After tea the party was met at Stoney Cross by Mr P. L. Winchester of the Forestry Commission, under whose guidance a visit was made to Salisbury Trench Enclosure where *Quercus petraea*, which was perhaps the indigenous New Forest oak, was seen to be regenerating abundantly.

FRIDAY, 25 JULY

For the final excursion on 25 July, lead by Dr J. F. Hope-Simpson, the objective was Butser Hill, near Petersfield—the westernmost hill of the South Downs and also the highest, bearing chalk grassland, scrub and yew woods and a broad plateau of strongly acid clay-with-flints (surface pH 3·9). Although presenting no great floristic excitement, and sadly impoverished by the recent destruction of its plateau grass-heath, Butser Hill is rich in ecological demonstrations which are the more instructive because for over 30 years it has been the scene of published observations by members of the Society—Tansley, Adamson, Watt, and Hope-Simpson.* The party was conducted by Dr Hope-Simpson to the precise viewpoints of photographs taken in 1920 and 1940. With their aid it was seen that one of the yew societies, freed from heavy rabbit pressure, had recently been re-developing in the coombe-head, while another had remained almost stable. By a similar photographic comparison the deep, rabbit-ridden western coombe (Rake Bottom) showed an apparent waxing and waning of its elder scrub. The spur beyond (Ramsdean Down) showed two or three grassland ecotones (e.g. the limit of co-dominant *Poterium sanguisorba*). On its crest, small islands of clay-with-flints were found to bear a sharply localized dominance by *Agrostis* (*canina* and *tenuis*). Members who faced a whirlwind battle-course across Rake Bottom saw *Rhacomitrium lanuginosum*, a moss otherwise almost unknown on the chalk, and a little *Phyteuma tenerum*, a straggler from its region of great abundance centred a good 30 miles to the east. Tea was followed by a short inspection of the nearby Windmill Hill, where a further photographic comparison showed that the rabbit-devastated ground of 1940 now, after war-time destruction of rabbits, bore an almost closed fescue turf. *Sonchus* sp. was seen by a shaded trunk reaching a height of 6–7 ft.

This terminated a very successful Summer Meeting, during which so much of ecological interest was seen. The weather was excellent, and everyone thoroughly enjoyed the beautiful countryside through which we passed.

The Society is greatly indebted to both Miss F. M. London and Dr Manners who were respectively responsible for the arrangements and for accommodation, travel and food during the itineraries, and for leading many of the excursions.

We also thank Sir Robert Wood, and Prof. W. T. Williams for the hospitality given us at Highfield Hall, and Dr Hockley and Dr Hall for leading the fresh-water biology excursions.

AUTUMN MEETING AT LIVERPOOL

17–19 SEPTEMBER 1952

The Autumn Meeting was held at the Department of Zoology, The University, Liverpool, by kind permission of Prof. Pumphrey, F.R.S. Local arrangements were made by Dr H. B. N. Hynes. Members and visitors attending (30) were accommodated at Derby Hall.

On the evening of 17 September at 8 p.m. a Soirée was held at the Department of Zoology, at which Dr J. W. Jones exhibited his film of spawning salmon.

18 September was devoted to a symposium of stream fauna. Dr C. B. Williams was in the chair.

The first paper was given by Dr L. Davies on quantitative studies on the black-fly *Simulium ornatum* in a lowland stream. The work was carried out on, and near, a small stream in east County Durham, where *S. ornatum* composed about 99% of the Simuliid aquatic stages. Fortnightly samples of larvae and pupae were taken at three stations. Up to September of the first season's work, the figures indicated three peaks of pupal abundance, producing adults in April, late May and June, and in August, respectively.

Oviposition activity was studied by means of cylindrical sticky-traps placed horizontally a few inches above water-level, at suitable sites. Three such traps caught up to 300 female *S. ornatum* per week. Great

* Tansley & Adamson, *J. Ecol.* **13**, 1925; A. S. Watt, *J. Ecol.* **14**, 1926; J. F. Hope-Simpson, *J. Ecol.* **28**, 1940; **29**, 1941.

fluctuations in the weekly catch appeared to be mainly due to variation in the attractiveness of the oviposition-sites in the immediate vicinity of each trap. Observations were made on some of the factors governing the attractiveness of sites to gravid females. These factors included the water velocity, presence or absence of vegetation trailing in the water and the amount of splashing of the water.

Removal of the sticky-trap catches at hourly intervals on certain days showed that all but a few *S. ornatum* females laid their eggs during the hour following sunset, although on dull days in September, much oviposition activity was observed about 2 hr. before sunset.

All females caught on such traps were gravid and were accompanied by a negligible number of males.

