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Leader: Anthony Fletcher 3-6 September 1997

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Cover artwork by Claire Dalby
WHAT FUTURE FOR LICHENOLOGY?

“... as a founding member of the Society how do you view the possibility that in 10 years time there may be no-one doing serious research on lichens in a UK university? How is lichenology contributing to symbiology at large...? Do you have any observations on the performance of the Society or any advice for us?” These were among the questions put by the editor when he invited me to contribute to this issue of the BLS Bulletin.

When I started studying lichens as a postgraduate in 1951, there was no-one on the staff of a UK university who had lichens as a principal research interest, so I had to go to Uppsala University for a year to get a basic grounding in lichenology. Symbiology was scarcely recognised as a subject, and the BLS did not exist. Within the next 10 - 15 years, all this was to change.

As with many biological specialities, the study of lichens over the centuries has oscillated between peaks of interest and troughs of neglect. A L Smith’s monumental monograph recognized seven periods in the history of lichenology, the first of them from the days of Theophrastus (371 to 284 B.C.) until 1694. Those like myself, whose primary interest is in symbiosis, are concerned mainly with the seventh period, which starts in 1867 with Schwendener’s description of the dual nature of lichens and continues until the present day.

Schwendener’s paper brought lichens on to the centre stage of botany for a considerable while, especially because of the controversy it stimulated and the long time taken for it to be generally accepted that gonidia were algae and not buds produced from hyphae. In the introduction to his classic The Lichen-Flora of Great Britain, Ireland and the Channel Islands, Leighton (1879) states “I have purposely omitted any mention of the Schwendenerian Theory of Lichens, as I cannot but regard it as purely imaginary, ‘the baseless fabric of a vision’ . . . .”

In the couple of decades following Schwendener’s paper, there were various attempts to culture the symbionts and resynthesise lichens. The early and seemingly easy successful artificial synthesis of lichens such as Xanthoria parietina by Bomet and by Gaston Bonnier were not found repeatable by others, so that interest in the symbiosis went into substantial decline for the first part of the present century with the prevailing belief that Bomet’s and Bonnier’s successes were due to contamination.

Meanwhile, as interest in the physiology of higher plants began to develop, it
extended also to lichens, especially as foliose and fruticose lichens proved quite robust as experimental material, and there was not then the concern with the need for conservation. Very sound work on the photosynthesis, respiration and water relations of lichen thalli was carried out between the wars. It is worth remembering that during this period, when the number of academic staff in universities was very much smaller than at present, there were several researchers working and publishing on lichen physiology. Fraymouth and Smyth, both at Bristol University, published key papers on thallus physiology as did a number of others in universities in continental Europe. Otto von Darbishire, the Professor of Botany at Bristol, gave as his Presidential Address to the British Mycological Society in 1923, a masterly survey of current developments in lichenology.

The next - and substantial - wave of interest in the biology of lichens and their symbiosis reached its peak about half way through the second half of the present century, although its beginnings are perceptible in the late 30s and early 40s. In 1939 Thomas made, under incontrovertibly sterile conditions, the first substantiated artificial synthesis of a lichen, *Cladonia pyxidata*, which reached the stage of forming small podetia with scyphi (although his attempts to repeat this in a further 800 culture flasks all failed!). Quispel (1943) made the first important modern experimental observations on the mutual relations of algal and fungal symbionts through the ingenious use of lichenised crusts. Both Thomas, and Quispel in a later paper, suggested that sub-optimal nutrient conditions and perhaps maintenance of correct (and possibly varying) humidity conditions might be essential for successful artificial synthesis. This opened the way for the considerable and substantial achievements of Ahmadjian, starting in 1959, in developing reliable and defined conditions for the artificial synthesis of a range of species.

Coincidentally with these advances, I had the very great good fortune to start research into the lichen symbiosis just as radioactive isotopes were becoming widely used in the study of metabolic processes; I had learnt how easy these techniques were during 8 months spent in the laboratories of Melvin Calvin, who later won the Nobel Prize for elucidating the path of carbon in photosynthesis. In what now seem absurdly simple experiments, I was able to begin a programme of research into the transfer of carbohydrates produced in photosynthesis from the algal to the fungal symbiont.

Meanwhile an important avenue of field research had opened with the realisation of the extreme sensitivity of lichens to atmospheric pollution. This could be linked in part to laboratory observations on the remarkable capacity of lichens to absorb substances from solution. A much broader and stronger
link between the physiology of lichen thalli and their distribution in nature was forged through the work of a number of talented physiological ecologists, perhaps the most outstanding of whom has been Otto Lange whose excellent publications now span more than forty years.

