his friend, the Cyprian Eudemus, and dedicates a dialogue to him. He writes a moving hymn to Hermias, the uncle of his wife and his own benefactor. He erects an altar to Plato, his master. In his will he directs his bones shall lie with those of his wife Pythias, long since dead, and in accord with her own dying wish that wherever her husband should be buried, her own bones should be dug up and put in the same grave as his. He provides affectionately for his children and slaves. From the dull dialectician of our thoughts he becomes transformed into a personality of great attractiveness and stands side by side with Socrates and Plato as one of the moving figures of antiquity.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### FACTORS THAT INFLUENCE LIFE AND GERMINATION OF COTTON SEED

IN one of our previous papers, we brought out the fact[1] that the temperature which cotton seed can endure, without affecting the vitality of the seed, depends upon several factors: First, the amount of moisture present in the seed; second, whether heated in dry or moist atmosphere; third, and perhaps the most important, whether there is oxygen present during the process of heating. We found that by thoroughly drying and heating cotton seed in a vacuum to prevent oxidation of the fats and proteins in the seed, they will endure a temperature of boiling water for hours without affecting their vitality.

M. J. Hondas and M. A. Guillaumin[2] found that the seeds of the *Gerbera jamesoni* quickly lose their germinative power when exposed to air, because of the alteration occasioned in their fixed or essential oils or in their other elements. In fact, it is impossible to obtain a single germination after a lapse of a single week. As the seed, deprived of albumen, contains alluron, he assumed that its alteration is due at least in part to the oxidizing action of the atmospheric oxygen.

M. A. Guillaumin, using the method employed by the author of storing seed in a vacuum, found he was able to preserve such seed for a long period of time. Since the heating of cotton seeds in a vacuum increased germination and lowered the activity of fungus diseases, we decided to study the effect of heating cotton seed in the presence of chemically inert gases, such as hydrogen, nitrogen and carbon dioxide.

Hydrogen was the first gas to be investigated. After the seeds had been dried at a low temperature, the tubes were filled with hydrogen at 100° C and at atmospheric pressure. The seeds were then subjected to a temperature of 100° C for twenty-six hours. Only in one series of experiments carried out did any of the seeds germinate and then the plants were not as vigorous as untreated seeds, planted on the same date and growing under same conditions.

Upon obtaining such low percentage of germination, oils of the hydrogen treated seeds were extracted with ether by the soxhlet apparatus and iodine numbers determined by the Hubl method. The iodine numbers found ranged from 82 to 99, while the iodine numbers of untreated seeds varied from 104 to 115, which shows that the unsaturated oils that were formerly present in the seed had become partially saturated. From these results we concluded that the oils had been changed by the hydrogen to such a state that prohibited their being hydrolyzed by the enzymes, in order to supply the embryo with necessary food for development. From our experiments there appeared to be no decrease in the activity of the enzymes, incident to heating the seed.

In order to obtain further information in regard to the nature of the absorption of the hydrogen by the oils in the cotton seeds, the tube containing the cotton seed was connected with a very sensitive manometer (see Fig. 1).

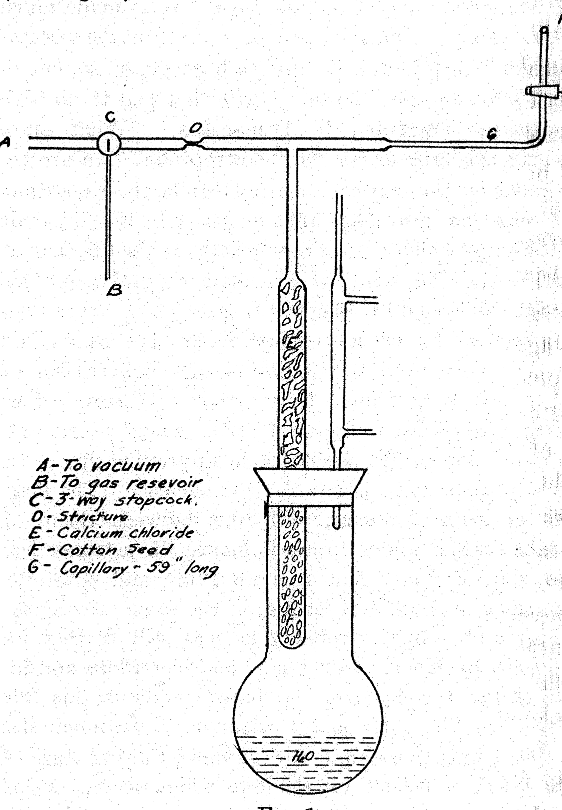


FIG. 1

[1] SCIENCE, Vol. LXII, No. 1487, p. 741.

