NOTES.

THE PLURILOCULAR SPORANGIA OF PETROSPONGIUM BERKELEYI.—While collecting Algae in July last year at Murlough Bay and the Giant's Causeway in the County Antrim, Mr. E. M. Holmes, with whom I enjoyed the privilege of collecting, kindly pointed out to me some specimens of *Petrospongium Berkeleyi*, Naeg., growing on the rocks very near low water-mark at Murlough, a little to the east of Miss Clarke's cottage; later I found it at the Giant's Causeway, but nowhere was it abundant.

The late Professor Harvey, writing of this plant (*Phycologia Britannica*, 1846-51, Pl. CLXXVI), says, 'On the west coast of Ireland it is plentiful in several places, and probably is pretty generally distributed along our shores, being overlooked on account of its being often nearly the colour of the rock on which it grows, and resembling in its fleshy appearance and feel the collapsed body of the common *Actinia*.' It belongs to the division of Brown Algae or Phaeophyceae, which are usually considered to multiply asexually by means of zoospores produced in large numbers in unilocular sporangia; these zoospores show a well-marked red eye-spot, two laterally fixed cilia, and a chromatophore. A sexual method of reproduction also obtains among many genera, consisting in the conjugation in pairs of isomorphous planogametes with the formation of zygotes. To this division, the Phaeosporeae, belong the well-known Tangles or Oarweeds of our coasts; together with a host of more inconspicuous and delicate forms differing very much from one another in habit and mode of growth.

Although each species is supposed theoretically to have both asexual unilocular sporangia and sexual plurilocular sporangia or gametangia, each cell of the latter rarely giving rise to more than one zoospore or gamete, there is a large number of plants in which only one kind of reproductive organ has as yet been observed. It was with a view of looking for the plurilocular sporangia in *Petrospongium*, which hitherto

[*Annals of Botany*, Vol. XIII. No. 11. September, 1899.]

have not been observed, that I collected a quantity of material for microscopic investigation, preserving it for this purpose in 3 per cent. formol.

A few weeks ago, when examining a series of sections prepared from this material, after being hardened in alcohol, stained in bulk in Delafield's haematoxylin, and embedded in paraffin in the usual way, I found a small number of plurilocular sporangia taking the place of a number of peripheral filaments, in close proximity to unilocular sporangia, both occurring on the same plants. At first I was in doubt as to their real character. In one section the plurilocular

Unilocular and plurilocular sporangia.

sporangia were observed to arise more or less at right angles from a basal filament running nearly parallel to the surface of the thallus, recalling the characters of a parasitic *Ectocarpus* or *Streblonema* growing attached to its host-plant; on more careful observation, however, I convinced myself of the direct transformation of the peripheral filaments giving rise to these sporangia, which were much fewer in number than the unilocular sporangia. They varied as regards shape and size, measuring from $.0459$ mm. to $.1134$ mm. long, the average breadth being $.0108$ mm.

An interesting point observed in the sporangia is the difference in size between the loculi of the same sporangium; and since each loculus usually contains but a single zoospore, there is a corresponding

inequality of size among the zoospores, and one is tempted to look for a physiological distinction between them.

The unilocular sporangia arise from the cells at the base of the cortical filaments, and do not ever seem to arise from the apices of the latter. The cortical filaments divide in an irregularly dichotomous manner, and in a few cases the apical cell of a filament becomes enlarged and divides so as to form two tiers of four cells each; this may represent a stage in the development of a plurilocular sporangium, although no intermediate stages were observed.

Petrospongium is closely allied to *Leathesia*, differing from it in form, consistency, and colour, and being at all stages in its life-history solid and fleshy; it would also seem to be nearly allied to *Castagnea* on account of the similarity between their reproductive organs, and also to *Mesogloia*. If we assume that it is not impossible that *Mesogloia* may give rise to plurilocular sporangia by a modification of some of its peripheral filaments, there is no very clear distinction between the three genera except one of habit and form, and these differences may be the result of a different mode of life.

Since the researches of Thuret in 1851, very little attention was given to the behaviour of the zoospores of these sporangia until, in 1881, Berthold demonstrated at Naples the fusion of two zoospores from the plurilocular sporangia of *Ectocarpus siliculosus*, thus proving that they were true gametes which produced zygotes after fusion. The gametes showed a physiological distinction during the process of conjugation; one of them became fixed and lost its cilia, while the other remained motile, so that we may speak of the former gamete as female and the latter as male.

Quite recently the accuracy of these statements has been doubted by Oltmanns, who attributed them to erroneous observation; however, Sauvageau, and more recently Kuckuck, have succeeded in repeating Berthold's observations, although Sauvageau says that conjugation takes place between the gametes much less frequently than Berthold found to be the case, a difference which he considers as depending partly on locality and time of year¹.

Kuckuck's experiments with the same plant were unsuccessful: but in the autumn of 1897 he made experiments with the zoospores from the plurilocular sporangia of *Scytosiphon lomentarius*, and in

¹ Oltmanns has since withdrawn his objections. Flora, 1899.

many instances immediate conjugation was observed between the gametes. He further found that the zoospores which failed to conjugate immediately after being set free from the sporangium, very soon entered on the resting condition, and in this state were incapable of being fertilized.

This fact leads us to inquire if, when the zoospores from the plurilocular sporangia fail to conjugate—assuming for the moment that in all cases they are true gametes—they perish; or are they capable of germinating parthenogenetically and giving rise to healthy plants? Sauvageau has been enabled to settle this question, and to prove that in *Ectocarpus virescens*, at any rate, these zoospores are not obligatory gametes, in the sense that they must conjugate or else perish; for after escaping from the plurilocular sporangia they move about for some time, and then become fixed, and later on germinate 'with the greatest ease and regularity.'

The researches of Berthold, Sauvageau, and Kuckuck, would seem to place beyond all doubt the true sexual nature of the conjugating gametes of *Ectocarpus siliculosus* and *Scytosiphon lomentarius*; but, in other cases, not yet fully examined, it is impossible to say definitely whether we have to deal with asexual zoospores, or with zoospores possessing a potential sexuality, on account of the great variability of their behaviour after they are set free from the sporangium.

Having regard to the great similarity between the antherozoids of *Ectocarpus siliculosus* and those of *Fucus*, and to the resemblance between the modes of the sexual process in these plants, there seems to be no reason why the Phaeophyceae should be divided into the two series, Phaeosporae and Phaeogamae.

My best thanks are due to Professor Johnson, who suggested to me some time ago to examine material of *Petrospongium* for plurilocular sporangia, *P. Berkeleyi* being found plentifully at low water at some points on the Irish coast.

H. HANNA.

Royal College of Science, Dublin.

SOME REMARKABLE MARINE MONOCOTYLEDONS IN JAPAN.—A discovery of unusual interest to Japanese botanists was made in the Luchuan Islands. On my botanical tour in the Yaya-yama Archipelago, situated close to Formosa, I found a remarkable