imply that the cotton plant is peculiarly sensitive to extremely low concentrations of ammonia nitrogen." We had stated that "the injury is related to a high concentration of free ammonia in contact with the roots."

He grew cotton "in sand cultures with sulphate of ammonia, ammonium hydroxide and calcium nitrate, respectively. Ammonium hydroxide was supplied in a complete nutrient solution at pH 8." "The concentration of nitrogen as ammonia in these cultures was higher than that of the total nitrogen in the cottonseed meal which was employed by Willis and Rankin."

The cottonseed meal we used contained 6.02 per cent. of nitrogen. Ordinary concentrated ammonium hydroxide, with 26 per cent. $NH_3$ has about 20 per cent. of nitrogen. Tiedjens' cultures, in which cotton grew satisfactorily, must therefore have been made up to contain 30 per cent. of concentrated ammonium hydroxide. We question the accuracy of this statement.

No details were given of the method of limiting the cultures containing ammonium hydroxide to pH 8.0. We are of the opinion that in establishing this low value arbitrarily he has at the same time and by the same means reduced the ammonium hydroxide to a correspondingly low concentration. If we are correct, the results given by Tiedjens are valueless in support of his contention that ammonium hydroxide is not more toxic than other nutrients.

It appears that our rate of fertilization was not correctly understood, even though we stated that this "was calculated on the basis of all fertilizer being placed in furrows 6 inches wide, spaced 4 feet apart and with the fertilizer mixed with one inch of soil in the bottom of the furrow." The soil in the pots was considered to represent a section of the drill.

Tiedjens states that we used "only 16 pounds of nitrogen per acre." This is about the average initial rate of application for cotton in the field, but it should be evident that the local concentration in the drill is equivalent to eight times the apparent rate.

It was said of our results that they "were apparently obtained where the soil buffer systems was inadequate." Inasmuch as nearly half of the fertilizers used in this country are applied to soils having this limitation, we see in respect of the soil used no basis for criticism of any generalizations we have made.

We do not claim infallibility for our deductions, but we find nothing in Mr. Tiedjens' work that can logically be construed to be contradictory to any of them. We must therefore hold to the opinion that free ammonia was the cause of the injury we observed, until it is shown by competent evidence that the same effect could have been produced under the conditions of our experiment by a factor we overlooked. And until we have this evidence we must consider that the use of ammonium hydroxide as a fertilizer constitutes a hazard to plants, except under very strictly prescribed conditions.

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## A POSSIBLE HORMONE-SECRETING REGION IN THE GRASS COLEOPTILE

CAREFUL experiments on phototropism in the coleoptiles of *Avena sativa* and other grasses, notably by Went and his associates, have apparently demonstrated the presence in this organ of a growth-producing hormone or "Wuchsstoff." An important aspect of the problem is a determination of the region where this substance is produced and the means of its transportation to the zone of bending. The only histological work to date is that of Tetley and Priestley,[1] who report that in coleoptiles of *Zea Mays* there seems to be no possible region for the production of such a substance, since all the tip cells of the coleoptile are highly vacuolate or seem otherwise to be inactive. These authors also believe that there is no possible path of transportation in the fibro-vascular bundles, as there is a strong upward movement of water and sap generally in the xylem, and the phloem elements are not yet fully differentiated. They conclude that phototropism here is not the result of any chemical substance but rather of differential tissue permeability on the two sides of an unequally light-stimulated coleoptile. They find no morphological regeneration in decapitated coleoptiles.

The hypotheses of the existence of a growth hormone evidently depends, at least in part, upon the demonstration of an appropriate histological structure for its production. In an endeavor to secure evidence on this point, experiments and histological studies have been carried on by the author with twenty genera of grasses as well as with certain dicotyledonous plants. The seeds were soaked in sterile distilled water and germinated in a moist chamber on moist filter paper in sterile Petri dishes. Some coleoptiles were studied directly, others after exposure to unilateral light. The length of coleoptile, time of exposure and other conditions varied with the experiments. Some ten thousand coleoptiles were used, mostly of *Avena sativa,* since this species is particularly favorable and has been the most commonly studied.