But the study of lichens is now in a phase of serious decline leading towards a trough of neglect. Those of us lucky enough to have been in at the peak of interest are growing old, with very few young successors. Lichenology is out of fashion with research councils, and inventory taxonomy seems not well regarded by museums and conservation agencies (unless of course it concerns birds, large furry animals or glamorous parasites). The "new" techniques dominating so much of biology - such as molecular genetics and DNA sequencing - have found no novel and dramatic applications in lichens. But, it will not always be so. When I started research, the high peaks of biochemistry were in the elucidation of metabolic pathways, and "street credibility" from one's laboratory peers was gained only if the enzymes involved could be prepared in pure crystalline form; all this is now irrelevant old hat. Molecular biology will go the same way in due course, because it cannot on its own solve the fundamental biological problems of: how humans should identify and classify organisms in practice; how the growth, development and reproduction of those organisms interact with their environment to give their observed distribution; and how this distribution will change in response to climatic change and other consequences of human activity. We must keep in mind that the present dominance of molecular biology is constraining the development of many other branches of plant science besides lichenology.

New phases of interest in biological specialities, such as lichenology, begin when a new and appropriate technique becomes available (as happened to me with the advent of radioactive tracers) or new avenues open up (as with Ahmadjian's work on synthesis, or field studies on the effects of atmospheric pollution on distribution). When the flow of new discoveries made from these avenues becomes exhausted, a decline sets in until the next new approach appears. One cannot predict when this will occur. But whatever it may be, it is important that it should be such as to keep lichens in the main stream of plant biology and not leave them as an isolated and minor speciality. There are two key general areas in which lichenology is main stream: (a) symbiology; and (b) ecology and biodiversity.

(a) Symbiology. Lichens are still regarded as a key example of symbiosis, and they are still the association for which there is the best and most specific picture of the transfer of organic compounds from a photosynthetic symbiont to its
partner, a picture which is much less clear, for example, in mycorrhizas, legumes, or associations between algae and lower invertebrates. For all associations, one major unsolved problem is how existence in symbiosis triggers the release of organic compounds from the photosynthetic symbiont. Biotrophy is the nutritional strategy of half of all fungi, and it could be lichen fungi which hold the key to understanding all this.

Specificity of symbionts for each other and mechanisms of recognition during the establishment of a symbiosis is another central problem in symbiology. Superficially, legume/Rhizobium associations appear to be leading the way, although the superabundance of papers dealing with a small number of agricultural plants are of little help to us in understanding the processes in natural communities where legumes are abundant, such as the monsoon forests of the Far East. Mycorrhizas are a problem because of the unculturability of the ubiquitous vesicular-arbuscular fungal symbionts, while alga/invertebrate associations are hampered by insoluble technical problems arising from the fact that most are intracellular. Again, lichens might well hold the ultimate key.

(b) Ecology and biodiversity. Lichen - dominated vegetation covers approximately 8% of the earth's land surface, and this must always ultimately give them an important role in global plant ecology. They are by far the most sensitive to atmospheric pollution of any of the major groups of macroscopic plants, and this must add to the importance of their role at a time of growing concern about the impact of human activities upon the natural environment. One of these impacts is loss of biodiversity, and as concern about this extends slowly outside fashionable groups of organisms (birds, tigers, whales, etc) lichens, as a major and unique biological group of fungi, must again become of central concern.

The importance of taxonomy, the amateur, and the British Lichen Society. Whatever new approach triggers the next phase of rising interest in lichens, it is absolutely essential that it be underpinned by a sound and active base of work in taxonomy. The current very serious decline in the number of professional taxonomists for most groups of organisms will cause long term damage to key areas of the future development of biology.

In the particular case of the study of lichens, however, there is a chink of light illuminating this otherwise gloomy scenario. Past history shows that the amateur lichenologist can play a vital role in stemming the tide of decline. The term “amateur” has no pejorative overtones, and refers merely to expert
lichenologists who happened to earn their living by some other profession such as accountancy, school-teaching, farming, etc. In Jack Laundon’s excellent account of the formation of the BLS in *Bulletin 77*, he shows that it was Dougal Swinscow, most of whose career was spent on the editorial staff of the *British Medical Journal*, whose initiative led to the formation of the Society (his published papers on lichens later led him to be awarded a D.Sc. from London University). Almost half the members of the first Council of the BLS were amateurs, and it was partly their approach and understanding which has given the BLS its essential tradition of welcome and helpfulness to beginners.

Past history also shows that the study of lichens does not die out during the troughs of neglect that are interspersed between the peaks of interest. The BLS has a key, unique and essential role to play as a well organised resource for protecting lichenology in its current period of apparent academic decline. When worldwide interest in lichens begins to grow again, as it surely will, the existence of the BLS will help its rapid development.

References

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