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Went F W. Wuchsstoff und Wachstum. (Growth-substance and growth.)
Recueil Trav. Bot. Néerl. **25**:1-116, 1928.
[University of Utrecht, the Netherlands]

The continuous formation of a growth-promoting substance that can be handled physically and is formed in the extreme tip of the Avena coleoptile is proved. A method for the quantitative analysis of this substance is worked out. As a result of these investigations, Blaauw's theory of phototropic curvature has to be put aside. [The *SCI*® indicates that this paper has been cited at least 200 times since 1955, making it the most-cited publication ever published in this journal.]

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"Sixty years ago, I was a student of botany in Utrecht, the Netherlands, where my father (F.A.F.C. Went) was professor of botany and director of the botanical laboratory and garden. This laboratory had become well known because of theses on phototropism by Blaauw,[1] Arisz,[2] van de Sande Bakhuyzen,[3] and Koningsberger.[4] So it was natural that I also chose phototropism as my main research subject.[5,6] At that time, the prevailing theory was that of Blaauw,[1] who claimed that a curvature of a plant organ toward or away from a light source was due to differential growth of the lighted and the darkened sides. So a group of us, advanced students of botany, hotly discussed the reasons for this differential growth.

"Now, since Charles Darwin, it was known that this phototropic curvature was induced by the stem tip, so we hypothesized that the stem tip either supplied a growth-promoting or growth-inhibiting substance to the lighted or darkened side of the stem. Did such substances exist? A German (Seubert)[7] and a Hungarian (Paál),[8] both botanists, had indicated that a growth-promoting substance actually existed, so I tried to find out whether it was produced by the stem tip. And, indeed, the first test showed that this was the case. By placing oat seedlings' tips on gelatin, this substance acquired growth-promoting activity, so it was thought that a substance had diffused from the seedling tip into the gelatin (or agar). This could be shown by placing the gelatin one-sidedly on a decapitated seedling, which then after an hour curved away from the treated gelatin. It was found that the curvature was proportional to the amount of growth substance diffused in the gelatin or agar. Thus, all sorts of properties of this growth substance (later named auxin) could be investigated. It was light and heat stable, and, through its diffusibility, its molecular weight could be approximated (between 350 and 400 daltons).

"I was anxious to establish that auxin had a molecular weight, and thus was a material substance and not a ghost or nonmaterial principle, as some of my less materialistic friends suggested. And whereas light had little effect on the production of auxin, its diffusion downward was diverted from the lighted to the darkened side. Since a Russian botanist (Cholodny)[9] had suggested this a year earlier, the process of phototropism was called the Cholodny-Went theory. During the next decade, much more work with auxin, which was universal in plants and was involved in geotropism, bud inhibition, root formation, and many other processes, was carried out. Thus, auxin was found to be a universal plant hormone, and in the course of time, other plant hormones were discovered (kinins, gibberellins), and an unending series of publications followed.

"The main reasons the plant hormone literature multiplied so much in the next years were that: 1) auxin, if not identical with indoleacetic acid, had exactly the same physiological role in the plant, 2) derivatives of indoleacetic acid were just as active or more active in the plant, and 3) so many plant processes could be controlled or guided by plant hormones that, within the last 30 years, hundreds of substances have been found to be plant growth regulators and thousands of researchers are using them now in controlling plant growth.[10] Recently, I was invited to tell details about my discovery 50 years ago of the first plant hormone at a meeting of hundreds of plant-growth-regulator investigators, assembled for a weed-control conference, because the first substance used for weed control was related to auxins: dichlorophenyl acetic acid."

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3. **van de Sande Bakhuyzen H L.** *Analyse der Fototropische Stemmingsverschijnselen*. Groningen: de Waal. 1920. 153 p.
4. **Koningsberger V J.** Tropismus und Wachstum. *Recueil Trav. Bot. Néerl.* 19:1-136, 1922.
5. **Went F W.** Concerning the difference in sensibility of the tip and base of Avena to light. *Proc. K. Akad. Wetenschap. Amsterdam* 29:185-91, 1925.
6. ----------. On growth-accelerating substances in the coleoptile of Avena sativa. *Proc. K. Akad. Wetenschap. Amsterdam* 30:10-19, 1926.
7. **Seubert E.** Über Wachstumsregulatoren in der Koleoptile von Avena. *Z. Bot.* 17:49-88, 1925.
8. **Paál A.** Über phototropische Reizleitungen. *Ber. Deut. Bot. Ges.* 32:499-502, 1914.
9. **Cholodny N.** Beitrage zur Analyse der geotropischen Reaktion. *Jahrb. Wiss. Bot.* 65:447-59, 1926.
10. **Bunström H,** ed. *Encyclopedia of plant physiology. Volume 14. Growth and growth substances*. Berlin: Springer-Verlag, 1961. 1357 p.