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THE PHYCOLOGIST

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The Newsletter of the British Phycological Society

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Editor:
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Editorial

The UK Governments recent announcement of a multi-million pound increased investment in science must have heartened a number of researchers throughout the country. What was particularly pleasing about this announcement was the increased funding for postgraduate students and the recognition that successive cohorts of young researchers had been under-funded for several years. Partly as a consequence of this the attractiveness of a career in research had declined dramatically. It has always been surprising, given that postgraduate research must account for the major part of research output in the UK and in other European countries, that these students have been so under funded. Just prior to this announcement the Irish government also announced what, for them given past expenditure on scientific research and/or development was a massive, apparently unprecedented, increase in funding for key research areas, particularly biotechnology. What was disappointing, however, was the absence, in this package, of a significant increase in postgraduate research funding to complement this investment. Despite the recent UK announcement, my impression, based on anecdotal information, is that support for postgraduate research in these Islands still falls far short of that made available by our European counterparts. One wonders, therefore, whether we will ever get the best return out of any new monetary investment, unless this is complemented by a comparable investment in able postgraduate researchers. Failure to do this in the short term has even more serious consequences in the long term, as we could be left with a workforce that does not have the skills to realise the potential that extra funding could bring. It's all very well talking today about a booming economy it's another thing sustaining that boom for the future.

Sometime ago I indicated that I was trying to commission a series of articles on useful techniques, under the heading, 'Phycological Tips'. The first of a series of three, appearing in successive

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editions of 'The Phycologist' starts in this issue. The three articles deal with how to improve your use of the light microscope and have been written by **Reimer Simonsen**. It is clear to me that, despite recent advances in microscope technology, the light microscope is still one of the workhorses of any laboratory and yet we have forgotten, or in many cases never learnt, how to use this instrument to its greatest capacity. Hopefully, the information in these articles will prove useful.

Finally, this is also the time to think about nominations for the BPS council. Vacancies exist for a total of three new ordinary members. Further information is given on page 7.

HISTORICAL CORNER

Patrick Geddes- 'That smart fellow'

The new year's Honours list for 1932 included a knighthood for Patrick Geddes 'for services to education'. His title came just in time-he died in the following April. Whilst his life's work spanned education, town planning and sociological matters, as a young man some 43 years beforehand he had earned his niche in the history of Phycology.

He was born in 1854 in Ballater, Aberdeenshire. In 1857 the family moved to Perth and in due course he attended the Academy there, being more interested in the 'modern' side and becoming an avid reader. On leaving school and encouraged by his father (a firm believer in self-education) he followed a number of exploratory paths- art school, cabinet making, banking. Then in 1874 both agreed that his future lay in the academic world. With his botanical interests now foremost he entered Edinburgh University in October 1874 to study under the Regius Professor of Botany, J Hutton Balfour ('Old Woody Fibre' to his students). In Gedde's own words 'but the briefest of contacts with the formalistic treatment then paramount there, disillusioned me, even to immediate revolt'. He returned to Perth after one week. He had found another vision of Biology through reading T.H. Huxley's *Lay Sermons* and he now knew that scientist under whom he must study. This decision led to some heart searching by his parents. They were members of the Free Kirk; his father was an Elder and his mother had long hoped to see her son one day in the pulpit. For him to go to London was acceptable but to place him under the tutlage of Huxley was very different. The agnostic views of 'Darwin's bulldog' were well known in Scotland, as well as his attitude to orthodox religious beliefs. In the end, with some trepidation, they let their son follow this new path. After a false start he now seemed set on an academic career.

Geddes moved to London late in 1874. Huxley was Professor of Natural History in the Government School of Mines, and in the third year of occupation of new accommodation in a red brick and terra cotta building in South Kensington. On the top floor he had a large domed lecture theatre and a large teaching laboratory, this last his particular joy. Here he had a more spacious domain than the cramped quarters that had been his in the School's old building in Jermyn Street. Here, with support from the Science and Art Department of the Government, he set out annually to produce his 'Scientific Missionaries to convert the Christian Heathen' – science teachers, the need for which had become all too obvious after the passing of the 1870 Education Act. Geddes had to spend his first academic session in making up the deficiencies in his knowledge of the physical sciences. His studies under Huxley commenced with the 1875-76 session, a morning lecture (of unpredictable length) during the winter and the laboratory open all day and every day, winter and summer. In Geddes's own words 'here was the very first of laboratories, as also of lectures truly and broadly biological; and thus with our initiation to not only elementary, but elemental, understanding of the various viewpoints of the sciences'. It was a regime exactly suited to Geddes's active and enquiring mind. Towards the end of the 1876-77 session he was set a small scientific task to examine the radula action of a whelk and a limpet, on the muscular control of which Huxley had his own ideas. Geddes's careful dissections showed that his mentor's pet

theory was wrong- much to Huxley's delight- "Pon my soul you're right! You've got me! I was wrong! Capital! I must publish this for you!' The correction was published with full acknowledgement to Geddes and using his drawings. Henceforth Geddes was 'that smart fellow' to Huxley and his associates.

