

that of the controls; in the cucumbers, the percentage of increase over the controls was about 34 per cent. Dry weight percentages of wet weight and ash weight percentages of dry weight were greater in the rayed plants than in the controls, the former as much as 19 per cent. greater in the tomatoes, the latter as much as 13 per cent. greater. Numbers of leaves were greater in the rayed plants.

It is interesting to note that the incremental method induced greater increase in growth than did the constant period method, when the quartz-lite filter was used; with the unscreened arc, the injurious effects were considerably reduced by the former method of treatment. At 50 inches, in some cases, the constant period method seemed actually to retard growth slightly, even when the lamp was screened, whereas the incremental treatment caused the plants to grow somewhat more rapidly than did the controls. The reaction in the case of the incremental method seems to be of a two-fold nature: first, a gradual adjustment to the new environmental factor, then an increased growth rate under the influence of the gradually increasing intensity of that environmental stimulus.

This work was carried out under the direction of Dr. Ernest S. Reynolds. A detailed report is to be published later.

HARRY J. FULLER

THE HENRY SHAW SCHOOL OF BOTANY,
WASHINGTON UNIVERSITY

HETEROTHALLISM IN PUCCINIA CORONATA

THE sporidium of *Puccinia coronata* Corda, on a *Rhamnus* leaf, germinates by forming a short beak, pierces the outer wall and enters the epidermal cell. The sporidial nucleus usually divides before entry. In the epidermal cell the fungus grows into a primary hypha of 4 to 6 cells, from each of which a branch forms which penetrates to the subepidermal region and develops there into haploid mycelium.

The mycelium spreads between the epidermis and the palisade, forcing the two layers apart and forming a continuous mat or stroma several cells thick. From this stroma hyphae grow down between the palisade cells into the spongy mesophyll. Haustoria may be unbranched or may fork dichotomously once, twice or even three times.

On the subepidermal stroma the pycnia form at fairly even intervals. Later a similar but smaller stroma forms next the lower epidermis and a few pycnia appear on it, which open onto the lower surface of the leaf. In old infections the whole upper stroma with its pycnia may peel off leaving the palisade layer exposed.

Puccinia coronata is at least partly, perhaps wholly, heterothallic. Eight *Rhamnus* plants bore 1 infection each. They were carefully isolated. Seven of the 8 remained sterile, that is, produced no aecio-spores. On another plant bearing 6 infections the pycniospores were well mixed. Five of the 6 produced open aecia.

The sterile infection produces aecia which reach a considerable size but they form no spores. In these sterile aecia, however, there appear at a certain stage of development cells with 2 or 3 nuclei. These cells grow irregularly and their nuclei increase in number, but sooner or later they deteriorate and die. Multinucleate cells are to be found in practically 100 per cent. of all the older sterile aecia. A few of these multinucleate cells survive to a great age. In one sterile infection 62 days old there were living multinucleate cells of monstrous size, highly irregular in form and each containing 15 or 20 nuclei.

In the fertile infection the aecia produce spores regularly. Here are to be found an abundance of cells with 2 nuclei, some with 3, very rarely 1 with 4 or 5, but never the monstrous multinucleate cells so characteristic of sterile aecia.

The point at which the sporophyte is initiated in the fertile infection would seem to be variable. A few binucleate cells have been observed near a pycnium, in the subepidermal stroma, in hyphae between palisade cells, in the mycelium of the spongy mesophyll and above the aecium. Rarely a cell fusion can be seen between hyphal cells at some distance from an aecium. Cell fusions are most frequently found at or near the upper edge of the aecium, several cells above the sporogenous layer. In the majority of cases several cell divisions take place between the initial binucleate cell of a series and the basal cell which will produce the spores. Basal cells and spores are usually binucleate, rarely tri- or quadri-nucleate.

RUTH F. ALLEN

BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE, AND
CALIFORNIA AGRICULTURAL
EXPERIMENT STATION,
BERKELEY, CALIFORNIA

BOOKS RECEIVED

- HOUSTON, R. A. *Intermediate Physics*. Pp. xviii + 638. 588 diagrams. Longmans, Green. \$4.20.
JEANS, SIR JAMES. *The Mysterious Universe*. Pp. viii + 163. Illustrated. Macmillan. \$2.25.
KINGSLEY, NATHAN H., and EDWARD J. MENGE. *Laboratory Studies, Demonstrations, and Problems in Biology*. Pp. 208. Bruce. \$1.28.
Rockefeller Foundation, *Annual Report, 1929*. Pp. viii + 402. Rockefeller Foundation.
WASHINGTON, HENRY S. *The Chemical Analysis of Rocks*. Fourth edition, revised. Pp. xvi + 296. Wiley. \$4.00.