[2] Bibliothèque Universelle Lausanne, Aug., 1923.

The seed and calcium chloride were placed in the tube as usual and allowed to dry thoroughly. The tube containing the seed was then connected to the manometer. The entire apparatus was evacuated to .001 mm pressure and hydrogen allowed to flow in from a reservoir at atmospheric pressure. In the meantime the water in the flask was heated to boiling. The stricture marked "D" was sealed, thereby confining the gas in the apparatus. The stopcock on the capillary tube was opened and a mercury pellet above it allowed to fall into capillary tube "G."

At the end of thirty hours of continuous heating the mercury pellet advanced the entire length of the tube, indicating the absorption of hydrogen by the oils. The room temperature was held constant within two degrees, as a change of four or five degrees affected the position of the pellet.

Nitrogen was likewise studied in the same way as hydrogen and with one exception a germination of less than 50 per cent. was obtained. The seed which germinated were not as vigorous as untreated seeds planted under the same conditions. After extracting the fats in the treated seed, the iodine numbers were found to correspond closely to those of the original seeds, varying from 105 to 109.

A manometer of the same type as that used with hydrogen was used with nitrogen. Following the first three or four hours of heating the mercury pellet was blown entirely out of the opening marked "H." It was evident that there was a decomposition of the proteins or other vital constituents resulting in a lower percentage of germination. The enzyme action appeared to be normal.

Carbon dioxide was tried upon cotton seed, under the same conditions as previously stated. A decomposition was noticed when the manometer was used, but it was much slower than with nitrogen. At the end of thirteen hours of heating in an atmosphere of carbon dioxide no germination was obtained.

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## COLLECTING AMPHIOXUS

DURING the month of March, 1926, I made a collection of some five thousand Amphioxus along the west or gulf coast of Florida. The specimens taken were found in situations varying between a mixture of mud and sand with some vegetation and a mixture of shell and sand. In all cases, sand was the predominant feature of the ocean bottom in which the animals burrowed.

Search for specimens was usually made at low tide. Collecting at other times was mechanically difficult. At low water the bars are more or less exposed and Amphioxus was found in many such bars. The specimens were not scattered but were usually found concentrated along the landward edge of the bar. As the waves roll in over the sandy sea bottom, the bars are built for the most part with a long slope to seaward. On the landward side they frequently show an abrupt drop of a foot or two. The incline of this drop may be as steep as 45 degrees. At the water's edge, along this short but abrupt incline, the Amphioxus were found congregated, at low tide.

When the Amphioxus are abundant their presence is indicated at low tide, by the presence of small holes in the sand. These holes are made by the burrowing animals and are usually at right angles, or nearly so, to the horizontal plane of the water. The animals lie in the burrows near the subterranean water line but whether with the head up or down is not easy to say. Sometimes when the shovel is pushed into the sand an individual Amphioxus will shoot its full length or more out of the sand as though pricked from behind. It seems fairly certain that these specimens come out of their holes head first.

Collecting was carried on as follows. A sieve made of reinforced copper wire tacked on to a square frame was used to sift the Amphioxus from the sand. Three to six or eight Amphioxus was the usual catch for one shovel full of sand. Along with the Amphioxus, there was usually a considerable amount of broken shell. Other animals, such as sand stars, Annelid worms, an occasional Lingula, many empty Dentalium shells with perhaps a few living Dentalium were also present. Now and then a Balanoglossus was noted; on one bar, sand dollars, varying in size from an eighth of an inch up, were found among the broken shell.

The material containing the Amphioxus was dumped on to a square of black oilcloth where the animals flopped about like miniature eels or burrowed beneath the shell and other débris. If by chance they found themselves on the sand of the bar, they disappeared like a flash, head first, into the sand, providing the bar had but recently emerged from the water. If the bar had settled, the animals were frequently unable to bore into it and in dry sand they were helpless. The movements used in boring into the wet sand are nothing more than the lateral oscillations of the body used in swimming. In short, if the sand contains sufficient water, the animals swim down into it.

The depth to which Amphioxus burrow at low tide was not fully determined; in general they seem to keep near the subterranean water level. On bars that yielded an abundance of specimens at ordinary low tide few specimens were to be found at spring tides, at which time these bars are left high and dry. At such low tides, however, plenty of specimens were