Throughout his time at South Kensington Geddes had been fascinated by the microbial world of the 'Infusoria', in which the borderline between plants and animals seemed to be ill-defined. During the 1877-78 session an event took place which was to remain for him ' a vivid and memorable lesson in biology'. In the summer of 1877 he was seeking new academic pastures, with encouragement and help from Huxley. He spent a short time in Cambrdge, but then felt that Continental schools might be more advantageous. Huxley now suggested a year in another London laboratory and got him a short term scholarship to work at Universtiy College London under J.S. Burden-Sanderson, Jovrell Professor of Physiology, and E.A. Schager, Assistant Professor. Here one day he was occupying some spare time examining a sample of pond water. The first slide revealed nothing more exciting than some euglenoids and motile bacteria. He was about to remove the slide when someone gently nudged him aside. A beard appeared over his shoulder. It was Charles Darwin on one of his rare visits to London, and who had entered unobtrusively. Darwin looked carefully into the microscope, silently at first, then called out excitedly 'I say! They're moving- they're moving! Sanderson! Sanderson! Come and see- they're moving! Look at it!' The lesson was one never to be forgotton. The great man, now in his 69th year, could still be thrilled by seeing some wriggling algal cells in a drop of water. From now on the examination of any slide was to be a unique event.

Towards the end of the 1877-78 winter Geddes suffered a 'sharp illness' of an undefined nature. Medical advice was that he should seek a complete change from his indoor academic work in London. Again Huxley came to his aid, virtually ordering him to spend the Easter vacation at the Roscoff Marine Biological Station on the coast of Brittany. This one visit was not enough. At the end of the academic session he returned to spend the summer at the laboratory. He joined in the many laboratory activities, dredging from a boat and shore collecting. He also made his first independent biological discovery when studying the 'greening' of the intertidal sand accompanying tidal movements. This was due to a massive population of the small flatworm *Convoluta roscoffensis (C. schultzii)*. The green pigment was (in his own words) 'a true chlorophyll, having the usual solubility and fluorescence and giving a spectrum resembling that of vegetable chlorophyll'. The animals could also produce oxygen and accumulate starch in sunlight. Geddes considered that this was a unique example of a 'vegetating animal', basing his conclusion on five key observations:

1. The green cells 'are not irregularly scattered but form an almost continuous layer in every individual'.
2. They 'are not of definite shape, nor bounded by any cellulose coat, but are regularly ellipsoidal, semi-fluid, naked'.
3. They are 'rarely if ever to be seen multiplying by transverse division'.
4. They 'do not survive the death of the animal for any length of time'.
5. The pigment occurs as uniformly diffused though the semi-fluid protoplasm of nucleated and granular cells, not collected in granules as in plants'.

Hence to Geddes this was not an example of an 'animal lichen', since in lichens the algal component retains its integrity. His results were published in 1879 in *Archives de Zoologie Experimentale et Generale* and in the *Proceedings of the Royal Society*. He was now regarded in Europe as a brillant and up and coming biologist, to some even an emerging 'Scottish Darwin'. As expected, great interest was arousing by his 'vegetating animal', albeit with caution in some instances. Seemingly 'that smart fellow' had arrived. With such a growing reputation it would seem odd that one of his biographers should point out that for Geddes this work on *Convoluta* was 'his only biological contribution of a factual nature, all his subsequent work in biology being of another kind'.

In the spring of 1879 he received financial support enabling him to work at the Naples

Marine Biological Laboratory and in the summer he helped set up a course in Marine Biology at the University of Aberdeen. In the autumn he was awarded a small grant (£50) from the British Association to go to Mexico City, hence his accommodation was assured and there would also be a companion on some of the collecting expeditions, carried out on horseback. These were somewhat of an adventurous nature in an area well known for its banditry. When alone Geddes carried with him £5 as potential ransom cover- crosses at the tracksides were constant reminders of those less fortunate. Whilst some material was collected, the Mexican venture brought disaster. His sight deteriorated and he became blind, a condition probably resulting from many years of intensive microscope work and exposure to bright sunlight on the Mexican plateau. He spent some 10 weeks in this condition, his only consolation being from readings from his brother and sister-in-law. There was inadequate medical help and the constant fear that the condition was irreversible-his mother had become permanently blind in 1873. Eventually his sight began to return, sufficiently for him to return home in March 1880. In later years he was to describe this traumatic event in Mexico as 'the worst, yet best, experience in my life'. During his period in darkness he had been able to think and assimilate knowledge, with the result that one word was to describe his later work as thinking, namely, 'synthesis'.