[1] U. Tetley and J. H. Priestley, "The Histology of the Coleoptile in relation to its Phototropic Response," *New Phytol.*, 26: 171–186. 1927.

The coleoptiles were fixed with best results in Allen's B 15 fluid, although various modifications of Flemming's and Merkel's fluids were fairly successful. Chromo-acetic acid, formalin acetic alcohol and Bouin's and Carnoy's fluids gave rather negative results. Sections were stained chiefly with Flemming's triple stain, although Heidenhain's iron-alum-haematoxylin was satisfactory, especially with a safranin counter-stain. Living material was also studied.

In general the epidermal layer is highly developed, suggesting for it a secretory function. Over the tip of the coleoptile the cells are particularly numerous, with large, deeply-staining nuclei, dense cytoplasm, small vacuoles and many granules. These cells are essentially isodiametric. Continuous with them and extending down the sides of the coleoptile, the epidermal cells gradually become longer, finally reaching a length of from twenty to forty times their width. These cells also have large nuclei and abundant contents. There is a marked contrast, both at the tip and along the sides, between these epidermal cells and the tissue immediately beneath, the cells of which have smaller nuclei and are highly vacuolate.

It is suggested that the hormone is produced in the tip cells, which would explain the well-known results of decapitation. It is further suggested that this hormone is transported to the region of bending by rapid streaming of cytoplasm in the long epidermal cells. Cyclosis has been observed in the epidermis of intact coleoptiles of all genera of grasses studied, and coleoptiles removed from young plants have shown active streaming in Russian mineral oil for a period of 840 hours under ordinary conditions. The rate corresponds roughly with the time necessary for transportation between illumination and response.

A comparison of the illuminated and unilluminated sides of the coleoptile in stained sections shows no morphological differences, and in decapitated stumps there is no immediate visible regeneration, suggesting that the presence of a hormone involves no evident difference other than change in cell size.

It may therefore be concluded that an adequate histological basis exists for the secretion and transportation of a growth hormone in the grass coleoptile.

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## HASSTILESIA TRICOLOR STILES AND HASSALL, 1894—A NEW REPORT

ON February 3, 1932, the junior author brought into the laboratory viscera from two wild rabbits (Sylvilagus) killed the day before in the swamps west of Tuscaloosa, Alabama, which he had secured from some hunters. On examination of the intestinal contents of one of the rabbits, a male, the senior author found numerous trematodes. These were fixed and stained with ordinary laboratory technique and determined as *Hasstilesia tricolor* (Stiles and Hassall, 1894). As this is the first report of this species from Alabama, it was thought worth recording. The previous records, according to the Zoological Division, Bureau of Animal Industry, Washington, D. C., are from Maryland, District of Columbia, Virginia, New York, Louisiana and Texas.

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# SCIENTIFIC BOOKS

*Seven-place Trigonometric Tables.* By H. BRANDENBURG. xxviii + 340 pp., 2nd Edition, 1931, Alfred Lorentz, Leipzig. Price, bound, 36 marks.

*Six-place Trigonometric Tables.* By H. BRANDENBURG. xxii + 304 pp., 1932, Alfred Lorentz, Leipzig. Price, bound, 32 marks.

COMPUTING machines, including those that enable multiplication and division to be performed with little labor, have an ancestry that goes back several centuries, but it is only in this generation that they have been manufactured in such quantities and of such sturdiness as to make them good bargains wherever any considerable amount of computing has to be done. This news has by no means reached all the people who might profit by it, and even now multiplying machines are not in use among business men, for example, nearly as much as they deserve to be. For scientific applications (astronomy, geodesy, physics, geometrical optics and the like) the use of such machines has brought with it the necessity for natural trigonometric functions. Hitherto only the logarithms of these functions were required and were available, the computer if need be modifying his formulae, by the introduction of auxiliary quantities or similar devices, so as to transform all the operations to multiplication and division and thus to adapt them for logarithmic use. Some computers seem to be inclined to assume that these logarithmic tables are soon to be entirely superseded by the natural functions. This is surely a mistake, as in many cases the logarithmic computation is still the better. Be this as it may, there has been and is a pressing need for tables of the natural functions. Many authors have