available for computing the carbon dioxide evolved. Corrections for volume should be made on account of the changes in the bulbs; otherwise the calculations are exactly similar to those for the method hitherto used with the Krogh manometer.

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THE PHYLLOTAX—A PRACTICAL APPARATUS FOR DEMONSTRATING DIVERGENCE

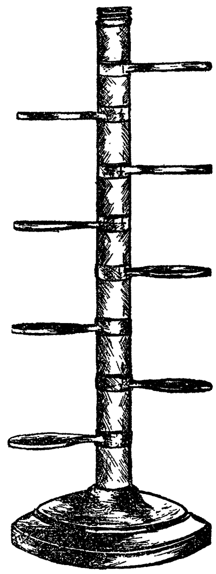
TEACHERS of botany have often found it difficult, if not impossible, to obtain adequate plant specimens for the purpose of properly illustrating their lectures on divergence. Even when such plant specimens are available, the fact remains that quite a number may be required to illustrate the main types of divergence.

I devised a few years ago an apparatus which, I think, will prove of some use. It consists of a metal stem along which are placed, at regular intervals, a number of leaves, each one being attached to a ring revolving about this stem, in order to give any desired divergence. If the divergence $\frac{1}{2}$ is wanted, two leaves should be met at regular intervals before the observer returns over the starting-point. Let us take a less simple case, for example the divergence $\frac{2}{5}$, which requires two complete revolutions around the stem before a leaf is found above the starting-point: there should then be five leaves, each forming with the next an angle of 144°.

All divergences have a value ranging from $\frac{1}{5}$ to $\frac{1}{2}$. The most common ranges are from $\frac{1}{3}$ to $\frac{2}{5}$, and are known as the "normal series." In illustrating divergence, it is of course more suitable to use the simplest cases, *i.e.*, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, and $\frac{2}{5}$. Such divergence as $\frac{3}{7}$ or $\frac{3}{8}$ can not be illustrated in a lecture. It might be convenient to indicate on the apparatus Fibonacci's angle: 137° 30′ 28″. This angle is the limit towards which the different values of the normal series converge, but it should never be considered as a type of divergence in itself.

DESCRIPTION OF THE APPARATUS

A metallic stem is vertically fixed on a stand. On the stem are placed, as stated before, equidistant revolving rings, each bearing a leaf. Every one of the rings has inscribed on it the fractions denoting divergence. It will be easily understood that the relative position of the fractions differs from one ring to the other. One would naturally expect to find these fractions on the fixed axis of the stem, *i.e.*, between the rings; setting every leaf to a predetermined fraction would give the divergence wanted. But this process has its drawbacks since, for instance, to get the divergence needed, we have to revolve the whole apparatus to find the figures. On the other hand, if the fractions are on the revolving rings and the stopping points for each leaf along the same vertical of the fixed axis of the apparatus, the observer will have only to face the stopping points and to move each leaf until the fractions for a given divergence are all set on the said stopping line.



HOW THE FRACTIONS ARE PLACED ON THE DIFFERENT REVOLVING RINGS

The first ring, whether at the top or at the bottom, will always remain in the same position for all demonstrations of divergence. On this first ring, it is not the leaf that is brought to the stopping mark, but a chosen point which is found on the ring 45° from the leaf. This prevents any fraction from occurring on the succeeding rings at the point of attachment of the leaves. Otherwise rather broad rings would be required for easy reading of fractions on account of the leaf at that point. The positions of all fractions on the other rings depend on the position of the mark on the first ring. The fraction $\frac{1}{2}$ on the second ring will be found 180° away from the mark of the first leaf, *i.e.*, 225° from the point of attachment. The fraction $\frac{1}{3}$ on this same ring will be 120° apart, instead of 180°, *i.e.*, 165° from the leaf. On the third ring the fraction $\frac{1}{2}$ will be 180° away from its position on the second ring and this will bring the third leaf to the original position of the first one. On this third ring the fraction $\frac{1}{3}$ will be 120° away from its position on the second ring, *i.e.*, 285° from the leaf. And so on.