On returning he found that any microscopical examinations and fine experimental work brought on severe and incapacitating headaches. Hence any follow-up to his *Convoluta* resarch was now out of the question. It was for others to demonstrate that his 'vegetating animal' was a highly efficient obligate symbiosis between the flatworm and an alga, as a result of which the flatworm can grow in the laboratory phototrophically on CO_2, nitrate, phosphate and mineral nutrients in a sea water medium in light. F. Gamble and F.W. Keeble, as reported in 1907, succeeded in isolating the algal component, describing it as a quadriflagellate *Carteria*. They also achieved an 'artificial infection' by showing that the motile algal cells were attracted to the uninfected egg cases of the flatworm. More definitive studies from the mid-1960s on have verified the true nature of the association, with the alga identified as a new species of prasinophyte, *Platymonas convolutae*, by I. Manton and M. Parke in 1967. Both the fine structural changes in the algal cells within the flatworm and the biochemical aspects of the association are now the subject of standard texts.

Geddes returned to Scotland in 1880 as Assistant (Demonstrator) in Practical Botany in the University of Edinburgh under the recently appointed Regius Professor Alexander Dickson. In 1881 he set up a demonstration of the green *Convoluta* at a meeting of the Royal Society of Edinburgh in order to convince the Fellows present that the chlorophyll was an integral part of the animal and not of plant formation. In the same year he had received a much treasured letter from Charles Darwin, who had 'read with admiration your research on the results of the presence of chlorophyll in animals'. In 1981 Graham Gooday reported on the results of a re-examination of the green *Convoluta*, using present day methods where necessary (Nomarski interference and electron microscopy), and especially keeping in mind the five key observations quoted above on which Geddes had based his conclusion. The 1981 studies showed:

1. The cells of *Platymonas* once taken up by the juventile *Convoluta* divide and keep pace with the growth of the animal, coming to lie as a closely packed layer between the muscle cells over the entire surface, with the dense packing on the dorsal surface almost twice that on the ventral surface.
2. The algal cells lie as pleiomorphic protoplasts, probably in extensions of the original digestive syncitium, so giving a high area for cell-cell communications between symbionts.
3. In adult animals kept in the laboratory about 2% of the algal cells undergo mitosis.
4. In a present day culture medium a small proportion of the algal protoplasts will regenerate the thecae, flagella and eyespots.
5. The cup-shaped chloroplast enveloping the pyrenoid and nucleus is so orientated that the dome-shaped base of the cup, and hence most of the chlorophyll, faces outwards.

The conclusion drawn in 1981 was that Geddes could not be faulted on any of his 1879 observations. Bearing in mind the high productivity of the associated organisms in a disturbed environment such as intertidal sand, and the full use by the symbionts of the intimate biochemical reactions between their cells, Gooday considered that we should have some sympathy for Geddes's conclusion that he had discovered a 'vegetating animal'.

During Geddes's time at Edinburgh two further papers on algae were published, the first on a species of *Enteromorpha*, ('dry as dust' according to him), the second on the 'yellow cells' in Radiolarians and Coelenterates, in which he pointed out their ability to liberate oxygen. It would seem, however, that botany became less and less his main interest, other than through articles in encyclopaedias. A journal article on cell theory, incorporating his studies on 'Infusoria' and 'Protista', does stand as a sound review of the knowledge then available. Other interests were crowding in- classification of statistics, analysis of the principles of economics, political economy, slum clearances. When in December 1887 Alexander Dickson died from a heart attack, whilst enjoying a game of Curling on a frozen pond on his estate in Peebleshire, Geddes staked his claim for the vacant Regius Chair with a 90 page application which seems to have been more of a propaganda assault. All to no avail-Issac Bayley Balfour, son of 'Old Woody Fibre', was appointed. At the time he was Sherardian Professor at Oxford, and with a pedigree and publications list showing total dedication to Botany. Geddes was appointed Professor of Botany at University College, Dundee in 1888. He was employed (and paid) for half the year, leaving time for his extra-mural activities. During his time at Dundee the first studies on field ecology in Scotland were carried out, and it is said that his interpretations of environment-function-organism were later translated into place-work-folk in his sociological and town planning ventures.

At no time in his academic career did Geddes take a degree. Such an attribute was to him unnecessary, although in his younger days prize winning, especially if there was a monetary award, was a different matter. Reputation was all that counted. We may reflect that his own reputation was at first built on a phycological phenomenon which he misinterpreted. We may also question whether a non-graduate who lived in so many different intellectual worlds would ever find a niche in the present day academic environment.

A.D. Boney.