Studies of biting activity on cattle within half a mile of the stream showed that in calm weather biting commenced less than an hour after dawn and continued throughout the day until dusk, with a large peak of biting activity about 1–2 hr. before dusk.

In the discussion which followed the President suggested that suction traps might be used to catch adult *Simulium*, and, when Dr Davies remarked that electricity was not usually available in the places where this sort of work was done, said that he had known of a small water wheel used to generate current for this purpose. In a discussion of larval density Prof. Varley pointed out that, in species with a restricted oviposition site, the gradual spread of the larvae after hatching made catches of small and large larvae per unit area difficult to compare. Further information suggested that the biting of *Simulium* is not much affected by temperature, is reduced by wind, and controlled mainly by light intensity.

Miss R. M. Badcock then gave a paper on comparative studies in the population of streams. In her initial remarks Miss Badcock dealt with the problem of classifying streams for comparative purposes. In view of their great environmental complexity comparative quantitative data on the fauna of different streams had to be treated with caution. Nevertheless, where methods and seasons are comparable, certain conclusions can be drawn from a study of the numbers of organisms in quantitative samples, a point which may be illustrated by reference to samples from tributaries of the Welsh Dee and of the Kävlinge River system in southern Sweden. These samples of fauna from stony stream-beds indicated a denser population at the Swedish stations than at the Welsh and a decrease in the fauna in winter samples from stones in all stations. Quantitative sampling also helped in assessing predominant organisms and depicting the stream community.

Various factors thought to be involved in differential qualitative and quantitative distribution were discussed with reference to these Swedish and Welsh streams. Important factors in this survey were considered to be:

(1) Geographical location.

(2) A wider temperature range in the water at the Swedish stations (0–24° C.) than at the Welsh (1–16° C.).

(3) A lower rainfall in the Swedish area than in the Welsh, which together with more wooded land in the upper reaches of the Swedish streams, reduced the tendency to scouring spates at the Swedish stations, resulted in lower normal water velocities and permitted the occurrence of more sheltered micro-habitats.

(4) Chemical composition of the water. The water at the Swedish stations was more alkaline and harder than at the Welsh. Calcium content of the water—or perhaps the balance of salts—may have some direct chemo-physiological effect on certain organisms but it seems more likely that in the majority of cases water—or more eutrophic water—influences the fauna indirectly by increasing the algal food supply. The water was well oxygenated at the sampling stations and oxygen was not considered to be a differential factor in this survey.

(5) Shelter provided by vegetation. *Cladophora* at the Swedish stations may have increased the population density of certain organisms, e.g. *Ephemerella*, amongst stones by providing local concentrations from which they could radiate to the bare stones.

As the streams were well stocked with fish at all the sampling stations it is unlikely that the denser invertebrate population in these Swedish streams is connected with relative paucity of fish predators.

A discussion followed on sampling methods, and Dr Macan observed that Miss Badcock's technique probably missed many nymphs of *Rithrogena* (Ephemeroptera) as these cling tightly to small stones. Prof. Varley thought that the lumping together of all species in one order was not justified, and that distinction between carnivores and herbivores should be made. E. D. LeCren pointed out that figures based on surveys of the type described represented standing crops and that two rivers with similar

standing crops at any given time might differ markedly in productivity. He thought that the rate of digestion of food by fish required further study.

Dr H. B. N. Hynes then gave an account of *Gammarus duebeni* in fresh water. The normal habitat of *G. duebeni* is brackish water in which it occurs from Siberia to France and all round the British Isles. In some western British Isles it is reported from purely fresh-water habitats.

Reliable records of the occurrence of this species and of *G. pulex* in Britain have been collected and mapped and these show that the distribution of the two species are quite vicarious. *G. pulex* occupies most of the British mainland, while *G. duebeni* occupies the islands, e.g. Shetland, Fair Isle, Orkney, Inner and Outer Hebrides, Ireland, Isle of Man, Holy Island, Bardsey and Stockholm. *G. pulex* is known only from a few islands.

In two areas, however, both species occur on the same land mass. These have been investigated in detail and are The Lizard and the Isle of Man. In the former it is clear that *G. pulex* is at its westerly limits and has only relatively recently got to the peninsula. It is suggested that in time it will push *G. duebeni* out of the streams it now occupies, from which *G. pulex* is still absent. In the Isle of Man, it seems clear that *G. pulex* is a recent introduction. Here the two species actually occur together in two watersheds, but it can be shown that conditions in both tend to prevent their mixing.

It is concluded therefore that *G. pulex* can replace *G. duedeni* in fresh water. The same appears to apply to marine species of *Gammarus* in the sea itself.

Work is continuing with introduction experiments in the Isle of Man, but this has so far proved inconclusive, and seems to take a long time to bear fruit.

