seem to me surprisingly like fragments of a lantern and teeth. The absence of a lantern in fossils of so primitive a type as Bothriocidaris would not seem to me surprising in view of the usual absence of any trace of a lantern in many (if not most) specimens of fossil Echini where yet one is known to have existed. These fragments figured by Mortensen are to me quite suggestive of the occurrence of a fairly typical lantern in Bothriocidaris.

I must give it then as my decided conviction that Mortensen's new data on Bothriocidaris strongly confirm the old view that that interesting fossil really represents an ancestral stock for all Echini, and amply justify Jackson's system of classification in the group.

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NUTRITIONAL REQUIREMENTS OF TROUT

DURING the past summer an agreement was executed between the U. S. Bureau of Fisheries, the New York State Conservation Department and the New York College of Agriculture at Cornell University for the purpose of conducting on a cooperative basis experimental studies in fish culture relating especially to fundamental problems of nutrition and physiology of fishes. Complementing, and to a certain degree paralleling, studies of fish feeding conducted at the bureau's experimental fish culture stations, the new undertaking will deal particularly with the digestibility of various nutrients by trout, the vitamin requirements essential to an economical and successful ration, and with enzymotic and other physiological and metabolism studies.

These investigations are under the direction of Dr. C. M. McCay, of the Animal Nutrition Laboratory at Cornell University, and are conducted in the bureau's hatchery near Cortland, New York, where the bureau will furnish suitable hatchery facilities, including the hatchery building and such rearing ponds as are needed, the stock of eggs and part of the feeds necessary for rearing fish. The New York State Conservation Department is providing the necessary funds for the compensation of the technical assistants involved in this work and for special apparatus and feeds needed for the experiments. The State College of Agriculture provides necessary laboratory facilities at Cornell University for experimental work and analyses not readily conducted on the hatchery premises. The bureau will incubate the eggs and will rear the surplus fish not needed for experimentation, which surplus at the end of the season will be available for filling applications for stocking adjacent waters. However, fish production will be subordinated to a vigorous prosecution of the scientific investigations in order to find ways of cheapening the operation costs in the several hundred hatcheries scattered throughout the nation.

Feeding experiments with brook trout were started at the Cortland experimental hatchery during the month of August and are being run by A. V. Tunison, who was formerly in charge of similar work in Connecticut. The feedstuffs that are being studied at the present time are dry buttermilk, cottonseed meal, peanut meal and a number of dry skim milks. These are the dry foods that have proved the most promising during the five preceding years during which similar research was carried out by Dr. McCay in Connecticut. In the present study the tests have been made more rigid than formerly by studying only feedstuffs of which origin and processing are known. This has been made possible through the cooperation of the producers' associations such as the American Dry Milk Institute. A series of dry skim milks, made by different methods, are involved in the testing.

Since one of the most important problems in using dry feeds is that of physical composition, a series of special binders are being tested. These binders are dextrins similar to those found in corn syrup. The method of preparation of each of these compounds from corn starch is known. Preliminary work indicates that one of these dextrins is quite superior to the others, but it is too early to anticipate which one of the dry skim milks will prove the most satisfactory. The spray process milk is better when only physical composition is considered.

All earlier work has shown that trout will grow well upon dry skim milk alone for twelve to fourteen weeks. After such a preliminary growth period they die quite rapidly unless this diet is supplemented with raw meat. In order to develop a concentrate of this raw meat factor some method of assay must be established. For this work the policy of feeding dry skim milk for three months has been adopted. After this period, when the body reserves are exhausted, special preparations will be fed as supplements to determine if they are as potent as raw meat in permitting the trout to continue growth and life. This method of testing is similar in principle to that now employed in measuring the vitamin A potency of cod liver oil.

In addition to studies upon brook trout two experiments are being run with groups of brown and rainbow trout in order to secure growth curves under identical water and feeding conditions. All earlier studies have shown that trout upon full feed increase their body weights during the growing season by a constant percentage. This is true of none of the higher animals, since they all grow very rapidly when young and gradually cease to grow as they approach adult size. Only two growing seasons have been

studied previously with trout. New groups are being established to be continued for a series of years, since the rate of growth is one of the factors in the economy of producing fish for food.