British Phycological Society Winter Meeting
2-5 January 2001
University of Liverpool

CALL FOR ABSTRACTS

Abstracts are invited from anyone wishing to present a paper or a poster at the BPS winter meeting to be held at the University of Liverpool, 2nd – 5th January 2001. There are special sessions on *'Symbioses'* organised by Bruce Osborne and *'Molecular Ecology/Population Genetics'*, organised by Gareth Pearson. The title of the Applied Session is *'Algae, Nature Conservation and New European Legislation'*. A number of invited speakers have already accepted, including Linda Medlin (Alfred Wegner Institute), Paul Crittenden (Nottingham), Jeff Ducket (King's, London), Jeanine Olsen (Groningen), Dave Adams (Leeds) and Angela Douglas (York).

Postgraduate students who are presenting papers are eligible to be entered for the Manton prize. Students who are presenting posters are eligible for the BPS poster prize.

1. Abstracts should include a title, author(s) and affiliation(s) as indicated in the box below.
2. They should include an outline of the work that has been undertaken and the key results.

3. They should not exceed 250 words.
4. Please indicate clearly whether you intend to present a paper or a poster.
5. Please indicate the presenting author by putting it in bold.
6. You must state if you wish to be considered for either the Manton prize or the BPS poster prize.
7. Please follow the instructions in the box below for submitting your abstract.

TITLE OF PAPER/POSTER

AUTHOR(S)

AFFILIATION(S)

Please send your abstract, preferably as a word document attachment, to Dr Juliet Brodie at j.brodie@bathspa.ac.uk or alternatively in the body of the e-mail. If this is not possible, abstracts can be faxed to Juliet on +44 (0)1225 875776 or sent to her at Bath Spa University College, Newton Park, Newton St Loe, Bath BA2 9BN, UK.

Indicate: ORAL or POSTER presentation

Indicate: MANTON PRIZE or BPS POSTER PRIZE (students only)

The maximum size for posters is 82 cm long by 80 cm wide.

Deadline for abstracts: Friday 27th October 2000. Abstracts submitted after this date will not be considered.

BRITISH PHYCOLOGICAL SOCIETY FUNDING

The British Phycological Society has funds to support a range of activities for student members and to sponsor events that are considered within the remit of the society. The different categories are outlined below. Requests for funding are dealt with via the British Phycological Society Algal Affairs Committee. Further enquiries and applications for funding should be made to the chairperson of the British Phycological Society Algal Affairs Committee. This is currently **Professor Brian Moss, School of Biological Sciences, Derby Building, University of Liverpool, Liverpool L69 3BX. (brmoss@liverpool.ac.uk).**

All applicants will be considered by the Algal Affairs Committee, whose decision will be final. It is important to remember that the British Phycological Society cannot guarantee to support all applicants.

STUDENT FUNDING

1. **Funds to support student members attending the British Phycological Society Winter Meeting**

Deadline: 1 November

Conditions: A poster or a talk will be presented.

Applications:

i) Applicants should send a letter of application giving a brief c.v.

ii) They should confirm their membership of the British Phycological Society, or include a completed membership application form.

iii) Supervisors should send a letter of support.

iv) A statement of costs indicating the sum requested from the British Phycological Society, as well as any other resources available to the applicant should be included.

As a guide to possible funds, the society has tried to meet bed and breakfast and registration costs and up to half of economy travel costs, although the actual sum awarded will reflect the number of applications received and the funds available.

impossible to resolve the structure. But then I realised that there was the question of whether it was impossible, or that it was me that was unable to deal with the problem. In addition, there still remained the question of whether or not the microscope was properly equipped. The latter often reminded me of amateur photographers complaining that their 'camera did not take good pictures', a silly remark that, sadly, might just as well be applied to microscopes and to some microscopists.

Reliance on the equipment alone can be quite deceptive. Thus, Fredrich Hustedt, my teacher for whom I have the deepest respect, ascertained that the structure of some diatom or other could not be resolved and adds that he confirmed this with an apochromatic oil immersion with a numerical aperture of 1.4 and a low-voltage lamp. I happened to own Hustedt's old microscope with the apochromat 1.4 and also his low-voltage lamp (both now incorporated within the Hustedt Collection at Bremerhaven) and I found that the low-voltage lamp has no iris diaphragm which is necessary for Köhler illumination- itself a perogative to avoid stray light. Further, the condenser on his microscope is not made for oil immersion, thus restricting its aperture to a valve of just below 1. Hustedt, therefore, was simply not in a position to resolve the structure of a number of diatoms, mainly because he had no condenser with the necessary aperture. Many diatomists do not immerse the condensers, and for simple routine investigations it is also not necessary. My observation of many visitors to the Hustedt Collection has also shown that they will not even use immersion oil when it does become necessary, e.g. in critical situations or for photomicrography. They had simply relied on the otherwise excellent equipment and expected that the wonderful optics would solve their problems.

