

throughout the core. They are therefore of no use for zonation purposes." Focussing attention on the larger species, she was able to establish eight zones distinguished chiefly on the abundance of five species. Apart from one case where the lower diatomaceous earth contained roots, moss leaves and fruits, catkin scales and birch pollen, very little pollen was found. Occasional grains of *Pinus* were noted. With the exception of the lower part of the upper laminated clay, both clay layers contained no diatoms in appreciable numbers.

Of the species found, all are known as living forms except *Melosira arenaria* var. *hungarica*, which is confined to the lower parts of the core, and is recorded from fossil deposits in Hungary. "Most of the species, including all the abundant species are littoral forms not altogether surprising, since the core was obtained from relatively shallow water." (Note: This might be adduced as evidence for no considerable change in lake level since glacial times.) Of the sixty-two species and six varieties, four have been recorded from the present Windermere plankton but not the littoral region, ten from Windermere littoral but not plankton, ten from both littoral and plankton. Thus most of the species from the cores have not been recorded for the lake. A noteworthy feature is the fact that *Asterionella gracillima*, so abundant in the plankton at present, has not been recorded from the cores. Fourteen species have been designated by Mr. Ross of the British Museum as having arctic, arctic-alpine or northern distribution.

It is to be hoped that Miss Pennington will be able to continue this very interesting work, especially on cores which we hope to obtain from deeper water. In this way it should be possible to throw valuable light on the past climatic and biological history of Windermere and other lakes.

FAUNISTIC STUDIES

by T. T. MACAN and H. B. N. HYNES.

FAUNISTIC WORK ON ADULT ANIMALS. Macan's work on the ecology of corixid water bugs was published in June, 1938, but during the year additional field data, extending and corroborating the conclusions drawn, have been obtained. In addition comparison

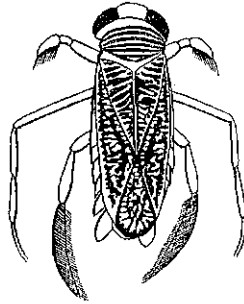


FIGURE 9. A corixid, *Sigara scotti*.
[Reproduced by permission from *Country Life*.]

with the fauna of the highlands of Scotland was made during a fortnight's collecting leave, and a visit was paid to a reservoir where a dense population of corixids is causing trouble.

Further collections have shown that Wise Een Tarn, near Wray Castle, exhibits the whole corixid succession which accompanies the development of vegetation under conditions where there is little silting and the amount of organic matter in the soil is increasing fast. The results are shown in figure 10. This is the usual succession in waters of the Lake District though most tarns only show the end stages of the succession and lakes only show the early stages. Thus in the reed-beds of Windermere, where the development of vegetation leads to stagnant conditions and a change from a "silted" to an "unsilted" type of plant succession, *Sigara striata*, *S. distincta* and *S. fossarum* are the common species, *S. scotti* is rare and has only been found in two reed-beds and *S. castanea* has not been recorded.

In marked contrast to the succession in Wise Een Tarn is the succession in Knittleton Lake shown in figure 11. This lake is quite small and the development of vegetation is considerable. A small patch of open water in the middle is completely surrounded by well-developed *Phragmites* beds; outside these there is, on one side, a shallow stretch of water with a peaty bottom and little vegetation, and, on the other, an extensive floating raft of *Sphagnum* and *Myrica*. Thus conditions round the edge are clearly "unsilted" and this is reflected in the dominance of *S. scotti* in the open environment on the shelf and of *S. castanea* in the thick *Sphagnum* (actually an isolated

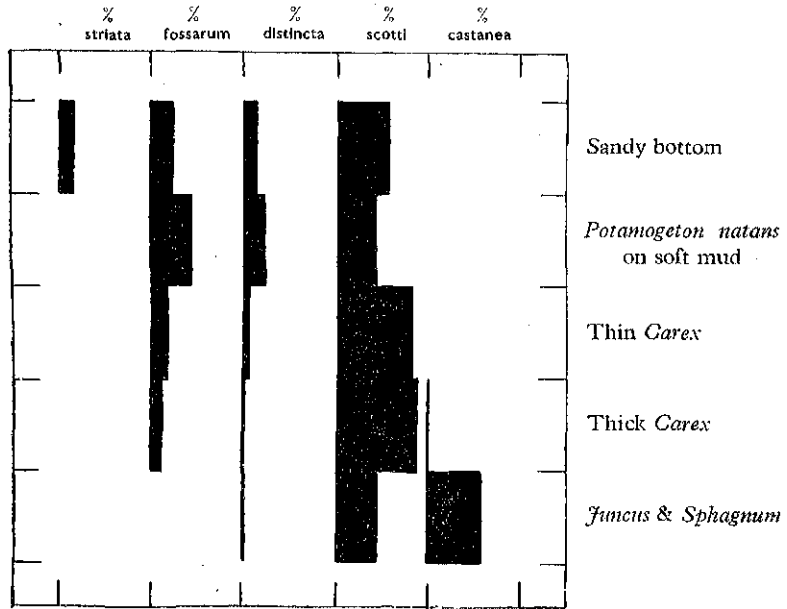


FIGURE 10. Succession of Corixidae in Wise Ben Tarn. The histograms represent the percentage of each species in the types of environment indicated.