Work has also been done on the suggestion that fresh water and brackish water specimens of *G. duebeni* belong to different biological races, but the conclusion is that they do not. The distribution of the fresh-water type is, for instance, very scattered, they cannot be shown to differ in salinity tolerance or structure of the antennal gland, and they interbreed readily and produce normal offspring.

Several points require further elucidation, the most important being the unexplained absence of both species from apparently suitable streams. This does not appear to be due to water chemistry nor associated organisms.

During the ensuing discussion Dr Hynes said that there was no apparent connexion between the absence of *Gammarus* from certain streams and the presence of any other animal; and that although *G. duebeni* has been kept successfully in the laboratory in the Isle of Man in water from the stream whence it was taken, this has not been achieved in Liverpool. Prof. Varley applauded Dr Hynes's transplantation experiments and said he thought the apologetic references to them quite unwarranted.

Dr Janet Harker followed with her paper on the migration of a mayfly nymph. Quantitative studies of the nymphal population of *Ecdyonurus torrentis* in a Lancashire stream showed that there was a sudden drop in numbers downstream in November, 1949, 1950 and 1951, coinciding with an increase in numbers upstream. Marked nymphs released and collected again after 24 hr. were found to have moved some distance upstream. Laboratory experiments show that there is a marked increase in activity at this time. A similar increase in activity can be affected by lowering the temperature of the water and placing the nymphs on an unstable bottom; these two conditions being also apparent in the stream on the occasions when migration occurred.

Studies of the diurnal rhythm of the nymphs show that the greatest activity occurs between 5·0 and 7·0 a.m., and probably most of the migration takes place in this period. Marking experiments carried out only between 9·0 a.m. and 5.0 p.m. showed that there had been no appreciable movement during those hours.

An increase in numbers downstream in February was noted, but was not as great as the upstream increase in November. Marked nymphs were found to move very slowly downstream at this time, and the activity was not increased. These results suggest that the nymphs tend to be washed downstream as the ice cover breaks, and that no true migration occurs in early spring. In reply to questions Dr Harker said that the upstream migration that she had observed did not lead apparently to crowding near the top of the stream, and that she had not observed a downstream migration at any time of year.

T. T. Macan opened the afternoon session by giving a paper on *Ephemeroptera* of a stony beck. The stream studied was small, being 1000 yards long, and receiving not far from the source two tributaries which rise rather further from the mouth than this. The width probably nowhere exceeds 2 yards and the

water comes up to the ankles during normal flow. The level rises rapidly when there is heavy rain. The flow has not been measured; the significant point is that the current is of such speed that the bottom is stony. The fall is about 100 ft. per mile in the last two-thirds and thrice that in the upper third. There is little vegetation. The beck drains agricultural land.

Ephemeroptera nymphs have been collected from six stations every month for 3 years. The collections have been made with a net; a fine net catches an astonishingly large number of tiny nymphs that pass through coarser netting. A shovel sampler bringing up a known area of bottom which is then tipped into calcium chloride solution so that the animals float to the top has been used.

The common species are *Baëtis rhodani* and *Rithrogena semicolorata*; also abundant are *Ecdyonurus torrentis*, *Baëtis pumilus* and *Ephemerella ignita; Ecydonurus venosus*, *Heptagenia lateralis*, *Habrophlebia fusca*, and *Paraleptophlebia submarginata* occur regularly though in small numbers. The composition of the population has been unexpectedly constant during the three years.

Rithrogena is a univoltive species that emerges in May and lies dormant in the egg stage during the summer. *Ephemerella ignita*, on the other hand, lies dormant in the egg stage all winter and nymphs are found only in summer. Both species of *Baëtis* have several generations in a year.

B. rhodani goes downstream just before emergence and some of the other species probably do the same.

Ecdyonurus torrentis in the lowest reaches of the stream and *Rithrogena* higher up are possibly vicarious to some extent, and *Ephemerella ignita* has been found only in the lower reaches. Otherwise the composition of the population is similar all up the beck, though total numbers are much smaller in the tributaries.

The President and Prof. Varley both thought that Dr Macan was wrong in believing that big annual fluctuations in the populations of species were usual.

An account was then given of spates as a factor in the ecology of rivers by Mr W. R. Munro. There are three main ways in which spates may affect the fauna of a river. First, where the bottom is unstable, many organisms may be crushed and destroyed by the molar action of moving stones. Secondly, they have an indirect effect upon the fauna through alterations in the food supply and in the arrangement of bottom materials. Thirdly, even in rivers with stable beds, it has been suggested that spates bring about a redistribution of the fauna, reducing the population in the more exposed parts of a river and depositing the animals so dislodged in the quieter and more sheltered habitats, from which the depopulated areas are reinvaded during normal water conditions.