Hustedt once taught me, 'the most important part of the microscope is the brain above it'. He did not remember who had coined this rule, but it is certainly an elementary truth. It means that the microscopist and, consequently and particularly, the diatomist must do their homework and become familiar at least with the basic theories governing microscope optics and performance. It is regrettable that at colleges and universities these things are virtually absent in the curricula of many students, because they are thought to deal not with science, but with 'handicraft'.

My series of articles are not intended to provide the basic theoretical background mentioned above but to give additional hints that I have found useful for my work over the last 30 years. Many visitors to the Hustedt Collection were shown several of my 'tricks', which some of them may have passed on subsequently as their own inventions. I have been urged by others to communicate these tricks to a somewhat broader public to prevent their becoming lost. I realise that this is the age of scanning electron microscopes, which, in a way, are more primitive to handle and yield better images than those of the light microscopes. Further, I have met with some allusions of outdatedness for my virtually exclusive LM treatment of Hustedt's diatom types. However, I am stubborn enough to assume and to predict that the light microscope will remain the basic instrument used in diatom research, in spite of the fact that every young student today has access to an SEM. This note may contribute to placing LM treatments on a par with any knowledge of SEM operation.

I. Mechanical and Optical Commodities

One thing of the utmost importance with the light microscope: its perfect service condition. Microscopes should be serviced by authorised service personnel every second year. I remember a colleague asking for fine silicone oil in our workshop. After a week he returned with the stage movements of his microscope blocked. He had used the oil for making his stage move more smoothly, and this resulted in the creation of a very heavy paste because of the dust enclosed in the slits. It must be kept in mind that no oil whatever belongs at any place on the microscope. Where necessary, the proper kind of grease is applied, and this only in very small quantities. It should be remembered that no ordinary workshop carries the different kinds of

lubricant used in microscopes, only the manufacturer. In cases of emergency, old grease layers may be wiped off with a piece of lens-cleaning paper or with a Q-tip wetted with a little chloroform. A thin application of Vaseline will then lubricate the part, but only until the proper service is available.

No dust belongs anywhere near a microscope. The service personnel will properly dust the optics and re-lubricate the parts where this is necessary. A rubber bulb with a two-way valve can be used to blow dust from the eye lenses of the oculars and other parts prone to collect dust. The rubber bulb, by the way, should not be too small and ought to be kept under cover. For a time I used to keep mine on the desk, with the result that it became contaminated with dust and I sand-blasted the eye lens of one of my eye-pieces so badly that it had to be replaced. Another incident may also be noteworthy. A young student used one of our microscopes for a small project. When she returned the microscope after three months, the eye lenses were ruined because she had painted here eye lashes. I was told that the mascara she had used contained oxidised and highly heated manganese which can be very hard and thus scratch the glass surface of the eye piece.

Some standard microscopes, e.g. the Zeiss Standard series, have light windows very close to the light-field iris diaphragm. The glass covering this window is particularly sensitive to dust on both inner and outer surfaces, because the diaphragm is focused into the object image plane. Even very small dust particles will then show as shadows in the final picture, remaining stationary when the stage is moved. They will also appear on micrographs. The dust particles are apparently the cover-glass with a short brass tube and a cover-glass on its upper end, thus elevating this point away from the iris diaphragm. The condenser-filter assembly will be just above the tube when turned down.

An important part of former microscopes appears to have fallen victim to the rationalisation of the manufacturers- the circular, central, revolving mechanical stage. This is an important tool and certainly not only for diatomists. The rotation is indispensable when elongated objects (diatoms among them) are to be photographed. Thus, in many of my micrographs the long diatom had to be positioned diagonally in order to fit into the film frame. When Nomarski differential interference contrast is used, the rotation is extremely important, because the contrast depends heavily on the direction of the structural elements of the objects, e.g. the striation of pennates or the elements forming these. The arguments of the manufacturers that the mechanical stages with deep-lying movement handles are more ergonomic is correct, but they use it as a pretext for abandoning the manufacture of revolving stages, which demands much more skilled handwork than the non-rotating stages. Consequently the production costs of the latter are about one sixth of the former.

The makers of the microscopes generally provide yellowish-green filters with their instruments. These filters normally have the greatest transmission at a wavelength of 546nm. This is the wavelength for which the aperture values engraved on the objectives are calculated and with a daylight blue filter, that also comes with a microscope, I found that this light was normally too yellow. I therefore use Schott glass filters BG 18, which transmit a bluish-green light. The positive effect of this filter (plus the daylight filter) can be verified visually.

After the manufacturers of modern optics have succeeded in eliminating the optical defects of their products to a very large degree, quite often by making multi-lens systems, one of the more important of the remaining shortcomings of light microscopes is the presence of stray light. Even with strict Köhler illumination there continues to exist a small amount of such stray light. One must realise that there are many glass-air surfaces in the optical components of a microscope, and in spite of modern coatings we should take into account that there is always a small chance of stray light. Every small amount of the latter impares the performance and hence the resolution. Since diatomists are always working near the optical limits, they should minimise this undesirable effect. In my

microscopes I have inserted a polarising filter in a slot that is made to accept filters. It is situated above the objective. The filters are at an angle of 45° in a SW-NE direction. When inserting this filter its effect can be seen immediately under high magnification.

