

visits being indeed a strong point of the meeting, since the North East includes so many types of heavy and light industry. The sites visited included the Wilton and Billingham works of Imperial Chemical Industries, Ltd., the Pyrex glass works at Sunderland, two coal mines, factories making springs and pumps, works for gas, soap and mining machinery, the Ediswan lamp and valve factory, Parsons and Marine Engineering Turbine Research and Development Association, Reyrolles switchgear works, and the premises of Associated Lead Manufacturers, and of the Grubb Parsons Optical Co., Ltd. A visit was also made to the Radiochemical Laboratories at Durham, where accurate analyses of small quantities of rare gases are performed. Samples of gas from the upper atmosphere, taken in the United States by means of rockets, are sent to Durham for analysis.

The meeting also included discussions on M.K.S. units, on science teaching in secondary modern schools, and on science and religion.

The final morning again began with lectures, by Dr. S. L. Ranson on the metabolic activities of cellular particles, Dr. J. H. Wilkinson on small-scale organic preparations, and Mr. P. C. G. Isaac on public health engineering.

During the meeting, all the science and engineering laboratories of King's College were open, and members, manufacturers and publishers again gave their usual exhibitions; the manufacturers and publishers expressed great satisfaction at their excellent housing in the new Chemistry Building.

Special exhibitions were also arranged by the Northern Lighting Bureau of the Electric Lamp Manufacturers' Association and by the British Iron and Steel Federation. For the former, the area representative, Mr. R. J. Fothergill, had prepared a fascinating experimental display, including, in a corridor, an illuminated sign, the light from which detected whether one's shirt had been washed in particular detergents. For the Iron and Steel Federation, Capt. J. F. W. Mudford, area training organizer, had a comprehensive collection of all the Federation's educational literature, together with specimens and static models of its productions.

The social side of the meeting was catered for by an evening concert in King's Hall, preceded by a reception at which members and their ladies were welcomed by the Lord Mayor and Lady Mayoress of Newcastle upon Tyne, the Rector of King's College, and the Chairman of the Association and Mrs. Dyball. The playing in of the Lord Mayor by the Northumbrian pipes of Mr. Jack Armstrong was a touch characteristic of the locality; and the concert, which included piano solos by Miss Margaret Evans, Northumbrian songs by Mr. William Robinson, and pipe music by Mr. Armstrong, was much appreciated.

The Association is deeply indebted to all those who helped with the preparation of the meeting, and especially to the registrar, Mr. G. R. Hanson; to Prof. W. F. Cassie, who arranged the tours of the engineering laboratories; and to Dr. Chalmers Burns, director of music, who obtained the artistes for the concert.

It may be permissible to quote the final comment of a witty member from a famous Scottish public school, who said that he was going home "a wider and a humbler man; wider in that he had been fed so well, and humbler in that he had learnt so much".

W. H. DOWLAND

## THE BRITISH FLORA DURING 1954

THE flora of the British Isles has been the subject of such thorough investigation, as compared with most other countries, that advances in knowledge can now be expected mainly from the application of new techniques and from the closer study of small groups. These were the approaches adopted by most of the exhibitors at the annual exhibition meeting of the Botanical Society of the British Isles, arranged in the lecture room of the British Museum (Natural History) on November 28. It was evident that cytology and careful analysis of variation are still yielding some of the most interesting results, and that the study of hybrids is proving of far greater importance than was supposed a few years ago.

One entirely new development was illustrated by H. J. M. Bowen (Radiobiological Research Unit, Atomic Energy Research Establishment, Harwell). By means of activation analysis—the ashes being irradiated with neutrons in the Harwell pile, and the radioactive strontium then separated from all the other elements by conventional methods—he has determined the amount of strontium present in material from about forty species of plants. He finds that plants growing on ordinary soils contain 1–50 parts per million of strontium, but in the limited areas in Britain where the soils contain large concentrations of this element (as the sulphate, celestite; or as the carbonate, strontianite), plants are found to contain up to 2 per cent or more of strontium by dry weight. All the species examined were found to be accumulators. The Avon Gorge is one of the areas where considerable concentrations occur in the rocks, and the concentrations in some of the rare species found there (for example, *Arabis stricta* 1.06 per cent, *Anisantha madritensis* 1.16 per cent) are also high. Further investigation may show that the distribution of certain plants may be related to concentrations of strontium.