Work carried out on the upper reaches of the River South Esk in Glen Clova, Angus, although limited in its scope, appeared to confirm the last-mentioned effect of spates, with particular reference to the Plecoptera and Ephemeroptera.

The results also indicated that there were differences in the average size of nymphs of some species of Plecoptera in two different habitats. It is possible that such differences are due to the selective manner in which spates may affect different size groups of the same species and that the nature of the substratum may be important in this respect. Dr Macan thought that the sampling method used was also open to the objection that many Rithrogena nymphs would be missed. He also asked if Mr Munro could tell the meeting anything about the trays which had been used for sampling at Pitlochry. Mr Munro replied that he had not had any experience of this work but believed that the technique had not proved very satisfactory. The President stressed the necessity of having some indication of the magnitude of error involved in any set of samples.

The final paper of the symposium was given by A. Swain on the fauna of the Nene and Welland. Both the Nene and Welland are strongly influenced by the Lias Clay lands which they drain. They have cut through relatively soft sediments giving rise to silted conditions which favour a preponderance of slow-water communities, particularly on the Nene.

The fauna may conveniently be grouped into 'marginal' forms and 'bottom' forms. The marginal forms inhabit the fringing vegetation and contain, for example, the larvae of Ephemeroptera, Odonata, Trichoptera, and Plecoptera, and also Corixids, fresh-water shrimp and snails. The bottom form consists mainly of Chironomid larvae and Oligochaet worms.

In general, the fauna of the River Nene is varied, except where conditions due to artificial causes occur. For instance, below Earls Barton where a large amount of organic material enters the river, there is a well-defined decline in the fauna, both in species and numbers, except for bottom forms. Further

downstream the marginal forms decrease while the bottom forms remain numerous, and eventually, near Islip, the bottom forms decrease to low numbers. Below this point, there is a gradual increase in the numbers and species of animals.

The character of the River Welland is rather different from that of the Nene. At many places the river is shallow and swift flowing, with the bottom consisting of stones and rocks. Much of the vegetation grows on these stones and harbours a rich fauna which is more or less equally distributed throughout the whole width of the river.

In comparing the Nene with the Welland it is apparent that the fauna of the two rivers owes much to the configuration of the two channels. In the case of the Nene there is usually a shelf extending a few feet from either bank, on which most of the aquatic vegetation grows, and the rest of the channel is deep with a muddy bottom. The Welland, however, is a shallow river along a greater part of its length with little distinction between marginal and bottom fauna. Mr Swain was asked about species identification and he replied that for most groups this had not been done.

The President, in his final remarks, thanked Prof. Pumphrey for his hospitality and the facilities put at the disposal of the Society, and also Drs Hynes and Jones for the excellent arrangements made for the meeting.

Excursion on 19 *September*

A party of some twenty people proceeded by bus to Bala, stopping on the way to look at a small stream and also to visit the experimenta tank on the River Alyn where Dr J. W. Jones's work had been done. After lunch in the town the party went to Bala Lake and spent about an hour there, some people going out on the Liverpool University Zoology Department launch. The return was by the Dee Valley and, as the rain of the morning had cleared and the sun was shining, the drive was most enjoyable. A halt was made at Llangollen and Dr Hynes showed members *Eucrangonyx gracilis*, the American amphipod that has recently reached Britain and which is still confined to a very short stretch of the River Dee.

BRITISH BRYOLOGICAL SOCIETY MEETING AT LEEDS

26–28 September 1952

The British Bryological Society extended an invitation to members of the Ecological Society to take part in their autumn meeting. Several members of the Society took advantage of the invitation to attend as guests, and all appreciated the opportunity to join in a meeting which was very successful and enjoyable.

The meeting, attended by about fifty people, began with a soirée in the Botany Department, University of Leeds, on the evening of 26 September, at which a variety of exhibits of Bryological interest were on view. The following day four papers were read:

Morning

Dr C. H. Gimingham and Miss E. M. Burnett — Investigations of correlation between growth-form and habitat in mosses.

Prof. A. R. Gemmell — Regeneration in *Atrichum undulatum*.

Afternoon

Dr P. Greig-Smith — Taxonomy of British species of *Lejeunea*.

Prof. I. Manton — The spermatozoid of *Sphagnum* and other Bryophytes.

Each of these papers was followed by a lively discussion, and in connexion with the last one Prof. Manton had on view a large selection of remarkable electron microscope photographs showing the spermatozoids of *Sphagnum* and other Cryptogams, in which details of the structure of cilia were demonstrated.

On 28 September an excursion to the woods and riverside near Bolton Abbey, Wharfedale, took place. A large number of interesting species of Bryophytes and Lichens were collected. The enjoyment of a very profitable day was enhanced by the beautiful autumn coloration of the Bolton Woods.