which can be studied in all their details, drawn and excellently photographed with a green filter.

K. HRUBY
CHARLES UNIVERSITY
PRAGUE, CZECHOSLOVAKIA, EUROPE

A NEW PARAFFIN EMBEDDING MIXTURE

DIFFICULTY in obtaining a paraffin of satisfactory consistency in which to embed and section biological material led to the development of the following formula. The use of neither of the substances added to the common paraffin is original with the writer (having been in fairly common use fifteen to twenty years ago) although the proportions and combinations may be.

A stock solution of crude rubber in paraffin is first made. Crude rubber is available in thin sheets, either smoked or unsmoked. Both kinds work equally well. The sheets of crude rubber are chopped up with a scissors and dropped in melted Parawax or any similar common paraffin. The paraffin should be smoking hot and the mixture should be stirred occasionally. Three to four hours are required to completely melt the rubber. About 20 grams of rubber can be dissolved in 100 grams of paraffin.

EMBEDDING MIXTURE

Parawax	100 grams
Rubber-paraffin mixture	4–5 grams
Beeswax	1 gram

Filter through paper (paper towels serve this purpose excellently).

This mixture is pale yellow in color, does not crystallize readily, and is of a waxy consistency that sections unusually well. It has been in use in this laboratory for the past three years and has materially increased the success of large classes in micrology.

ROBERT T. HANCE
UNIVERSITY OF PITTSBURGH

SPECIAL ARTICLES

PHOTOPERIODISM AS A CAUSE OF THE REST PERIOD IN STRAWBERRIES

EXPERIMENTS made by the authors on the light requirements of strawberries have suggested an explanation of the cause of the rest period in this plant. The strawberry plant in northeastern United States becomes more or less dormant with the onset of low temperatures in the fall. Low temperatures alone are not responsible for dormancy, for many varieties remain dormant even when taken into a warm greenhouse in late fall. However, if plants are first given a low temperature rest period until about January 1, when brought into a warm greenhouse, all varieties grow vigorously, even though the days are still short. After the rest period has been broken, leaf growth and flower production is rapid. Plants covered with boxes in the field in January, so placed as to exclude all light, blossomed at about the same time as those in the open. Temperature and not light was the controlling factor after the rest period was broken.

If plants in the greenhouse are given additional light for several hours each night, beginning in November before they have had a low-temperature rest period, many but not all varieties grow vigorously. Each variety and species shows a characteristic response to the length of the daily light period at this time. If, however, the daily light period is lengthened beginning in early fall (September 1) before the days become short, the plants of all varieties we have tested make a vigorous vegetative growth throughout the entire winter and do not require a low-temperature rest period. Some varieties under such increased light periods produce some flower clusters, depending on their particular daily light period response. In contrast, plants not given additional light start fruit bud formation with the onset of short days, and if the temperature is above 60° F., plants of many kinds go into the rest period.

In one test, plants of some 51 varieties were given electric light until 10:00 each night to supplement daylight, beginning September 1. Until February their growth was almost entirely vegetative. They produced an average of 0.7 flower clusters per plant by that time, while control plants under normal light but similar temperatures had averaged 3.8 clusters. By June 9, the control plants had averaged 20.2 clusters, while the plants under the lights had averaged 4.8 clusters each. Continued growth seems to be correlated with relatively constant exposure to the photoperiodic requirements of the particular variety. Growth in some form apparently can continue over a fairly wide range of light exposures. For ordinary varieties very short daily light periods initiate a rest period, short light periods result in continuous fruiting and longer periods in vegetative growth only. Rest periods then seem to result from nutritional conditions following exposures to short daily light periods. *Fragaria virginiana* and varieties adapted to the Northern and Eastern states require a rest period after exposure to days as short as 12 hours daily light. *F. chiloensis,* varieties of the Northwest derived in part from it recently, and Southern varieties do not need a rest period until the days are much less than 12 hours. In fact, after exposure to days as short as 9 hours at the relatively low temperatures used they still grew freely.