A number of very interesting hybrid grasses were exhibited. Dr. A. Melderis (British Museum (Natural History)) showed *Festuca rubra* × *Vulpia membranacea*, which was collected by several members on the Society's field meeting at Southport, and later by Miss M. McCallum Webster on dunes at Sandwich. In both places it evidently occurred in some quantity. A similar hybrid was exhibited by C. E. Hubbard (Royal Botanic Gardens, Kew) from Vazon, Guernsey. He also showed *Agrostis stolonifera* × *A. semiverticillata* from Vazon, *Festuca arundinacea* × *Lolium perenne*, and a variegated form of *Poa annua* from a shrubbery at Kew. With N. Y. Sandwith (Royal Botanic Gardens, Kew) he exhibited *Agropyron repens* × *Hordeum secalinum* (× *Agrohordeum langei*), collected by Mrs. C. I. Sandwith in 1945 from Shirehampton.

Two other hybrids exhibited which are new to the British list were *Carex binervis* × *C. punctata* from rocks near Barmouth, shown by P. M. Benoit, and *Mentha aquatica* × *M. rotundifolia* (*M.* × *maximiliana*), collected by Miss B. M. Sturdy near Penzance, and shown by R. Graham. J. D. Lovis (University of Leeds) provided an interesting demonstration of ferns. *Asplenium adulterinum* is a tetraploid species ( $2n = 144$ ), intermediate in morphology between *A. viride* and *A. trichomanes*, and is found on serpentine rocks in central Europe and Fennoscandia, where it usually grows with one or

other of the species mentioned. It may yet be found on serpentine rocks in the more remote parts of Scotland. Investigation showed that it is amphidiploid, with the diploid form of *A. trichomanes* ( $2n = 72$ ) and *A. viride* ( $2n = 72$ ) as its probable parents. The hybrids *A. trichomanes* ( $2x$ )  $\times$  *A. adulterinum*, *A. adulterinum*  $\times$  *A. trichomanes* and *A. viride*  $\times$  *A. adulterinum* have been synthesized. *Asplenium*  $\times$  *breyinii*<sup>1</sup> was also exhibited.

Another aspect of the importance of the study of hybridity was demonstrated in the exhibit by Prof. T. G. Tutin (University College, Leicester) of British material of *Symphytum*. The plant usually referred to as *S. peregrinum*, which is frequent, and very variable, appears to be the central part of a hybrid swarm from the cross between *S. officinale* and *S. asperum*. Dr. E. F. Warburg (Department of Botany, University of Oxford), who has been re-examining material of alleged hybrids in connexion with work on the new "Plant List" which the Society has in preparation, exhibited herbarium specimens of some of the plants on which published names have been based. He found that some of these 'hybrids' are morphologically convincing; but others, such as *Lotus*  $\times$  *davyae* and *Potentilla*  $\times$  *cryeri*, are apparently only forms of one of the alleged parents.

The University of Manchester exhibit on *Senecio* covered an excellent example of a polyploid hybrid which is fertile, and this is to be described as a new species. *Senecio squalidus* ( $2n = 20$ ) was crossed with *S. vulgaris* ( $2n = 40$ ), and from the hybrid ( $2n = 30$ ), by colchicine treatment, the synthetic polyploid ( $2n = 60$ ) was produced. This was exhibited in three forms: mid-ray, long-ray and rayless. The synthesized plant was found to agree in morphological characters with a natural polyploid found in North Wales by H. E. Green in 1948, which was seen wild in quantity again this year, and which has persisted in cultivation since its discovery. A technique for growing species of *Euphrasia*<sup>1</sup>, which are partially parasitic, was demonstrated last year by P. F. Yeo (University of Cambridge). This year he exhibited artificial hybrids of *Euphrasia occidentalis* with *E. salisburgensis* var. *hibernica* and with *E. pseudokerneri*, which had been grown with their parents on *Medicago lupulina* as the standard host.

In 1952, *Artemisia norvegica* was discovered in north-west Scotland<sup>2</sup>. Critical examination by Prof. E. Hultén of the circumpolar group of closely related species to which this belongs has shown that the plant from Scotland is distinct, and it has been described as ssp. *scotica*<sup>3</sup>. The type material on which the new taxon is based was exhibited by the Department of Botany, British Museum (Natural History). The Department also showed specimens of *Rubus arcticus* from its collection labelled as collected from Ben Lomond and "Ben-y-glo", for comparison with one from "Ben Lawers, 1837" recently detected in Cosmo Melville's herbarium in the Butler Museum, Harrow, by R. M. Harley. This circumpolar species occurs in Scandinavia, and further search may well confirm it as a British plant. The Museum also exhibited interesting sheets of *Carex lepidocarpa* ssp. *scotica*<sup>4</sup>, *Nuphar pumila* and *N. intermedia*<sup>5</sup>, and viviparous grasses<sup>6</sup> to illustrate recent papers in *Watsonia*. P. S. Green (Royal Botanic Gardens, Edinburgh) showed seeds, specimens and a map of the distribution of *Stellaria nemorum* spp. *glochidisperma*, which he has recently described for Britain<sup>7</sup>.

