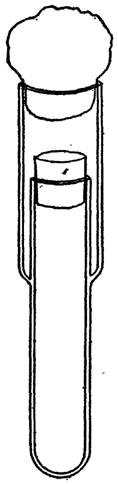
ing each time to avoid infection and is time consuming. Used in this operation the double-necked tube



is supported in the ice pack at an angle of 45°. When the inner plug has once been removed it is left out, the outer cotton plug alone being used. This may freely be removed and replaced many times without flaming. The tube can thus be used throughout the operation (in our case thirty cultures) without removal from the ice pack, with much saving of time and no danger of infection. Even in experiments where heparin is used to prevent clotting and the ice pack dispensed with the double-necked tube saves much time and is an additional precaution against contamination.

As will be seen from the diagram this tube consists of a small test-tube 7½ cms in length, 1½ cms in diameter and rounded off at one end. A collar is fused to this tube about 2 cms from the open end. It projects 3 cms beyond the open end of the inner tube. The jacket has a total length of 5 cms and a diameter of 2 cms.

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SPECIAL ARTICLES

VITAMIN B_2

WHEREAS considerable progress has been made on the concentration of vitamin B_1, comparatively little work has been reported on the purification and concentration of vitamin B_2. Within the last year only two communications, one by Chick and Roscoe,[1] and the other by Narayanan and Drummond,[2] have appeared on this subject. In the first paper a partial separation of the B_2 fraction from B_1 is reported. The process leading to the separation was very complicated, involving many steps. In the second paper, which has appeared very recently, vitamin B_2 is active in daily doses of 0.006 gm.

Over a year ago, we succeeded in separating the B_2 fraction from B_1 in a very simple way. Itself added to a vitamin B-free diet, it did not maintain growth of white rats; with 0.00015 to 0.0002 gm of our vitamin B_1 fraction, it maintained normal growth.

Fraction B_1 is adsorbed on silica gel at pH 3. The filtrate is rich in vitamin B_2, but still contains some vitamin B_1. By precipitation with acetone a material is obtained of which daily doses of 0.015 gm in addition to 0.0002 gm of B_1, both added to the standard diet, suffice to maintain normal growth of white rats. By repeating the extraction six times, a material is obtained from the filtrate of which daily doses of 0.005 gm are required. Finally, when this material is dissolved in water and precipitated with alcohol containing one per cent. of hydroiodic acid, a material is obtained of which daily doses of 0.0007 gm suffice to maintain normal growth of white rats.

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1 Chick, H., and Roscoe, M. H., *Biochem. J.*, 23: 504 (1929).

2 Narayanan, B. T., and Drummond, J. C., *Biochem. J.*, 24: 19 (1930).

THE BEHAVIOR OF WINTER WHEAT IN ARTIFICIAL ENVIRONMENTS

IN physiological investigations of diseased as well as healthy winter wheat plants, frequently it has not been possible to obtain satisfactory results with the plants produced in greenhouses and experimental culture chambers. Such plants produce abnormally long leaves and leaf sheaths, and tillering tends to be reduced during the early growth stage (predormant stage) previous to the stage of winter dormancy as compared with plants grown in the open. These abnormalities have made it practically impossible to study the rosette phase of the wheat-mosaic disease under controlled conditions throughout the year, and to obtain satisfactory heading in winter varieties.

In 1925, studies were started with the definite aim of determining methods for obtaining normal winter wheat, especially during the predormant growth stage in experimental culture chambers.

As a basis for determining normal development, measurements were made on field-grown Harvest

Queen winter wheat plants at the end of the autumn growth period. The mean length of the longest leaves and longest leaf-sheaths on each tiller and the number of tillers on each plant are satisfactory standards of comparison. The average length of the longest combined leaf and leaf-sheath and the average number of tillers are equally satisfactory in most work. The present standard plant has, when planted an inch apart in the drill row, 5.5 tillers; the longest combined leaf and sheath is 16 cm long, and the plants are recumbent. Plant development is affected by season and soil conditions, but the standard given is the average for plants at the end of an autumn favorable for winter wheat.

Plants grown under glass at all the temperatures studied produced longer leaves and leaf-sheaths and fewer tillers than plants grown simultaneously at the same temperature, but not under glass. These abnormalities have been greatest, however, at high temperatures and during the long days of summer. Several commercial glasses having higher transmitting qualities for the ultra-violet than ordinary glass and also some of the nitrocellulose and cellulose-acetate products in clear sheet form and in screen wire form were tested for their effect on normal plant development. One product, a Corex glass (G 980 A), showed some advantage over common glass, but this advantage was not great.

Daylight was supplemented by artificial light from Mazda lamps, the Cooper Hewitt mercury vapor work lamp and the Hanovia Luxor Model Quartz mercury-arc-lamp, but the additional light from these sources failed to overcome the influence of glass on the plants. The tests did indicate, however, that the Cooper Hewitt mercury vapor work lamp, which produces a yellow, green, blue and violet spectrum, caused less elongation of foliage and less reduction in tillering than the Mazda lamp.

In studies on the design of plant culture chambers it was found that wheat grown near 59° F. in the winter approximated the normal more closely than plants grown near the same temperature in midsummer. This suggested that the length of the day influenced the elongation of leaves and sheaths and tiller production, and that a short day would compensate to some extent for the difficulties introduced by glass. Harvest Queen wheat plants grown near 59° F. and with the day shortened to seven or eight hours averaged five tillers each, with the longest sheath and leaf averaging 15 cm in length. The plants were slightly more recumbent than is usual for this variety in the field. In other respects the plants were morphologically normal in comparison with field-grown plants entering the period of complete dormancy.