In the next issue (Number 57, November 2000), I will deal with measures to improve the resolution of images.

Reimer Simonsen

THE CULTURE COLLECTION OF ALGAE AT GÖTTINGEN UNIVERSITY, GERMANY

The main function of the "Sammlung von Algenkulturen Göttingen" (SAG, Culture Collection of Algae Göttingen) is to maintain and supply selected algae and cyanobacteria to the research community and industry. In effect, the SAG culture collection is a living resource of culture material serving the research, teaching and biotechnology communities mainly throughout Europe. Primarily microscopic algae and cyanobacteria from freshwater or terrestrial habitats are maintained, but also marine algae and microscopic stages of some seaweeds are available. The collection covers an extremely broad taxonomic range with algae and cyanobacteria originating from an equally diverse variety of geographical and ecological niches. A variety of colorless protists which are closely related to or derived from photosynthetically active algae is also available and some strains even represent parasitic algae.

Representatives from almost all lineages (phyla and classes) of eukaryotic algae and cyanobacteria can be found in the SAG. With presently 2141 strains (representing 486 genera and 1228 species) the SAG is among the three largest culture collections of algae in the world. About 67% of all strains are green algae (278 genera and 773 species) and about 10% cyanobacteria (61 genera and 157 species). The Euglenophyta may form one speciality of the SAG collection because almost all genera (colored and colorless taxa) of this relatively small group are represented here. There is also a quite respectable number of freshwater red algae in the collection. At present, diatoms and dinoflagellates are still little represented and we try to obtain a greater number of strains and diversity for these groups.

The SAG originates from the collection started by Ernst Georg Pringsheim (1881-1970) in Prague in the early 1920's. Pringsheim's collection consisted of exclusively pure cultures and he was the first who made his cultures available to the whole scientific community. In 1939, the worsening political situation in Europe forced Pringsheim to seek refuge for himself and his family in Britain. A stock of his cultures then formed the nucleus of the Culture Collection of Algae and Protozoa (CCAP) at Cambridge University which was later split and located at Institutes at Windermere and Oban (Scotland). Pringsheim's Prague culture collection still exists today, it became expanded and is now located in Trebon (Czech Republic). The american phycologist Richard C. Starr (1924-1998) started a collaboration with Pringsheim at Cambridge which resulted in the establishment of another large culture collection (now University of Texas Culture Collection, UTEX, at Austin). In 1953, Pringsheim accepted an offer from Göttingen University and although 72 years old, decided to restart a culture collection there which was possible through the initial help of his wife Olga Pringsheim. Because of the activity of Wulf Koch, who was the collection's curator from 1954-1979, the SAG soon took over extensive service functions. In 1964 the collection already offered 912 strains of 628 species. The enormous growth and further establishment of the SAG's functions for research and education was then the work of Uwe Gert Schlösser who was responsible for the SAG until his retirement in 1999. Today, the SAG management and scientific development is within the responsibility of Maike Lorenz as the curator, Dierk Mende as the organisational and IT

assistent, and Thomas Friedl as head of the Department of Experimental Phycology.

The SAG is part of the University of Göttingen which covers all staff costs and provides culture rooms and laboratories. It is located at the Albrecht-von-Haller Institute for Plant Sciences and is integrated into the Department of Experimental Phycology. The university recently helped greatly with the renovation of the laboratories and provided new research microscopes including image analysis. The running costs of the collection are exclusively financed by the sales of culture strains.

At present, research in the department focuses on the molecular evolution and taxonomy of green algae, diatoms, cyanobacteria and lichen symbionts. Present research is carried out by a group of 10 staff which includes one permanent technician, one post-doctoral researcher, two PhD students, and three undergraduate students. Research is supported by the German Science Foundation ("Deutsche Forschungsgemeinschaft", DFG). The SAG is involved in education with laboratory classes that focus on the morphology and molecular evolution of algae and cyanobacteria and performs culture experiments in plant physiology courses.

The SAG catalogue of culture strains can be accessed in searchable form at the SAG web-site **http://www.gwdg.de/~epsag/phykologia/epsag.html**. A new issue of the hard-copy catalogue will become available in the near future. SAG is a member of the World Federation of Culture Collections (WFCC) which provides valuable links to other culture collections worldwide. There is an exchange of culture strains between algal collections to increase safety in maintenance.