During the past summer, experiments were started in the Animal Nutrition Laboratory at Cornell University upon fish to learn more of their digestive processes. This involved the use of aerated aquaria with fish taking oxygen from the same water for periods of several days. An aquarium was discovered which operates very satisfactorily when aerated by the ordinary inexpensive suction pump that can be attached to any water faucet. The aquarium in this case was an earthenware jar with a lid of special design and ground to fit.

HENRY O'MALLEY
U. S. Commissioner of Fisheries

PARTHENOCARPY AND SEEDLESSNESS IN VITIS VINIFERA

SEEDLESSNESS in *Vitis vinifera* has been reported on by Muller-Thurgau in 1898 and 1908 and by Y. Oinoue in 1926, but no thorough microscopical investigation of this subject has hitherto been undertaken. This report deals only with the two most important commercial varieties of seedless grapes, Sultanina, or Thompson's Seedless, and Black Corinth. Muller Thurgau states that Sultanina ovules are incapable of being fertilized, although the pollen tubes enter the ovules, and that the Black Corinth ovules are also incapable of being fertilized, but that their pollen tubes do not enter their ovules. Oinoue reports that in both of these varieties one male nucleus fertilizes the egg, but that the secondary nucleus of the embryo sac is never fertilized and gradually disintegrates. The author finds, however, that a high percentage of Sultanina embryo sacs are perfectly normal at anthesis and are fertilized normally. At the time of anthesis the polar nuclei have already fused and the antipodals completely disappeared. According to A. N. Berlese, and the author's own investigations, this is the normal condition in seeded varieties of *Vitis vinifera*. Even in seeded varieties, a high percentage of abnormal embryo sacs occurs.

Within two or three days the pollen tubes can be seen traversing the nucellar cap and entering the egg apparatus.

Almost immediately after the entrance of the pollen tube the secondary nucleus, instead of degenerating, as reported by Oinoue, divides and redivides. When pollen tubes could not be found in several cases examined in which the stigma had apparently been injured, the secondary nucleus remained undivided.

Development beyond this stage varies greatly. In normal grape seeds the endosperm does not encroach much upon the nucellus until the seed has reached approximately its full size, and the embryo hardly begins its development for perhaps several weeks after fertilization. Sultanina seeds frequently develop some endosperm tissue, and embryos of over a hundred cells have sometimes been observed.

However, the abnormal conditions which are correlated with the final degeneration in Sultanina seeds can always or nearly always be readily detected even at the time of anthesis. In the region of the micropyle, among other abnormalities, the inner integument is much exserted beyond the outer and often curved back up the side of the ovule. In a normal *Vitis vinifera* ovule the outer integument at least equals the inner. Within two weeks after fertilization the entire seed coat development has very obviously gone astray.

It is not claimed that the abnormal physiological conditions in the Sultanina ovule never prevent the formation of a perfect embryo sac, but the author believes that as a rule, at least one normal embryo sac has been developed and fertilized in each normal Sultanina berry.

In the Black Corinth, on the other hand, there are, as a rule, no normal embryo sacs. Occasionally a seeded berry sets, and in the course of an examination of thirty or forty berries two or three embryo sacs appeared to be normal. But ordinarily all four embryo sacs are in various stages of disintegration at the time of anthesis. The polar nuclei have almost never fused. The egg apparatus may be missing entirely or in various stages of degeneration. Often the only nuclei in the sac are three or four clumped together in the center of the sac. The pollen tubes enter the locules in the great profusion characteristic of seeded varieties of grapes, but they seldom enter the micropyle and only rarely penetrate the nucellar cap.

Further details will be published later.

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PHOTOPERIODISM AND CHRYSANTHEMUM PRODUCTION

THE production of flowers early in the season when prices are usually highest is one of the problems of the present-day florist. This end is quite often obtained by early planting, heavy feeding and correct pinching of buds.

With chrysanthemums in Colorado these practices do not produce flowers early enough to be of material value economically. Chrysanthemums yield readily to shortening of the daylight period and earlier flowering results from shading. While this fact has been