Strawberries are grown commercially from regions having several weeks of continuous light in midsummer, such as Alaska, to regions of successively shorter daylight periods southward to Ecuador having 12 hours of daylight, and in winter, in Florida in days with less than 11 hours of daylight. Varieties that succeed in subtropical climates do not require a rest period, at least when grown under the day lengths in the subtropics. Although there is evidence that better growth may sometimes be obtained on such varieties after exposure to low temperatures for a time, they do not require a rest period under light conditions that prevail at Washington, D. C.

A study of the responses to light and rest periods seems to show that the strawberry varieties now grown in regions of short and of long days have actually though unconsciously been selected for adaptation to the light and rest period conditions of those regions. Varieties grown in subtropical regions are sufficiently adaptable to grow continuously under light periods of less than eleven to more than thirteen hours, and in these regions do not require a dormant period. Varieties adapted to Northern United States do not grow well under the short days of Southern states, and soon die out, while southern varieties make too vigorous a growth under the long days of summer in the North.

The strawberry is an evergreen, and upon exposure to suitable light periods some varieties after becoming dormant resume growth. In others apparently nutritional conditions have progressed to a point where light alone as we have used it is insufficient to cause renewal of growth. If the rest period in some other plants, especially in the deciduous ones, is due to similar causes, attempts to produce continued growth or to break the rest period by the use of lights should start before the leaves have fallen, or in some cases even as early as the end of June when the days are longest or even earlier to prove successful

GEORGE M. DARROW
GEORGE F. WALDO

BUREAU OF PLANT INDUSTRY
U. S. DEPARTMENT OF AGRICULTURE

A "SCURVY-LIKE" DISEASE IN CHICKS

IN the course of nutritional studies we have observed the development of a scurvy-like disease in baby chicks. The first external symptoms are usually observed about the third week. They are nervousness and lameness, which is apparently due to stiffness of the hock joints. These symptoms are followed by bleeding from pin feathers on the neck, wings or thighs. About the same time blood clots appear beneath the skin and in the muscle of the thigh, around the hock joint and at the base of the wings. Closely following these abnormalities are frequent hemorrhages around the head, neck, back, ribs, breast and keel. Abdominal hemorrhages and small hemorrhagic spots in the muscle of the intestinal wall are common. The most frequent symptom is that of dark erosion spots on the gizzard lining[1] similar to the condition described by McFarlane, *et al.*[2] In these experiments approximately 95 per cent. of the chicks had erosions on the gizzard lining, while over 70 per cent. were affected with external or internal hemorrhages. In chicks suffering from the disease the bones were often brittle and the bone marrow dry and colorless. The blood showed an extremely low hemoglobin content (as low as one gram per hundred cubic centimeters of blood) and the blood picture microscopically resembled that described by Hess[3] for human scurvy. There further seemed to be an association between the symptoms described and growth in that the more rapid the growth the earlier the symptoms occurred and the more severe they were.

The symptoms described were produced by feeding a ration composed of fish meal, ground yellow corn, yeast, ground oyster shell and sardine oil or cod-liver oil to chicks confined in battery brooders. Rations in which the yeast was omitted produced the symptoms to a lesser extent. The substitution of 10 per cent. of dried skim-milk for the yeast and a portion of the fish meal produced about normal chicks. However, a few cases of eroded gizzard lining and small hemorrhages were observed, even when the milk was included in the diet. Five grams of cabbage per bird fed to affected individuals during the fifth and sixth weeks resulted in a complete recovery at the end of this period.

In view of the symptoms described, the diets used in order to produce the disease and the fact that cabbage in small quantities brought about a cure, we believe that, contrary to previous reports, growing chicks may suffer from scurvy due to an absence of vitamin C in the diet. We further believe that they are either unable to synthesize vitamin C or under certain conditions they are unable to synthesize this vitamin in sufficient amounts to meet their require ments.

A more detailed report of these investigations is being prepared for publication.

WALTHER F. HOLST
EVERETT R. HALBROOK

UNIVERSITY OF CALIFORNIA

[1] Similar gizzard affections have been observed in baby chicks as early as the seventeenth day of incubation.

[2] W. D. McFarlane, W. R. Graham, Jr., and G. E. Hall, *The Journal of Nutrition*, 1931, Vol. IV, 331.

[3] Alfred F. Hess, "Scurvy, Past and Present," Philadelphia, 1920.