S. W. Ellis & Dr K. H. Goulding (Hatfield Polytechnic)

The effects of pesticides on *Chlorella*

The effect of 1, 1, 1-trichloro-2, 2-bis-(p-Chlorophenyl) ethane (DDT), gamma-1, 2, 3, 4, 5, 6-hexachlorocyclohexane (LINDANE), 0,0-dimethyl 1,2 di(ethoxycarbonyl) ethyl-1,2 phosphorodithioate (MALATHION), and 3-(3,4-dichlorophenyl)-1,1-dimethylurea (DIURON) on the growth and metabolism of *Chlorella* (CCAP 211/8p) was examined. DDT at less than 1 ppm had no effect on growth. However, at 1 ppm growth was inhibited for four days but, when growth commenced, it did so at a rate comparable with the control. Final cell yield was the same as the control. The degree of inhibition was shown to be dependent on the initial inoculum size and on the time of sampling. Lindane and Malathion had no effect on the growth of *Chlorella* irrespective of inoculum size and sampling time. Diuron was shown to markedly inhibit growth even at 0·1 ppm. Again the degree of inhibition was shown to be dependent on inoculum size and sampling time.

The effect of the four pesticides on the photosynthetic fixation of $^{14}CO_2$ was investigated. After 1 h exposure to 10 ppm DDT no effect on $^{14}CO_2$ uptake was apparent. However, after 20 h exposure $^{14}CO_2$ fixation was inhibited by 28%. Lower concentrations of DDT had less effect. As with the growth studies, Lindane and Malathion did not effect $^{14}CO_2$ fixation while Diuron caused severe inhibition. At 10 ppm inhibition was 99% while at 1·0 and 0·1 ppm inhibition was 92% and 31% respectively.

Diuron also caused a shift in the products of $^{14}CO_2$ fixation from polysaccharide to water soluble materials.

Chlorella was shown to rapidly accumulate ^{14}C-DDT. Tentative evidence that this accumulation was a rapid two phase process was presented.

Dr P. Edwards (Rutgers University, New Brunswick, N.J., U.S.A.)

The effects of pollution on benthic marine algae in Co. Durham

Bellamy *et al.* claimed at the 1967 meeting of the British Phycological Society that there has been over a 70% reduction in common benthic algae in Co. Durham during the last 100 years. The majority of algal specimens collected over 100 years ago have been re-examined in the light of modern taxonomy. Intensive field work was conducted on a seasonal basis in addition to provide contemporary records for comparison. It is now estimated that there has been only about a 16% reduction in common benthic marine algae in Co. Durham over the past 100 years.

Dr J. H. Evans (Royal Holloway College, University of London)

Biomass, cell volume and number analysis with the Coulter Counter

Extensive comparative investigations of traditional and electronic methods for the quantitative determination of phytoplankton indicate the generally higher precision and reliability of the latter method. In addition to a single-figure result—T.P.V. (total particulate volume), usually expressed as $\mu m^3 \times 10^8$ ml^{-1}—which can be used widely for spatial and temporal comparisons, particle numbers and/or volumes from selected size ranges may be abstracted from each sample analysis. These selected results may often be fitted to particular populations by establishing visually the size range within each population. Penetration of mucilage by the electrolyte (usually 0·5% Nacl) varies from one mucilaginous species to another so that, for example, *Microcystis flos-aquae* (Wittr.) Kirchn. shows no penetration while *Eudorina elegans* Ehrenb. shows penetration to the cell membranes. Intensive study of single populations, especially from uni-algal culture, indicate high precision of size determination with the Coulter Counter. The size ranges of the more commonly occurring freshwater phytoplankton taxa have been investigated.

W. F. Farnham (Portsmouth Polytechnic) and Mrs Linda M. Irvine (British Museum, Natural History)

The addition of a foliose species of *Grateloupia* to the British marine flora

Farnham & Irvine (1968) reported the occurrence of unusually large plants of *Grateloupia filicina* (Lamour.) C. Ag. around Portsmouth. Another large red alga, first found in the area in 1969, has proved to be a foliose member of the same genus. Plants occur around the Solent and in Langstone, Chichester and Pagham Harbours, in the lower littoral and sublittoral.