Dr. S. M. Walters (Botany School, University of Cambridge) demonstrated the use of the category 'sub-species' in taxonomy, pointing out that in current practice three different situations are involved, namely, the geographical sub-species, the "cyto-sub-species" and the "ignorance sub-species". He suggested that the use of the same category for genetically different situations is in no way either inconvenient or undesirable, and illustrated the point with reference to the diploid, tetraploid and hexaploid cytodesmes of *Polypodium vulgare* L., for which he advocated a sub-specific category. Dr. K. B. Blackburn and Miss A. W. Adams (King's College, Newcastle upon Tyne) provided an interesting exhibit of cytology of *Herniaria*. In the *glabra* group of the sub-genus *Eru-herniaria* the chromosome numbers show a polyploid series on a base of nine. S. Challenger (University of Bristol) exhibited flowers of *Dianthus gratianopolitanus* from Cheddar Gorge, which show a surprising amount of variation for a species with such a restricted distribution in Britain. Living plants, silhouettes of the fruit papillae and distribution maps of *Galium pumilum* in Britain were shown by K. M. Goodway, who suggested that this could be tentatively divided into western ( $2x$ ), montane (? hybrid), northern-limestone ( $4x$ ), southern-chalk (?  $8x$ ) and Cheddar (?  $8x$ ) forms. D. J. Hamblen (Queen Mary College, London) illustrated the cytology and ecology of Orobanchaceae and semi-parasitic members of the Scrophulariaceae<sup>8</sup>. A. C. Jermy (University College, Leicester) showed variations in *Carex nigra* and its hybrids, and M. C. F. Proctor (Nature Conservancy) of *Helianthemum canum*.

The main exhibit concerned with the distribution of British plants was that of the Society's distribution-maps scheme<sup>9</sup>, on which three full-time and two part-time assistants are now engaged in addition to the director. The nine hundred 10-kilometre squares for which volunteers have already accepted responsibility for the contribution of records were indicated on a large map, and further offers were received during the exhibition. Dr. C. D. Pigott (University of Sheffield) provided an exhibit to illustrate the fact that many northern plants reach the south-eastern limits of their distribution, and many southern plants their north-western limits, along a line that runs diagonally across central England, and used *Asplenium viride* and *Cirsium acaule* as examples. These meet but never overlap, and it is significant that near Sheffield the reproductive capacity of *C. acaule* is greatly reduced. There seems little doubt that this phytogeographical boundary is also a significant climatic boundary. J. E. Lousley showed photographs of the very rare orchid *Epipogium aphyllum* from a new locality in Oxfordshire. Dr. T. D. V. Swinscow exhibited photographs of ferns at Leagrave Station, Bedfordshire, where nine species had been found. They included both calcicole and calcifuge ferns, and their occurrence on a railway platform suggests that distribution of the spores may be facilitated by the traffic. R. A. Graham provided evidence that *Cypripedium calceolus* occurred in Yorkshire in 1954. P. M. Benoit showed *Salicornia perennis* from Barmouth and Mochras, Merioneth, as the first certain records for Wales. W. S. Lacey (University College of North Wales, Bangor) had an exhibit to illustrate his discovery of *Orchis trausteneri* in Caernarvonshire. Sub-fossil botany was represented by an exhibit by J. W. Franks (University College, Leicester) of plants from the 'N' horizon in

the Esthwaite basin. The drop in tree pollen, rise in grass pollen and occurrence of *Plantago lanceolata* suggest that this horizon may represent the beginnings of cultivation in the area.

A useful warning to modern collectors and commentators was implied in the exhibit by Mrs. H. N. Clokie (Department of Botany, University of Oxford) of selected sheets from the Du Bois (1690–1723) and Sherardian (1700–26) herbaria. These showed the confusion and loss of information which can result from illegible labels, or from mounting plants which could not be certainly associated with their labels. The Library of the British Museum (Natural History) displayed a magnificent series of unpublished drawings prepared for Church's "Types of Floral Mechanism" and unpublished text. The view was freely expressed that the publication of these fine additional drawings would be a valuable addition to the book already available.

A full account of the exhibits will appear in due course in the *Proceedings* of the Society. The meeting was attended by about two hundred and eighty members and guests.

J. E. LOUSLEY

<sup>1</sup> Lousley, J. E., *Nature*, 173, 113 (1954).

<sup>2</sup> Lousley, J. E., *Nature*, 171, 335 (1953).

