gidium if 2-valved would be a *Draba;* while the Californian genus *Tropidocarpon* has one species with 2-valves and one (*T. capparideum* Green) with 4. Tetracarpellary cultivated varieties of *Brassica* and *Isatis* are also known. Such instances as these, of the recurrence of similar characteristics in more or less closely related species or genera, support the view that variation is definite or "orthogenetic" rather than entirely fortuitous. The author believes that such facts are directly opposed to the older conception that species, genera, and families have a monophyletic origin. On p. 280 the gametic formulae of the reviewer's forms, *Capsella bursa-pastoris tenuis* and *C. bp. rhomboidea*, are transposed; and on p. 304 the date of the discovery of *C. Heegeri* is stated erroneously as 1907 and 1908, the correct dates being 1897 and 1898.—GEO. H. SHULL.

Geotropism and epinasty.—KNIEP[5] has studied in detail the part played by geotropism and epinasty in the orientation of certain foliage leaves. He makes much use of modified forms of the oblique and intermittent clinostats of FITTING. With these instruments FITTING[6] answered conclusively many questions on the geotropism of orthotropic organs that two or three decades of work with other instruments had left unanswered. Now, KNIEP proceeds to clear up a number of questions in a plagiotropic organ, the leaf.

In the main *Lophospermum scandens* was used, for the medium-aged leaves of this plant show no sleep movement and little tendency to dark rigor; therefore, they are well adapted to experimentation in darkness. When leaf blades of this plant are placed out of their normal rest position, they recover it by growth-bending of the petiole. During the bending the rate of growth of the middle line is greatly increased. KNIEP designates the usual position of the leaf as the *normal horizontal* position. If the plane of the blade is so changed that the petiole end remains in the original plane but the apical end falls below it, the angle it forms with the normal horizontal position is said to be negative. If this displacement continues $-180°$, the leaf is then in the *inverse horizontal position.* By a reverse movement from the normal horizontal rest position a positive displacement is brought about. If this displacement continues $+180°$, the *inverse horizontal position* is reached. If in darkness a plant is so tilted that a leaf blade takes a position of $-1°-114°$, a rapid growth sets up on the morphologically lower side of the petiole (concave bending) and the blade finally acquires its normal horizontal position. If the plant is so tilted that the blade holds any position from $-116°$ to $\pm 180°$, or from $+1°$ to $\pm 180°$, rapid growth begins on the upper side of the petiole (convex bending) and the leaf finally acquires its normal horizontal position. The labile rest position, then, is at approximately $-115°$.

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[5] KNIEP, HANS, Ueber den Einfluss der Schwerkraft auf die Bewegungen der Laubblätter und der Frage der Epinastie. Jahrb. Wiss. Bot. **48**:1–72. 1910.

[6] Jahrb. Wiss. Bot. **45**:675–700. 1905.

When a plant is rotated on an equally rotating horizontal clinostat, a convex curving always occurs regardless of the orientation of the plane of the blade with the axis; this is an epinastic movement. When the plane of the blade is vertical and the midrib horizontal, the leaf is said to be in a flank position; it is evident that there are two flank positions. If a leaf is left in a flank position, the petiole shows both a torsion and a convex bending which finally give the blade the normal horizontal position. By use of an intermittent clinostat which gives repeated 5–15 minute exposures in one flank position followed by equal exposures in the other, all torsion is avoided, but convex curving takes place. The successive flank exposures equalize the effect of gravity and allow epinasty to express itself. By use of the intermittent clinostat, equal exposures between $-45°$ and the two flank positions were given. In this case concave bending occurred, showing that the geotropic stimulus entirely overcame the epinastic; this gives a means of determining the relative strength of the two stimuli. KNIEP puts the question, Can a leaf blade be so oriented on an equally rotating clinostat that concave bending will appear? This is easily accomplished by the use of the oblique clinostat and the combined angles that are possible on it. The great possibility of combinations of angles of geotropic exposure due to variation in obliquity of the clinostat axis and the obliquity of the organ axis with the clinostat axis has been emphasized by FITTING.

This work is the natural outcome of the improved methods that FITTING has given for dealing with problems in geotropism.—WILLIAM CROCKER.

Photosynthesis.—SCHRYVER[7] believes that he has thrown some light on the mechanism of carbon fixation in green plants. He first describes a modification of Rimini's test for formaldehyde. By the test as modified, 1 p.p.m. formaldehyde gave the reaction, and by proper modification, both free and combined formaldehyde can be detected. Rather accurate quantitative estimates can be made in concentrations varying from 1 part in 100,000 to 1 part in 1,000,000. Films of chlorophyll were formed on glass plates by evaporation of ether solutions. Such plates, exposed to light in the presence of moist CO_2, showed a marked formaldehyde test; those similarly exposed in absence of CO_2 showed a slight reaction, and those in darkness none. The formaldehyde in plates illuminated in absence of CO_2 was supposed to be formed from CO_2 produced by the chlorophyll film. He believes the formaldehyde formed makes a rather stable compound with chlorophyll, much as it does with amino-containing compounds. He considers the reaction reversible, and represents it as follows: $\text{Chloro}^{H}_{H} + HCHO \leftrightharpoons \text{Chloro} - CH_2 + H_2O$. The removal of CH_2O in sugar formation will cause the reaction to move in the sense of the upper arrow, while accumulation of CH_2O will lead to the reaction moving in the sense of the lower arrow. These results agree with the

[7] SCHRYVER, S. B., Photochemical formation of formaldehyde in green plants. Proc. Roy. Soc. London B **82**: 226–232. 1910.