Maintenance of culture strains is presently done by routine serial subculture. It is planned to establish cryopreservation (the prolonged storage of algal strains in vapour of liquid nitrogen) to ensure physiologically and genetically stable cultures. Presently, two technicians are involved in maintenance and supply of the algal strains. A broad range of different media is applied to maintain algal cultures healthy and in optimal condition. Our cultures are stored in four culture rooms at 16/18/20°C and in culture chambers at 10 and 25°C.

The SAG continues to expand its collection through isolations and soliciting deposits from other researchers; it serves as an important depository for valuable cultures. We encourage investigators to deposit their newly-isolated strains with the SAG, thereby making them available to other scientists. Those cultures should be axenic or must not be contaminated with fungi or other eukaryotes. However, acceptance of deposits is at the discretion of the SAG because of staff-time limits. Safe-deposit on a confidential basis is, at present, not available. SAG cannot offer identification/ taxonomic service at present. However, we offer training courses for advanced students and scientists which concentrate on special taxonomic groups of algae and on cyanobacteria. Since the knowledge about morphology and taxonomy of algae is still decreasing , we like to promote the use of algal cultures for university courses.

The SAG library keeps an enormous variety of text books and monographs on the taxonomy, ecology and application of algae. It also includes E.G. Pringsheim's private library and a huge collection of reprints from publications where SAG strains have been used and/or from researchers which feel personally connected with the SAG. All recipients of cultures are kindly asked to send in return reprints of their publications when strains from the SAG have been used.

The SAG wants to develop further collaborations with researchers in all fields of phycology. We also seek for collaborations with the biotechnology community to promote the exploitation of microalgae for applications in pharmacy, plant pathology, agriculture and industry. The need to improve standards within collections in order to increase the biodiversity of strains retained in culture collections is a strong stimulus to establish scientific/research and bio-informatic links. Collaborations among culture collections with

particular emphasis on their role in conservation of aquatic and terrestrial algal biodiversity are essential.

Thomas Friedl

For further information on the SAG its activities and services see the SAG web-site or contact us at epsag@gwdg.de. Maike Lorenz and Thomas Friedl, Department of Experimental Phycology and SAG, A.-v.-Haller-Institute for Plant Sciences, University Göttingen, Untere Karsp¸le 2, D-37073 Göttingen, Germany.

A KEY FOR THE IDENTIFICATION OF BLUE-GREEN ALGAE (CYANOBACTERIA) OF THE BRITISH ISLES

Eutrophication and blue-green algae (cyanobacteria)

Eutrophication is recognised by the Environment Agency of England and Wales as a national water quality issue and has become more widespread in recent decades, resulting in deterioration of the aquatic environment and serious problems for water-use. Cyanobacteria (blue-green algae) are a major recognised symptom of eutrophication, and generally occur during warm, dry summers, with plenty of sunshine and little wind mixing, although blooms can also occur during other periods. Cyanobacterial blooms and scums are natural features of many waterbodies and are likely to remain so, although successful eutrophication control strategies may limit the extent of their development.

Cyanobacterial toxicity

Cyanobacteria are capable of producing severely toxic chemicals resulting in deleterious health effects, and even death in fish, livestock, pets and humans. Blooms may also have serious negative economic consequences for aquaculture (fish and shellfisheries).

Toxicity assessments of cyanobacterial scums/blooms continue to indicate a high incidence of toxicity (more than two-thirds of samples analysed are toxic). The Environment Agency, therefore, continues to adopt a precautionary approach, recognising the need to regard all cyanobacteria species and strains as capable of producing toxins, and hence to regard cyanobacterial populations as a threat to human and animal health and safety.

Environment Agency monitoring protocol

Monitoring of affected sites was extensive during the incidents of 1989 and 1990, when large cyanobacterial blooms were identified in UK inland waters, and intensive programmes were adopted for some sites. Since then, a reactive monitoring programme has been advocated, principally to cater for those water body owners and users who had not previously contacted the Agency. This approach reduced the earlier monitoring effort, allowing resources to be diverted into eutrophication control developments (aimed at reducing blue-green algal problems) – see www.environment-agency.gov.uk, 'Aquatic Eutrophication in England and Wales: A Proposed Management Strategy' consultation document.

The Agency's position

The lack of suitable reference books for accurate naming of blue-green algae has been a major hindrance to algological work within the Environment Agency. Whilst there are both beginner's guides and specialised taxonomic works (usually in foreign languages), a practical blue-green algal flora has not been available.

A collaborative project was set-up with the University of Durham to produce a key for identification of blue-green algae from the British Isles to assist Agency staff engaged in monitoring work. The principal output is a computer-based interactive system built from LucID Professional, a specialised computer package for developing biological identification systems. The system was produced initially in CD-ROM format and has subsequently been

made available nationally to Agency ecologists through the computer network on the Windows desktop.

The CD-ROM was officially launched by the Environment Agency and University of Durham on 30 May 2000.