<sup>3</sup> Hultén, E., *Nytt Mag. Bot.*, 3, 67 (1954).

<sup>4</sup> Davies, E., *Watsonia*, 3, 71 (1953).

<sup>5</sup> Heslop-Harrison, J., *Watsonia*, 3, 7 (1953).

<sup>6</sup> Wycherley, P. R., *Watsonia*, 3, 41 (1953).

<sup>7</sup> Green, P. S., *Watsonia*, 3, 122 (1954).

<sup>8</sup> Hambler, D. J., *Nature*, 174, 838 (1954).

<sup>9</sup> Walters, S. M., *Nature*, 173, 1079 (1954).

## HYDRAULIC TRANSPORT OF COAL

TRANSPORT of coal from the mines to the user represents an appreciable proportion of the energy in the fuel. Normally this is done by rail or sea transport; but transportation through pipes as a suspension in water is another possibility. The advantages of hydraulic transport over short distances within the workings of the colliery are apparent—either underground or on the surface, or even as an alternative to normal cage winding. There is, however, the possibility that hydraulic transport of coal could be operated over much longer distances; this has already been accomplished up to five miles, and a hundred-mile pipe-line is planned in the Pittsburgh area. These advantages and many others were described by Dr. Idris Jones, director-general of research, National Coal Board, in an introductory address to a colloquium on "The Hydraulic Transport of Coal" held by the National Coal Board in London during November 5–6, 1952 (pp. vi+75. London: National Coal Board, 1954), which was opened by Sir Charles Ellis.

Although there is in existence much experimental data on the transport of solid material by water streams in open channels and pipes, the numerous factors involved have hindered the formulation of any theory which will give a full understanding of the transport process in pipes. The purpose of the colloquium was to assemble and compare such results as are available and to discuss tentative theories. The first four papers dealt mainly with fundamental theory and the development of dimensionless groups characterizing the flow of suspensions through pipes, with lump sizes up to 4 in. Some of the authors admitted that the present theory is inadequate, and

it is evident that this is only the beginning of research on this subject. The second group of four papers described the development of coal feeders and experimental installations in France and at Markham Colliery.

The discussion on the papers is included in the publication, and the proceedings form a useful basis for further study of a subject which is becoming of increasing practical importance. H. HEYWOOD

## RECENT WORK IN MAYAN ARCHAEOLOGY

OVER a long period of years, the Carnegie Institution, through its Archaeological Department, has produced a most valuable series of publications, most of which deal with the Maya area. The shorter studies in this series have appeared in volumes of *Contributions*, of which that under review is a useful example\*.

No. 52, by Howel Williams, deals with some human and animal footprints first discovered seventy years ago on the outskirts of Managua, Nicaragua, which aroused a great deal of interest when they were found, owing to their supposedly great age. This was based on the considerable depth of four metres at which they were found, and was estimated at 50,000 years or more. Further examples were found at the same horizon in 1941, so it has been possible to study the question afresh. Williams shows that the deposits in and under which they occur are pumices and mud-flows associated with vulcanicity, which must have been accumulated at a great rate, so that their age has been grossly exaggerated. The prints are abundant, and may well have been made by people fleeing from a rain of ash from the volcano Masaya. On the scanty evidence of a sheard of Usulután ware found on the site at a considerably higher level, it is concluded that the footprints are between 3,000 and 5,000 years old. The author holds out little hope of obtaining material for radiocarbon dating, so it is unlikely that this estimate can be improved on.

The second paper, No. 53, by A. V. Kidder and E. M. Shook, describes the partial excavation of a complex temple mound containing at least two important burials at the Maya site of Kaminaljuyú, near Guatemala City. The authors, with J. D. Jennings, have already published an important work on Kaminaljuyú; but it is a very large site and a great deal remains to be done. This was largely a rescue dig, necessitated by the destruction of part of the mound by brick-making activities. The mound proved to belong to the Miraflores phase of the Pre-Classic or Middle Culture Period, dating in all probability from the first part of the first millennium B.C.; the authors had suspected that this might be so, but had been loth, in the absence of positive proof, to ascribe so large and complex a structure to this early period. The importance of the work lies mainly in the recognition of this fact, which may make it necessary to postulate the emergence of 'Classic' social structures, for example, a ruling class, in pre-Classic times, and perhaps to revise our chronological nomenclature accordingly.

Something is known of the archaeological record of the Maya in Northern Yucatan from the Formative

\* *Contributions to American Anthropology and History*, Vol. 11, Nos. 52–56. (Publication 596.) Pp. vi+236. (Washington, D.C.: Carnegie Institution of Washington, 1954.) 6.75 dollars, paper; 7.50 dollars, cloth.