The author emphasizes the similarity between botanical features in temperate zones and in the tropics and furthers his idea of the universal viewpoint in botany by his method of presenting such topics as leaf fall and annual rings connected with growth. He presents them as being the effects of adverse conditions rather than as due to a winter season. The necessity of stressing this method of presentation is easily seen when one remembers that even some recent textbooks of botany state specifically or leave the inference that all trees have annual rings of growth.

The illustrations, of which there are 518, are the most attractive feature of the book and are its most valuable contribution to the teaching of botany. Done directly under the author's supervision by assistants racially and temperamentally fitted for the most painstaking accuracy, they represent an enormous amount of patient work and study. And the result is worth the effort! The text is unique in the large number of original drawings. Of the 465 cuts (there are 53 half-tones) only 28 are redrawn wholly or in part from the works of others. The drawings certainly ought to be "an inspiration to the student and an incentive for him to make good ones himself." Considerably over half of the species used for illustrating various principles are of universal distribution, available in both temperate and tropical countries.

The plan of the book follows even more closely than recent texts the idea of the inseparability of structure and function. After a chapter on the plant and one on the cell, the leaf is discussed and, in the same chapter, such physiological topics as hydration, photosynthesis, respiration and transpiration. This is followed by a chapter on the stem, including responses, movement of materials and growth, and a chapter on the root, including absorption, growth and a discussion of soils. Each chapter ends with a discussion of specialized leaves, stems and roots, respectively. Chapters on the flower, heredity and evolution, and the fruit and seed follow; and under these headings the functions of pollination, digestion and germination are taken up. The divisions of plants, discussed under the headings Thallophyta, Bryophyta, Pteridophyta and Spermatophyta, cover only 128 pages, the greater part of the book being devoted to the structure and functioning of the higher green plants. The author believes that the greater importance of the higher plants in the students' environment justifies a greater amount of space being devoted to them. A final chapter on plant geography covers the various types of vegetation of the world as determined by environment, such as tropical rain forests, cold temperate deciduous forests, tundra, deserts, fresh-water vegetation and others. Several pages are devoted to succession and climax vegetation.

Controversial matter is avoided, but several of the newer phases of botany are considered, such as colloids, hydration and the effect of light on growth. Certain points are discussed somewhat more fully than is usually the case in elementary texts; as movement of stomates, trichomes, phyllotaxy, arrangement of mechanical tissues, soils, Mendelism, plant breeding, evolution and the kinds of food stored in plants.

Care is taken to avoid using an undefined term, hence the first part of the text may seem cumbersome because of the definitions of terms given as the discussion proceeds. These terms are later however more fully explained in their proper place.

The laboratory botany follows the text closely and gives a series of 185 exercises, headed drawing, experiment, observation; or combinations of these depending on what is required in the exercise. The directions in the early exercises are very full, but as the student gains familiarity with the subject they are shortened. The author prefers that the student secure information not obtainable by observation of the specimen or the experiment from the manual rather than from the instructor. Likewise few questions are asked of the student, the author believing that "too many questions hinder rather than encourage independent thought and observation." The exercises, as is the case with the text, are written in a general way so as to be "applicable to average plants rather than to a particular species," thus furthering the author's emphasis on general principles of botany. The two books are intended to cover a year's work with beginning classes in botany but have been used for semester classes by omitting many of the laboratory exercises and portions of the text. Even in a year's course some of the material may be omitted at the discretion of the instructor. This applies particularly to the lower forms of plants.

Representing as it does the views of another botanist as to how the subject should be taught, the book is likely to be of interest and value to those engaged in teaching.

The publishers deserve credit for the excellent work done in reproducing the line drawings and the half-tones.

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THE POSSIBLE ORIGIN OF THE ANGIOSPERMS

DR. H. HAMSHAW THOMAS, lecturer in botany of Downing College, Cambridge, has just published an important paper under the caption: "The Caytoniales, a new group of angiospermous plants from the Jurassic rocks of Yorkshire."[1] The origin of the

[1] Phil. Trans. Royal Soc. London, Series B, vol. 213, pp. 299–363, pls. 11–15, Feb. 21, 1925.

angiosperms has long been one of the "Dark Ages" in the evolutionary history of plants. This group, now the dominant plant type, seems to spring so suddenly into existence in the Middle Cretaceous, not only in one place but all over the world, with such a multiplicity of recognizable modern forms as forcibly to suggest that it must have had a long anterior period of development. But concerning this early history we are still pretty much in the dark, though an occasional ray of light stimulates further study and the hope that sooner or later we shall be able to work out a fairly complete account.

