The pupa is capable of some limited movements owing to the fact that some abdominal muscles are carried over from the larva. The muscles of the legs, however, are developed only after the cuticle is laid down and therefore lack the tonofibrillar attachments to the pupal cuticle, so that the pupa is quite unable to walk, swim or use its legs in any way.

3. Thousands of insects have been recorded hibernating as pupæ. Some of these no doubt do so; for example, some Pieridæ. But a high percentage of the records are incorrect and refer, in point of fact, to adults enclosed in the effete pupal cuticle and not to pupæ.

In order to avoid circumlocution, the term 'pharate' (φαρος, cloak, *pharus*, *pharata* (cloaked), pharate) is proposed to designate the phase of an instar which is enclosed within the cuticle of the previous instar. The relation of the 'prepupal instar' of Imms[9] and others to the instars is shown in the figure, which represents only the usual sequence of moults in the Holometabola.

H. E. HINTON.

Department of Entomology,
British Museum (Natural History),
London, S.W.7.
Feb. 4.

[1] Snodgrass, R. E., "Principles of Insect Morphology" (1935).
[2] Miall, L. C., *Nature*, **53**, 152 (1895).
[3] Poyarkoff, E., *Arch. Zool. Exp. Gen.*, **54**, 221 (1914).
[4] Imms, A. D., "A General Textbook of Entomology" (1934).
[5] Keilin, D., *Parasit.*, **16**, 240 (1924).
[6] Wigglesworth, V. B., "The Principles of Insect Physiology" (1939).
[7] Zavrel, J., *Publ. fac. sci. Univ. Masaryk, Brno*, **65**, 44, Fig. 10 (1926).
[8] Weber, H., "Lehrbuch der Entomologie" (1933).
[9] Imms, A. D., "Outlines of Entomology" (1942).

Oogamy in the Brown Alga *Halopteris*

SAUVAGEAU[1], from an examination of dried herbarium specimens, concluded that there was evidence that five species of *Halopteris* were oogamous, the best substantiated case being that of *H. hordacea* (Harv.) Sauv.[2,3]. No observations have hitherto been made on living plants of this species or on any of the other southern species suspected of oogamy. Using simple sea-water cultures, Sauvageau's findings have been confirmed in an intertidal form agreeing with *H. congesta* (Rke.) Sauv. and in a species from deeper water, presumably *H. funicularis* (Mont.) Sauv. Both species are common on the Wellington shores of Cook Strait, and, although asexual plants greatly predominate, sexual plants have been found in both winter and summer.

In both species the short-stalked oogonia and antheridia are borne close together in the axils of branched laterals and are indistinguishable in their early stages. The mature oogonium is white, faintly flecked with brown, and dehisces by an apical pore. The naked egg is slightly constricted during its passage through the pore, although assuming a globular shape when free (diam. *c.* 100 μ). The protoplasmic contents of the antheridium remain white and much vacuolated until almost the full size (diam. *c.* 120 μ) has been reached. Then successive division of the contents takes place until the mature antheridium, which is of a rich orange colour, contains a mass of regularly arranged oblong protoplasts, each about 3 × 4 μ; dividing walls, which are at first distinct, are later no longer evident. Dehiscence is apical, not through separate pores[4]. The liberated sperms, which are colourless except for two or three dense chromatophores, rest a short time before assuming active movement. In cultures dehiscence occurs only in fairly strong light. The actual sexual fusion has not been observed, but healthy germlings develop when a culture contains but a branch from a single plant so that self-fertilization may be assumed. The zygote secretes a wall and, without much increase in size, quickly divides to form a brown cushion of small cells. Rhizoids grow out from one side, while the first erect shoot arises from the opposite side, although similar shoots may later originate from parts of the rhizoid system. The embryos agree closely with those found entangled in the sexual spikes of *H. hordacea* and figured by Sauvageau[1].

Sporelings have been grown in culture from asexual plants of various species, including *H. funicularis* and *H. congesta*. The spore mass emerges through an apical opening in the unilocular sporangium and rests briefly before the zoospores (diam. *c.* 10 μ) round off and swim away. In plants collected from drift or kept too long out of water, all or part of the spore mass may fail to separate into zoospores, but the multiple fusion reported by Clint[5] in *Sphacelaria bipinnata* was not observed. The clumped spores frequently become flattened and polygonal and then jointly form a basal disk much like that shown in Sauvageau's figures of *H. scoparia*[6], for which, however, an entirely different origin is postulated.