These studies have been extended to include the later stages of development of Harvest Queen winter wheat and Purple Straw, a variety which has been classed as a winter type and also as a spring type. One experiment, started February 6, 1930, is cited.

During the first 28 days of growth the plants were in an experimental chamber held near 59° F. The following 32 days the temperatures followed a daily undulating curve having a minimum near 40° F. at 2 A. M. and a maximum near 59° F. at 2 P. M.

One half of the series received the full sunlight and in addition sufficient light from a Mazda electric lamp to produce a day approximating 16 to 17 hours; the other half of the experiment received sunlight for seven to eight hours daily. At the end of this 60-day period all the plants were removed from the chamber, placed in a small greenhouse and given approximately 17 to 18 hours of sunlight and electric light daily at a temperature ranging around a mean approximating 70° F.

The Purple Straw plants headed earliest (85 days after planting) when given a long day in their early stages, whereas the Harvest Queen plants headed quickest (92 days) when given the short day during their early stages.

The Purple Straw plants given the short day headed in 92 days. The Harvest Queen plants given the long day started to head in 97 days, but the heading of the culms was very irregular as contrasted with the rest of the series, and the plants tillered excessively.

Other tests conducted in 1928 and 1929 also show conclusively that, when plants are held at 40° F. or above during early growth, exposure to 16 to 18 hours of light daily retards heading and stimulates excessive tillering in Harvest Queen. However, this length of day hastens the heading process and does not stimulate excessive tillering in this variety if the small seedlings (plumules $\frac{1}{4}$ to $\frac{1}{2}$ inch long), or seeds which show the first stages of germination activity, are first subjected to 31 to 33° F. in a mechanical refrigerator for a suitable period before planting at the growing temperatures. These results indicate that early heading in winter wheat is influenced both by low temperatures and by short days during the early stages of development, either of these environmental factors operating singly at optimum compensating to some extent for excess of the other.

Our results show distinct advantages when conducting experiments under conditions approximating the seasonal fall and rise in temperature and day length. However, it is possible by properly combining day length and temperature greatly to hasten the heading process in chambers as compared with that in the field. We have obtained mature seed from winter wheat 100 days after planting by growing the plants in an 8-hour day and at 50° and 60° F. during the first 54 days of growth, followed by days ranging from 17½ to 18½ hours in length and temperatures fluctuating above and below 70° F. On this basis two, and under ideal conditions, three successive crops may be grown in 12 months. This is a distinct advantage in connection with genetic, physiological and pathological studies. Conditions favoring early heading and maturity, however, do not necessarily favor high yields of grain.

The plant culture chambers in which the tests were conducted were glazed with Libbey Owens flat-drawn single strength window glass. The chambers were located out of doors. They will be described more fully in another paper.

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THE CYTOLOGY OF CILIA FORMATION IN THE SWARM-SPORES OF MYXOMYCETES

THE swarm-spores of the myxomycetes have been studied in some detail by Jahn.[1] In this study the cilium is shown to develop directly from the centrosome. Wilson and Cadman[2] have referred to this body as the centroblepharoplast. During the mitosis immediately preceding the formation of swarm-spores, the poles of the spindle are occupied by centrosomes which give rise directly to the cilia of the resulting swarm-spores. As pointed out by Jahn, the time is very brief between the initiation of cilia-formation during the last phases of the division of the mother cell and the development of the cilium of each daughter cell. It is then apparent that, in order to be able to kill and fix favorable material for the study of all stages in this very rapid process of cilia-formation, it is necessary to be able to control accurately the stimuli which initiate this process and the conditions which make its completion possible. When this is accomplished, one may kill spores and prepare them for study at any stage of development desired. The methods which the writer[3] has used in his studies of the zoospores of various species of the lower fungi have been found to be applicable to the study of the swarm-spores of the myxomycetes.

In the study of *Reticularia lycoperdon* Bull. the writer has found that the cilia-forming organ in the swarm-spore is composed of several granules, instead of a single centrosome granule as described by Jahn. The basal apparatus is similar in many respects to those of the uniciliate spores of the species of Blastocladia and of Allomyces described by the writer (*loc. cit.*). There are, however, several very significant differences. The first phase when the basal granule or granules, as the case may be, tend to migrate away from the nucleus or its pole seems to take place more rapidly in the case of the developing cilium of *Reticularia lycoperdon* than in the uniciliate spores of species of Blastocladia and Allomyces. As the cilium matures these granules migrate back toward the nucleus in both cases, but in the case of the myxomycete swarm-spore they move quickly and completely back to the pole of the nucleus. In the uniciliate spores of the species of fungi studied the basal granule (blepharoplast) usually remains at the base of the cilium. This complex of granules, which appears as a single large granule at the base of the cilium of the mature myxomycete swarm-spore, is then of considerably more importance than a simple centrosome in the sense of Jahn's description. This structure may even be comparable to the entire basal apparatus of the uniciliate spores of species of Blastocladia and Allomyces.

A more detailed account of the physiology and cytology of the active stages of the swarm-spores of this and several other species of Myxomycetes will appear in a botanical periodical at an early date.

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[1] "Kerntielung und Geisselbildung bei den Schwärmern von *Stemomtis flaccida* Lister," *Ber. Deutsch. Bot. Gesellsch.*, 22: 84–92, 1904.

[2] M. Wilson and E. G. Cadman. "The Life History and Cytology of *Reticularia lycoperdon* Bull.," *Trans. Roy. Soc. Edinburgh*, 55: 555–608, 1928.

[3] "A Cytological Study of the Zoospores of the Genus Blastocladia," *Bot. Gaz.* (in press); "The Development of the Zoospores in the Oomycetes and the Cytology of their Active Stages," *Am. Jour. Bot.* (in press).

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