In 1904 Professor A. C. Seward described and figured a little leaf from the Stonesfield slate (Middle Jurassic) of East Yorkshire that has every appearance of being a dicotyledon. He wrote as follows: "Had the specimen been found in rocks known to contain remains of angiosperms, there would be no hesitation in identifying it as the leaf of a dicotyledon," but with characteristic caution he called it Phyllites sp., which is a convenient catch-all for any plant of doubtful systematic position. In 1912 Dr. Marie Stopes described petrified fragments of angiosperm wood of several types from the Lower Greensand beds of England. Remains supposed to be those of angiosperms have been reported from supposed Jurassic of Portugal, Australia and South America, but they are not wholly convincing.

The present study of Dr. Thomas is another possible link in the chain and is most welcome. The material on which it is based comes from the celebrated locality in Yorkshire, which has been an unfailing source of supply for Jurassic plants for nearly a hundred years. It is Middle Jurassic in age. The specimens described fall, according to the author, into four groups —two groups of carpels, fruits and seeds, one group of microsporophylls with anthers, and finally the leaves associated with these remains. They are placed in four genera, each with a single species, and fall within a single group, for which the name Caytoniales is proposed.

Perhaps the most important form is Gristhorpia, based on megasporophylls bearing subopposite, pediceled carpels and fruits, inclosing numerous ovules or seeds. The ovules are distributed irregularly over a large part of the inner side of the carpel wall. Much of the structure of the seed has been made out, including the micropyle and the several seed coats, but unfortunately the embryo could not be found. Evidently allied to this is Caytonia, which had the carpels similarly arranged in two opposite rows, but the ovules are disposed in two rows on the dorsal wall of the ovary. Many of the details of structure have been made out for these seeds also, though the embryo is missing. The male flowers, called Antholithus, consist of clusters of four-winged stamens, with peculiar-shaped pollen grains much as in Pinus, that is, there is a central portion with two lateral sacs or wings.

Great interest attaches to the leaves, long known as *Sagenopteris phillipsi,* that were found in close association with these fruits and seeds. The systematic position of *Sagenopteris* has been much discussed, and from their more or less close association with sporocarps of plants resembling those of Marsilia it has quite generally been referred to the Hydropterideae. Great numbers of these *Sagenopteris* leaves were found with the fruits and seeds and are apparently the only foliar organs that can with reasonableness be presumed to represent their foliage. As the author points out, with fruits and seeds as numerously represented as these are, it is natural to suppose that leaves would also be present. These leaves are described and discussed at length and numerous comparisons made with certain supposed early forms of dicotyledonous foliage, such as Rogersia, Proteaephyllum and Ficophyllum, from the lower Potomac of Virginia. In concluding the discussion of the leaves the author says: "We may take the view that, while it can not be regarded as definitely proved, there is a strong probability that the leaves of the Caytoniales were of the type known as *Sagenopteris,* and that it is more probable that *Sagenopteris* belonged to the Caytoniales than that it was the leaf of one of the Hydropterideae."

Dr. Thomas sums up his conclusions as to the possible affinities and interrelationships of these interesting plants as follows:

> A comparison of the Caytoniales with other seed plants seems to indicate that affinities may be traced with the Pteridosperms, Bennettitales, Gnetales and modern Angiosperms.
>
> Resemblances with the Pteridosperms may be found in the general form of the mega- and micro-sporophylls, while some of the details of seed structure in *Caytonia* are comparable with those seen in the Conostoma group.
>
> The comparison with the Bennettitales and the Gnetales is confined mainly to the structure of the integuments of the seed. The form and cutinisation of the micropyle in the seeds of *Caytonia* is more like that seen in *Gnetum* than in any other seed.
>
> The Caytoniales possess two of the features most characteristic of the modern flowering plants, *viz.,* the closed carpel with a stigma, and the anther with four longitudinal lobes. On this account it seems permissible to group them with the modern Angiospermae, though they do not seem to resemble any modern family. It is possible that they belong to a line of evolution which was quite distinct from that which gave rise to the modern Dicotyledons and Monocotyledons, and represent a parallel series of forms now completely extinct.
>
> The Caytoniales seem to occupy a position between the