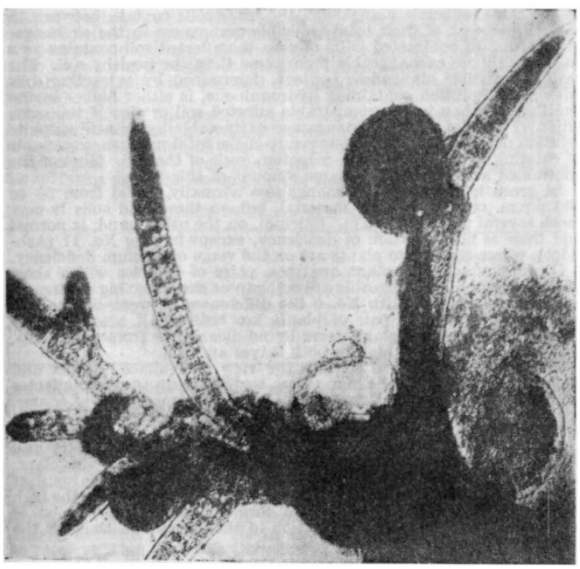
Active zoospores soon come to rest, secrete a wall, and, as in *S. bipinnata*[4], germinate to form a simple filament which when two months old may consist of as many as 30 cells, a few of which show longitudinal divisions. A few of the most advanced sporelings have a stouter uniseriate lateral arising from the primary filament.

Chromosome counts have not yet been made, but the known facts are consistent with the theory that a diploid sporophyte bearing unilocular sporangia alternates with a morphologically similar haploid gametophyte bearing antheridia and oogonia. In related plants[6,7] reduction division has been shown to occur at the first division of the sporangium. The experimental confirmation of the occurrence of oogamy and the bulky embryo point to strong contrasts within the Sphacelariales and provide further links between that order and the oogamous Dictyotales. A more detailed and fully illustrated account is in course of preparation.

LUCY B. MOORE.

Botany Division,
Plant Research Bureau,
Department of Scientific and Industrial Research,
Wellington, New Zealand.
Jan. 17.

[1] Sauvageau, C., "Remarques sur les Sphacélariacées", **2**, 321 (Paris, 1904).
[2] Fritsch, F. E., *Ann. Bot.*, N.S., **7**, 63 (1943).
[3] Fritsch, F. E., "The Structure and Reproduction of the Algæ", 2 (Camb. Univ. Press, 1945).
[4] Papenfuss, G. F., *Bot. Not.*, **437** (1934).
[5] Clint, H., *Publ. Hartley Bot. Lab.*, No. 3 (Liverpool, 1927).
[6] Sauvageau, C., *J. de Bot.*, **11**, 2, 44 (1909) (not seen).
[7] Mathias, W. T., *Publ. Hartley Bot. Lab.*, No. 13 (Liverpool, 1935).



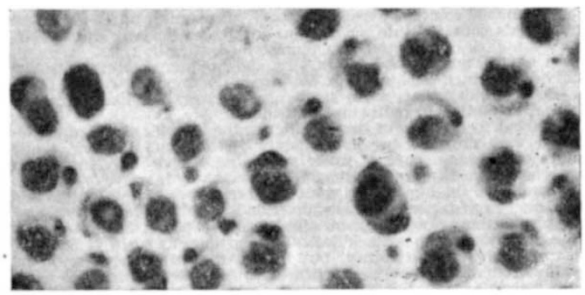
PORTION OF SEXUAL SHOOT OF *Halopteris congesta* (?), ISLAND BAY, WELLINGTON, NEW ZEALAND. AT THE BOTTOM A CLOUD OF SPERMS ESCAPING FROM AN ANTHERIDIUM; IN THE MIDDLE AN EMPTY OOGONIUM SHOWING AT THE TOP THE OPENING THROUGH WHICH THE EGG RESTING AGAINST THE BRANCH ON THE RIGHT WAS SEEN TO EMERGE. (*Photo: W. White.*)

Golgi Apparatus by Phase Contrast Microscopy

THE phase contrast optical system[1,2,3,4] is little known in Britain, and not many observations[5,6] of biological material by means of it have been reported. The system enables many structural details of living cells to be seen without preliminary treatment of any kind.

Recently, one of us (A. T. B.) procured a condenser fitted with annular slit apertures and objectives 20×, 40× and *HI* 90× equipped with ¼λ-phase retardation disks from the Carl Zeiss works at Jena. This was fitted to a standard monocular microscope.

It occurred to us that its application to cytological problems, with special reference to the Golgi apparatus, might yield some interesting results. This optical system was only available to us in this department for a few days, and for this reason the simplest cytological material only could be investigated, but the results obtained have been promising.



LIVING UNSTAINED SPERMATOCYTES OF *Lumbricus* SHOWING NUCLEUS AND GOLGI APPARATUS AS SEEN UNDER THE PHASE CONTRAST MICROSCOPE. (× *c.* 1,000.)

It is well known that in fresh unstained preparations of the male germ cells of many invertebrates[7] the Golgi apparatus is faintly visible. Fresh unstained smears of seminal vesicles of *Lumbricus* were examined under *HI* 90× objective. With the ordinary oil immersion lens the Golgi apparatus can just be seen as a bright area in close apposition to the nucleus. Under the phase contrast system, however, the Golgi apparatus stands out as a quite black structure comparable with the cytological picture obtained by the Weigl or Kolatchew methods.

In spermatocytes the Golgi apparatus appears as a typical sphere with a light centre comparable with the osmiophile and osmiophobe regions of the 'classical' apparatus. In spermatids it can be seen as a dark, flattened crescent resting on a clear sphere closely applied to the nucleus.