In the future, it is hoped that following the success of this collaborative project there will be additional keys in CD-ROM format for other algal groups, adopting the LucID interactive system.

Background information

The key aids the identification of any blue-green algal sample collected in the British Isles. It includes 320 species in 65 genera of freshwater, terrestrial and marine blue-green algae, and contains many illustrations and colour images together with species descriptions. Freshwater and terrestrial species follow the Coded list of freshwater algae of the British Isles incorporating recent taxonomic developments. The key was based on LucID Professional software developed at the University of Queensland, Australia and operates as a multi-access key with the user answering questions for whatever information they possess about the sample. LucID suggests possible names, and the user can then check the sample against the suggested species descriptions and images

Copies of R&D Technical Report E84, providing explanation of the LucID key and taxonomic accounts of genera, and R&D Technical Summary leaflet ES83 are available internally from the Regional Environment Agency Libraries/Management Support Officers and externally from WRc plc.

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EUROPEAN-WIDE STANDARD METHODS FOR ALGAL-BASED MONITORING

CEN, the European Standards Organisation, has a technical committee devoted to the topic of water analysis and, in recent years, this has branched out from chemical and microbiological methods to embrace ecological assessment techniques. The need for standard methods across Europe may not be immediately obvious, until one starts to count the enormous number of European Directives on environmental topics, and the burden that they place on member States to monitor and report on implementation. A feature of the last decade or so had been for ecological concepts to be enshrined in this legislation-hence the interest in standardising methodologies.

Lest you feel alarmed at this point about the prospect of Big Daddy in Brussels dictating how we as phycologists operate, I shall try, in the next few paragraphs, to explain the progress made so far on algal-related standards, following my visit to the April 2000 meeting of CEN's water analysis task group in Budapest.

The first suite of standards under development relate to the use of benthic diatoms. This reflects the wide use of diatoms around Europe both for general water quality monitoring and, more specifically, for monitoring related to the Urban Wastewater Treatment Directive and their potential role in the Water Framework Directive. The first

Standard in this suite related to sampling methods. It is currently at the first of two protracted 'comment' stages and will, assuming that national standards bodies approve, eventually have the status of a 'Guidance Standard'. It evolved out of discussions and comparisons by specialists from around Europe and effectively represents the features common to these existing methods that must be followed if data are to be used for routing monitoring purposes. This gives an organisation such as the Environment Agency scope to specify a more detailed method if they think this appropriate, so long as the key features of the standard are embraced. Further Guidance Standards on laboratory treatment and quality assurance (QA) of diatom data are planned.

The other specifically algal-related standard is a method for surveying entire benthic algal communities, as a complementary method to the use of diatoms or macrophytes. Broadly similar methodologies have been developed in Scandinavia, Austria and the UK (the latter by Brian Whitton and co-workers) and the content of such a standard was discussed at the 4th European Workshop on the Use of Algae for Monitoring Rivers in Durham in July.

Another work item of great relevance to all involved in environmental monitoring is the preparation of a guidance document on QA issues in ecological assessment. There is a vast literature on QA generally, and a large literature on the application of QA principles to environmental analyses. However, the latter usually presume an interest in chemical determinants and we see a need for clearer guidance for laboratories dealing with the complicated mix of qualitative and quantitative (or semi-quantitative) variables that is the ecologist's stock-in-trade. Although the topic is formally led by Austria, the UK delegation will be playing a key role in drafting the working documents for this standard. One of my objectives during these preliminary discussions will be to ensure that the methods are flexible enough to apply to small, highly specialist outfits, including consultancies and university research groups.

Finally, a few words about the Water Framework Directive. If this does finally receive assent from the European Parliament, then the face of environmental monitoring throughout the European Union will change drastically. Part of this change will be a shift towards use of ecological, as well as chemical, characteristics to define the quality of water bodies. The suite of ecological characteristics proposed in the Directive is broader than that used traditionally by the water industry, with more information on algae, macrophytes, fish and hydromorphological characteristics being required alongside that from benthic macroinvertebrates. For each of these groups, characteristic features of 'good ecological quality' is at best an issue that varies tremendously in space and time (and, at worst, is a purely subjective construct), this will need a strong 'steer' from the academic community. The point was made at Budapest that not enough good proposals were funded by the EU's 5th Framework Program. One colleague commented caustically that too many academics load their proposals with references to European Directives as a way of increasing the chance of a pet project being funded, rather then through a genuine understanding of European environmental policy. Those of us involved with this work at CEN are keen to see good proposals going forward to Brussels and, indeed, the chairman of the Ecological Assessment work group will endorse projects with specific value to the work of CEN. I will happily share our knowledge of the Water Framework Directive and CEN's needs with anyone interested in developing projects along these themes.

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Copy should be submitted, preferably, on disc (ms word for windows) and the editor reserves the right to edit the material before final publication.

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