Quantocks as areas of outstanding natural beauty, and is in informal consultation with the county councils about the Surrey hills and the Lleyn. The effect of such designation is chiefly to apply to such areas the powers conferred by the Act for the preservation and enhancement of natural beauty, and projects for these purposes, approved by the Minister, qualify for Exchequer grants of 75 per cent.

The other area considered by the Commission during the year as a possible national park, the Broads, presents problems not encountered elsewhere. The Broads themselves are diminishing in area, and this encroachment of land on water results from a complicated natural process not yet fully understood. Neither the origin of the lagoons nor the causes of their in-filling has yet received more than superficial investigation, and the Commission considers that such a scientific survey is an essential preliminary to any decision as to whether and at what points and at what cost restoration could be undertaken with any hope of success. Arrangements for such a survey are being discussed with the Nature Conservancy and the Ministry of Housing and Local Government, and it is hoped that the task will be undertaken by the Nature Conservancy in the near future.

Disappointment is again expressed at the slow rate of progress with the 'long distance routes', and the Commission's dissatisfaction with the Minister's decision to uphold the Manchester Corporation's contention in regard to the Pennine Way and Crowden Great Brook is recorded. Little progress was made in the establishment of new rights of way for the Cornwall north and south coast sections of the South-West Peninsula coast path; but more encouraging reports are given of the Pembrokeshire coast path, the Flamborough coast route and the South Downs route; a Welsh Highland route is under consideration. The Commission has been able to increase its publicity activities and plans to make more information available about the national parks and the long-distance routes and, as already noted, the ever-present problem of litter receives increasing attention under the publicity campaign with the Country Code.

In regard to development questions, the Commission notes that the Service departments consult the Commission on their proposals for the acquisition of land and erection of buildings and associated works required for the defence programme when these fall within areas in which the planning authorities know the Commission is interested. To ensure that the Commission is made aware of such proposals at the earliest opportunity and to facilitate liaison, the Commission now proposes to supply the Service departments with copies of special maps showing the areas in which it is interested. The Commission's views on the reconciliation of the claims of amenity with the duties of area boards to supply electricity at the lowest possible cost are reiterated; as a result of a general discussion with the Central Electricity Authority in which the Commission stressed the value of early consultation on new projects in areas of special landscape value, it is hoped to build up local liaison and by its means reach acceptable compromises. Meanwhile, the Ministry of Fuel and Power announced on June 27 that the North-Western Electricity Board has agreed to lay underground the whole of the new supply lines as far as Rosthwaite, including the circuit of Derwentwater, but decision on the remaining sections of the Borrowdale line are awaited. The Board has also announced that there will be no additional charge to consumers for the Hartsop scheme or in any other area where the Board is placing lines underground to preserve the beauty of the existing scene. As regards the North Wales hydroelectric power proposals, the Commission, while not offering outright opposition to the Bill embodying the Ffestiniog and Rheidol schemes, has submitted a detailed memorandum directing attention to points requiring special consideration, and it insists that it is essential that its representations should reach the Parliamentary Committee in the form in which they are made. This procedure has now been agreed with the Minister.

In regard to the proposed road racing circuit in the Peak District National Park under discussion by the Derbyshire County Council, the Commission records the opinion that it cannot see how any such proposals could be consistent with the maintenance of the area as a national park. The Conference of Park Planning Authorities held in London on July 26 provided a valuable opportunity for discussion of problems and for the demonstration of community of view.

## THE DEVELOPMENT OF THE POLAROGRAPH

THE thirtieth anniversary of the invention of the polarograph was marked by Prof. J. Heyrovský's recent visit to Great Britain at the invitation of the Polarographic Society, when he took the opportunity of delivering his presidential address to the Society, given in London at the Royal Institution on November 16. Prof. Heyrovský began by pointing out that 1925 was to some extent a nominal date for the invention of the polarograph. Like most inventions, it took a year or so to conceive and develop. The original design is still in use, and its performance is, in fact, superior to many of the commercial instruments which have been developed from it.

The exact reproducibility of the current-voltage curves obtained with the dropping-mercury electrode had made it worth-while to construct an automatic device (the polarograph) for the purpose of recording such curves. Therefore, in the original meaning of the word 'polarography' the use of an exactly reproducible electrode was of greater significance than the use of automatic recording. In recent years, however, there has been a tendency to neglect the importance of reproducibility and to apply the term 'polarography' to the automatic recording of current-voltage curves in general. Nevertheless, Prof. Heyrovský considered it desirable to restrict the use of the word to the investigation of all aspects of the dropping- or streaming-mercury electrode. These include a number of phenomena that are studied by current-time or potential-time curves. The current-voltage curves of solid electrodes, which were studied many years before the introduction of the polarograph, were not reproducible and so did not constitute polarography in the strict sense of the word, even though they might be obtained by means of the polarograph. Such considerations govern the inclusion of material in the well-known bibliography which is maintained by the Polarographic Institute of the Czechoslovak Academy of Science.

