from data obtained experimentally under conditions identical with those used in routine counting.

Beta radiations subjected to interior reflection can be divided arbitrarily into two groups: (a) some particles which start toward the counter are *deflected* away from

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