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SPECIAL ARTICLES

ONCHOCERCIASIS IN GUATEMALA

THE Harvard Expedition for the investigation of onchocerciasis in Guatemala has been working in that country since January 27. The disease in Guatemala is characterized by the formation of nodular tumors situated on or in the region of the head. The fibromatous tumors are of parasitic origin, and the adult male and female *Onchocerca coecutiens* are situated in the central portion of the tumor. We have been able to demonstrate that three species of *Eusimulium* flies are concerned in the transmission of the disease. For the present and until careful comparison has been made with published descriptions and museum specimens these species have been designated as follows: Species A (probably *Eusimulium avidum,* Hoffmann), a small black fly some 2 mm in length; species B (probably *Eusimulium ochraceum,* Walker) about the same size or a little smaller with yellow thorax, the abdomen half yellow and half black and the legs mostly black; and species C (probably *Eusimulium mooseri,* Dampff), slightly larger than the others, with the thorax and most of the abdomen yellow and the legs very extensively yellow. All stages of development of *Onchocerca coecutiens* have been repeatedly observed in these flies, and the development has been traced from the time the fly just bites the infected individual and thus ingests the microfilariae from his skin, on through their passage and development in the thoracic muscles, head and proboscis. We have been fortunate in securing permanent specimens of the infective filarial form passing through and emerging from the labium of the proboscis. In this study, 4,572 flies have been dissected and examined microscopically. Other insects and particularly culicine mosquitoes are not concerned with the transmission of the disease.

The mosquito has a considerably longer proboscis than the *Eusimulium* fly and evidently inserts the proboscis deeply in sucking blood. The microfilariae of *Onchocerca,* which are not encountered naturally in the blood, but are found in the lymphatics of the skin, are not even ingested by the mosquito when it is fed on infected individuals. Possibly also the saliva of the mosquito repels the microfilariae of *Onchocerca coëcutiens.*

In some of the cases in which the tumors have existed for long periods of time, disturbances of the eyes and loss of vision occur. We have been able to demonstrate microfilariae in such cases in sections of the peri-corneal conjunctiva, cornea and iris removed at operations or at autopsy. The continued presence and passage of the microfilariae through the lymphatics of the eye for long periods of time apparently give rise to an inflammatory condition and to a perivascular infiltration, in perhaps somewhat the same manner as occurs from the action of the trypanosome in the tissues of the central nervous system in sleeping sickness. In the course of time, peri-corneal, conjunctivitis, keratitis and iritis may result in such cases.

We have also investigated the blood and serum in the disease. Eosinophilia is present, and counts of eosinophiles of from 25 to 50 per cent. are usual. The serum of some of the cases of long standing gives a precipitin reaction with an aqueous or alcoholic extract of the tumors employed as antigen. However, a rabbit serum prepared by repeated intravenous inoculation of the animal with an extract of the tumors gave no such reaction.

In the clinical studies 1,383 individuals have been examined and the tumors removed in 261 cases. Some of the tumors have been hardened in Zenker's solution for histological study, while others have been used for the preparation of antigen and still others have been digested and dissected to obtain entire for study the adult male and female parasites.

The tumors (and the adult parasites within them) can be easily removed by operation under a local anesthetic, but in some cases the microfilariae continue to circulate in the body and are demonstrable in the skin and in some cases in the eye for at least several years. In order to rid the patient of the microfilariae which persist after removal of the tumors, experiments have been performed to discover a satisfactory filaricidal substance. Using a technique which gives a suspension in normal saline solution of an enormous number of motile microfilariae, it has been found that *in vitro* plasmoquinin in dilutions up to 1 to 10,000 effectively destroys the microfilaria. The motility of almost every parasite in the microscopical field ceases and they become apparently lifeless within thirty seconds; the several in the microscopical field which are not immediately killed no longer exhibit any lively movement (but may continue to bend more or less for 10 to 15 minutes) and are dead within about 20 minutes. Quinine in a solution of 1 to 5,000 produces somewhat similar results, but its lethal action is somewhat less marked while antimony compounds, neosalvarsan and mercurochrome are relatively ineffective. A serum prepared by repeatedly inoculating a rabbit with extracts of the adult filariae and embryos and with the tumors themselves has shown no filaricidal properties.

The members of the expedition, besides myself, are Dr. J. Bequaert, entomologist of the department of tropical medicine at Harvard University, Dr. M. Ochoa, parasitologist of the Board of Health of Guatemala, and Mr. B. Bennett, technician of the department of tropical medicine.

RICHARD P. STRONG

MOCÁ, MAY, 1931

INTRANUCLEAR INCLUSIONS IN LARYNGOTRACHEITIS OF CHICKENS

BEACH[1] has reported from this department the filtrability of the virus of laryngotracheitis in chickens. We wish in this place to record briefly the results of a histological study of spontaneous and

[1] J. R. Beach, SCIENCE, 72: 633, 1930.