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.

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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

known for a number of years, to the writer's knowledge it has not been made use of commercially. The past two years this practice has been carried out on an extensive scale in Denver greenhouses.

A greenhouse of 8,000 square feet of glass was equipped with black cloth shades that covered the entire crop of chrysanthemums in this house. These shades, or curtains, slid on rings on wires inside the house and could be quickly drawn off and on. The shading was begun on July 10 and continued until the terminal buds were well formed. The shade was placed over the plants about 4 P. M. and left there until about 8:30 A. M. the following morning. This practice brought chrysanthemums into bloom and on the market from 14 to 50 days earlier than the same varieties planted at the same time but not shaded.

Another house of 10,000 square feet of glass was arranged and similarly planted to the pompon type of chrysanthemum. These plants produced flowers from 16 to 30 days earlier than the same varieties without shade.

The quality of flower, length of stem and keeping quality is apparently unaffected by this practice of shading, especially in the midseason or late varieties. The earlier varieties, when shaded, however, tend to have smaller flowers and shorter stems.

The advance of the cutting period is of great economic importance, since it places flowers on the market when few or no flowers of that kind are to be had, with resultant favorable prices.

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SCIENTIFIC BOOKS

Bibliography of the Honourable Robert Boyle, Fellow of the Royal Society. By J. F. FULTON, M.A. Oxon. (Oxford Bibliographical Society, Proc. and Papers, Vol. 3, Pt. 1, 1931). Oxford, Oxford University Press, 1932.

THE handsome and scholarly publication before us for review calls vividly to mind the fact that the art and the science of bibliography have not as yet passed entirely from the minds of scholars. Nor has the appreciation of first-rate work waned because of the fact that so little bibliographical work is done. Of course there are "types" of bibliographical production ranging from a mere author-title compilation to extended and annotated lists and even abstracts. These, however, are good enough for ordinary scholarly and commercial use, but when it comes to preparing a bibliography such as has Dr. John F. Fulton, of the School of Medicine of Yale University, we are then dealing with the highest type of scholarly bibliography —compiled primarily for the critical scholar and librarian. Dr. Fulton has shown many fine traits in the preparation of his study of Honorable Robert Boyle's work. He not only has examined each of 258 items, but he has virtually weighed each one. There is a total of 367 entries in the bibliography. The results of his study are clearly shown by the exactness of the bibliographical data assembled. In his introduction, Dr. Fulton says:

> In order to disclose these things a modern bibliographer must "anatomize" his books: he dissects them with infinite patience, lifting their epidermis to find what lies beneath; he is concerned with their joints and ligaments, and has great delight in discovering parts which have been artificially replaced; he seeks for errors in the hand of the maker, but he views with charitable amusement all signs of human frailty. Bibliography is indeed an all-absorbing occupation, but its devotee is frequently face to face with those who fail to understand the source of his enjoyment. A mere list of bibliographical idiosyncrasies with mistaken signatures, pagination, and gatherings, has little appeal to any one not a collector of books; and however much a bibliographer may pride himself on "purity" he has difficulty in justifying his existence if he fails to make himself useful to those not pursuing his specialized field. He must reveal something more than the mechanics of bookmaking. He can endeavor to assess the importance of a book; he may say how the author came to write it, or investigate the influence which it exerted upon his contemporaries. With Boyle one can sometimes deal with these and related questions, and I have attempted to do so in the preliminary notes concerning each of his separate works. With his more obscure writings, however, the task has been difficult, and many of my notes will be found incomplete and inadequate.

The question as to the necessity of this sort of work is answered in the publication itself. The apparently growing interest in the life and work of Robert Boyle has called for further examination, particularly from the point of view of the historian of science. His work was the link between the alchemy of the Mediaeval Age and the chemistry of the modern period, which every reader of the "Sceptical Chymist" will discover for himself. He was one of the illustrious founders of the Royal Society of London, together with Wren, Hooke, Ashmole, Barrow, Wilkins and others, who represent the pioneer age of scientific progress in Great Britain.

The complete bibliography of the writings of Boyle reveals subjects of varied character, showing him to be almost encyclopedic in learning. Dr. Fulton has