The thallus is multiaxial, with a filamentous medulla containing characteristic stellate cells. The reproductive structures are also diagnostic of the genus *Grateloupia*, family Cryptonemiaceae. The carpogonia and auxiliary cells are found in distinctive ampullae. The mature cystocarp shows a filamentous pericarp and the carpospores are released through an ostiole. Tetrasporangia are cruciate. Spore-development is similar to that of other *Grateloupia* spp. (Chemin, 1937).

Ardré & Gayral (1961) concluded that most foliose *Grateloupias* in the Atlantic and Pacific represent one polymorphic species, *G. lanceola* J. Ag. According to Dawson *et al.* (1964), this also includes *G. doryphora* (Mont.) Howe, which provides the earliest name for this complex.

The foliose *Grateloupia* reported here belongs to the *G. doryphora* complex. As far as we have been able to ascertain, this species has not hitherto been collected in Britain and it appears to be a recent introduction. The nearest previous record is for southern Spain, (Gayral, 1958).

Dr P. Fay (Westfield College, University of London)

Some aspects of heterotrophy by blue-green algae

Anabaenopsis circularis West and *Chlorogloea fritschii* Mitra appear green when grown chemoheterotrophically in the dark on 0·03 M-glucose and 0·01 M-sucrose, respectively, in a medium free from combined nitrogen, indicating that pigment synthesis in these algae is neither dependent on light nor induced by light of some specific wavelength. The concentration of photosynthetic pigments was found to be slightly lower though still in the range present in algae grown in the light. Both species differentiate heterocysts during growth in the dark, and the course of heterocyst production is closely followed by that of nitrogen-fixing activity suggesting that compartmentation of the nitrogen-fixing enzyme system occurs also under conditions when cellular O_2 concentration is not effected by O_2 evolved in photosynthesis. Pigment synthesis is apparently dependent on nitrogen fixation as the variations in the concentration of pigments have followed, with a slight delay, a pattern similar to that of nitrogenase activity.

Both algae can immediately incorporate $^{14}CO_2$ on exposure to light following a prolonged period of cultivation in the dark. This supports the assumption that their photosynthetic machinery, including photosynthetic pigments, components of electron transport system and Calvin cycle enzymes, is reproduced during chemoheterotrophic growth in the dark. Sugars which support growth and nitrogen fixation in the dark have a marked stimulatory effect on the rate of photosynthetic CO_2 fixation by the photoautotrophically grown algae, and enhance acetylene reduction (nitrogen fixation) in the light as well as in the dark.

It appears that the biological value of facultative heterotrophy by blue-green algae is not solely in their ability of limited growth in the dark or in dim light but also in being able to generate a potential for immediate active photosynthesis on exposure to light. Moreover, the presence of dissolved organic substances may stimulate photosynthesis and nitrogen fixation by the photoautotrophically grown algae in light and may permit nitrogen fixation to continue at a comparable rate during the nocturnal dark period. The abundant occurrence of blue-green algae in waters with high concentration of dissolved organic matter may therefore reflect their ability to utilise organic substrates in the light as well as in the dark period.

Dr C. E. Gibson (Freshwater Biological Investigation Unit, Greenmount College, Antrim)

Seasonal variations in the morphology of *Oscillatoria redekei* Van Goor

Filaments of the planktonic blue-green alga *Oscillatoria redekei* Van Goor in Lough Neagh show predictable seasonable changes. The average filament length rises during the early part of the year and decreases during the summer. It was suggested that the average filament length may be related to the nutrient supply from the lake water, that a population with short filaments may be suffering from nutrient stress.

Possible mechanisms for the replication of filaments were discussed. If the division of filaments into two daughter halves involves the sacrifice of an intercalary cell, as has been suggested for another blue-green alga (Lamont, 1969) then the organic material released in this way may be of ecological significance. The possible adaptive value of changes in filament length was considered. It seems unlikely that any change in the flotation or sinking rate is great enough to be of consequence.