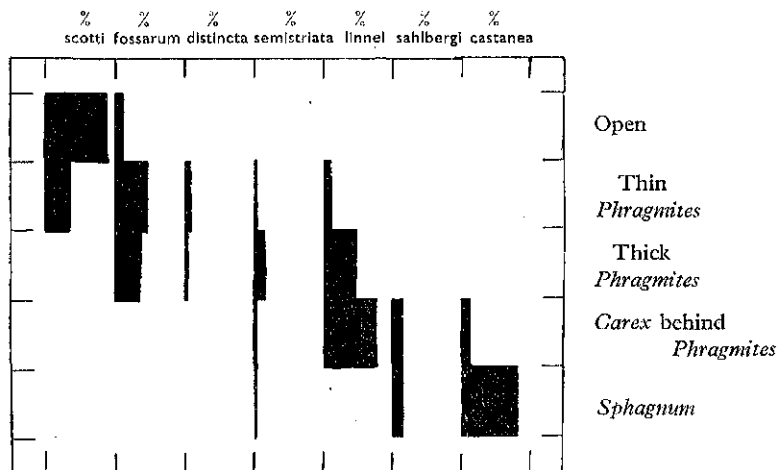


FIGURE 11. Succession of Corixidae in Knittleton Lake. The histograms represent the percentage of each species in the types of environment indicated.

pool on the *Sphagnum* raft). On the other hand the extensive development of *Phragmites* in the middle suggests silted conditions and it is interesting to note that, with increasing thickness of *Phragmites*, *S. fossarum* is replaced by *S. linnei* and that *S. sahlbergi* comes in at the end of the succession. This succession is believed to be typical of silted conditions but the evidence from Knittleton must be treated with caution, for, since its inflow is little more than a trickle, it is not silt which is responsible for the extensive development and persistence of *Phragmites*. Possibly the presence of large numbers of black-headed gulls which breed on the lake may be significant. The same factor may also be concerned with the presence of *S. semistriata*, a species which is rare in the Lake District, although sometimes associated with waters fouled by animals.

The published conclusions about the succession under silted conditions were based on scanty evidence taken from Helton and Knittleton Lakes and from deltas on Windermere and Esthwaite Water. Further collecting in Belham Tarn, Derwentwater and Rusland Moss has confirmed the conclusion that *S. sahlbergi* is the final species in the succession.

As shown in figure 10 the culminating species of the unsilted succession, that is, the species found where conditions are peaty, are *S. scotti* and *S. castanea*. This is true throughout the Lake District except at exceptionally high altitudes, but elsewhere peaty habitats are sometimes occupied by other species, thus *S. sahlbergi* is dominant in the lowland mosses of N. Lancashire and in two localities where every external appearance of peatiness was accompanied by an unusually high calcium content *S. germari* was found. It seems likely that the ecology of the different species of Corixidæ is related to quite small differences in the soil, and further study of these differences should yield information applicable to the study of many other groups. Interesting correlations between snail and corixid distribution have already been discovered. Careful collections in search of snails, using a roughly quantitative technique based on the results obtained by collecting for a standard length of time, have been made in about twenty tarns and lakes and the results corroborate the conclusions drawn in last year's report. There remain, however, some forty bodies of water for which analyses are available and from which it is believed that careful collecting will yield interesting results.

A paper on the water-beetles of the Lake District, written a year ago, has been withheld until another season's collecting has been done. The collection made during the year has been submitted to Professor F. Balfour-Browne for identification.

TAXONOMIC AND FAUNISTIC WORK ON IMMATURE INSECTS. Hynes has been working on the stoneflies since November, 1938, and has already obtained results of considerable interest. Examination of the stomach contents of a number of nymphs has shown that in the group as a whole a wide variety of food is taken. Three genera are carnivorous, six are herbivorous and one regularly mixes both animal and vegetable food. Most genera are catholic in their tastes but *Taeniopteryx* appears to feed exclusively on algae and diatoms scraped from stones. Observations have also been made on the feeding habits of adults.

The nymphs of most species appear to occupy well-defined habitats and the most important factor in the ecology appears to be the rate of water movement and the nature of the bottom. In a succession of environments from small upland becks flowing over moss-covered rock, through larger stony streams, to rivers, there is a marked change in the generic composition of the stonefly fauna. This biological and ecological work cannot of course be completed until it is possible to identify each species in its nymphal stage, and with this end in view extensive breeding work has been undertaken.

Macan has continued to breed other groups of insects during the summer and some eighty dragonflies belonging to thirteen different species and over a hundred ephemerids belonging to eleven different species were reared successfully. The number of species of ephemerids bred out has thus been nearly doubled, and it is probable that not many still-water species remain to be found in the Lake District. As the still-water species are the least well-known it is hoped to continue the work on them in the coming year in some part of the country where species unknown in the Lake District may be taken.

THE GROWTH OF BROWN TROUT

by E. B. WORTHINGTON and G. H. SWYNNERTON.

The size attained by a fish is dependent on its rate of growth and its age. In trout the rate of growth is not constant throughout