Paleozoic Pteridosperms and the recent Angiosperms, and thus they suggest a possible solution for one of the great outstanding problems of evolution.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MODEL OF MUSCULAR CONTRACTION[1]

IT is rather difficult to imagine the muscle-fiber shortening as a result of swelling and increase of internal tension. The following model, constructed on a suggestion of L. Wacker,[2] 1917, is useful to illustrate the possibility of such shortening to students. The muscle fiber is represented by a thin rubber condom. A cork disk, 3 cm in diameter and 1 cm high, is placed in the bottom of the condom, and a similar but perforated cork in the opening. This bears a glass tube for blowing into the condom. Outside the condom and over the corks are two rings of brass, between which threads are stretched, 1 cm apart. On blowing into the tube, the condom swells; but as the strings prevent it from lengthening, the sides bulge and so shorten the condom. The two positions are shown in the figures.

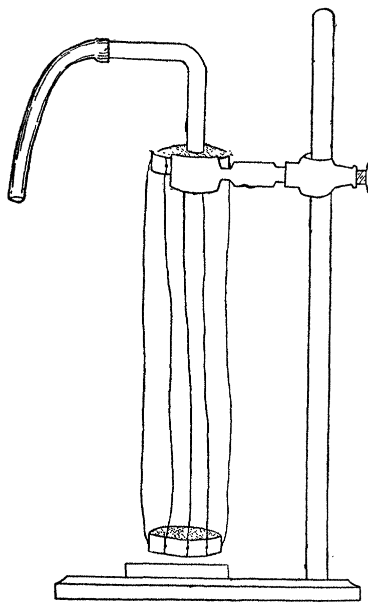

FIG. 1

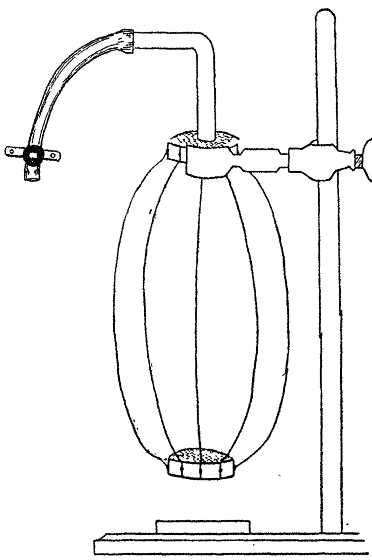

FIG. 2

The same phenomenon may be shown with dead small intestine from a rabbit or dog. A segment of intestine, about 10 cm. long, should be kept in normal saline solution for a day or two, at room temperature, to insure absence of vital tone changes. It is then arranged as in the Trendelenburg[3] peristalsis method. When the reservoir is raised, a centimeter at a time, the tracing lever shows progressive shortening, which disappears progressively when the reservoir is gradually lowered.

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SPECIAL ARTICLES

THE PRESENCE OF TREHALOSE IN YEAST

IN connection with studies on "Bios," an alcohol extract of Fleischmann's yeast was permitted to stand undisturbed for several months when a cluster of well-formed crystals was found clinging to the sides of the flask.

Preliminary tests indicated that it was a non-reducing, hexose containing di- or poly-saccharide. It was found to be exceedingly soluble in water and glacial acetic acid, either hot or cold, and somewhat less soluble in pyridine. It was insoluble in acetone. Unusual resistance to hydrolysis was shown by the fact that, after treatment with boiling glacial acetic acid, a Fehling's test was negative. Only when a solution of the crystals in N/2 HCl had been heated in a boiling water bath for one half hour was a positive Fehling's test obtained.

For more detailed investigation additional material was necessary. Securing these crystals a second

[1] From the Department of Pharmacology of the Medical School of Western Reserve University, Cleveland, Ohio.

[2] Wacker, L.: Arch. ges. Physiol., 1917, clxviii, 158.

[3] Trendelenburg, Paul: Arch. f. exp. Path. Pharm., 1917, lxxxi, 55.