With regard to the capillary, the mercury flow-rate should not exceed 2 mgm./sec. In concentrated solutions, failure to adhere to this condition leads to

unwanted maxima of the second kind, and Kryukova has attributed these to stirring of the solution in the vicinity of the drop. Kinks in the plastic tube which joins the capillary to the reservoir can be discouraged by a specially bent capillary assembly. The introduction of the horizontal capillary by Smoleř is of considerable interest, for the resultant current-voltage curves are smoother than those obtained with the vertical capillary, disturbances are absent and the oscillations due to drop formation are greatly reduced. Current-time curves of single drops show that the horizontal electrode obeys the Ilkovič equation more exactly than the vertical one. The horizontal electrode is conveniently achieved by bending the tip of a vertical capillary, so that the last 2 mm. or so is in the horizontal plane. The control of drop-time by the use of a small electromagnetic hammer is now proving useful, not only for the synchronization of the twin-electrode systems employed in subtractive or derivative polarography, but also for any circumstances in which it is desirable to reduce the drop weight from its natural value. The streaming-mercury electrode, originally introduced for oscillographic experiments, has proved useful in ordinary polarography, and an equation for its diffusion current has been introduced by Ríus, Llopis, Polo and Koryta.

Small fluctuations in the potentials of the two mercury pools as well as in the rate of flow of mercury through the twin capillaries have proved a practical hindrance to the elegant subtractive method. On the other hand, derivative curves are readily obtained by means of two synchronized electrodes immersed in one solution and differing in potential by about 10 mV. throughout the polarogram. Vogel and Říha have obtained derivative curves from a single capillary by means of a condenser-resistance circuit (their publication appeared about a year before that of Lévêque and Roth), and in this case it is necessary for the applied voltage to vary linearly with time. In yet a third method, a single capillary can be made to yield derivative curves by the use of a mirror galvanometer having a special 'two-coil' suspension. Here, the passage of electrolytic current through the first coil induces its time-derivative in the second one. The general advantage of the derivative curve is that its maximum gives information both on the half-wave potential (the quality) and on $di/dE$ (the quantity) of the electroactive substance. On the other hand, the sensitivity is only about 5 per cent of that obtainable from the normal polarogram. Furthermore, apart from the method, which employs twin capillaries, the half-wave potential depends on both the rate and direction of the applied voltage. Any discussion of derivative polarography would be incomplete without reference to the square-wave polarograph developed at Harwell by Barker and Jenkins; in its sensitivity, this instrument greatly exceeds any polarograph which has so far been developed.

Attention was directed by Prof. Heyrovsky to the little-known Kalousek method for studying the reversibility of electrode processes. By means of a commutator, the electrode is subjected to alternate cathodic and anodic polarization at between 5 and 10 cycles/sec. In these circumstances, a metal such as zinc undergoes cyclic deposition and dissolution. In acid solution, the resultant single anodic–cathodic wave shows the reduction process to be reversible. On the other hand, the formation of a double wave in alkaline zinc solutions indicates an irreversible process.

During recent years, polarography has been successfully combined with the chromatographic technique of separation, a method known as 'chromatopolarography' having been devised by Kemula. Industrially, the polarograph is finding an ever-increasing application as a continuous service indicator. For such purposes, the mercury-pool anode is unsatisfactory, since the whole of the mercury is eventually converted to calomel. To meet this difficulty, the dropping-mercury electrode in halide solution has recently been introduced as a stable reference anode. The continuous determination of oxygen constitutes one of the more prominent examples of the continuous service application, and in this particular example the mercury-pool cathode has proved to be about a hundred times more sensitive than the dropping-mercury cathode.

An interesting biochemical application of polarography is to be seen in the apparatus of Šerák. Here, the oxygen uptake of tissue preparations can be accurately followed over a period of time. In the medical field, the polarographic diagnosis of cancer is based on Brdička's protein test, now almost twenty years old, in which, after precipitating the bulk of the proteins from the patient's serum, the filtrate is examined polarographically in the presence of hexamminocobaltic chloride in ammoniacal solution. When the patient is suffering from cancer or some feverish condition, an exceptionally large protein wave, due to muco-proteins, is observed. Prolonged experience of this test suggested that it is 80 per cent certain, but the modified test recently introduced by Balle-Helaers appears to be 100 per cent certain; this modification involves graded alkaline denaturation, before precipitating the proteins with sulphosalicylic acid.

In theoretical polarography, a new field has been opened up by Wiesner and Brdička's discovery of the kinetic current, which depends upon the rate at which depolarizer is being formed at the electrode surface. Kinetic currents are independent of reservoir height and possess temperature coefficients of the order of 30 per cent per deg. C. Such investigations have led to important information about rate-constants; for example, all four rate-constants of the mutarotation of α- and β-glucoses are derived in this manner. Brdička's study of the reduction waves of weak acids has also led to the consideration of the absolute rate of recombination of ions.

The cathode-ray oscillograph is finding increased uses in polarography. In this way, it is possible to follow the polarographic current-voltage curves on one mercury drop of 5–8 sec. duration. In an alternative approach, the potential-time curves are obtained.

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# THE GEOGRAPHICAL ASSOCIATION

## ANNUAL CONFERENCE

THE annual conference of the Geographical Association, held at the London School of Economics and Political Science during January 3–6, was noteworthy this year for two main aspects, namely, the emphasis given to papers on London and the London Basin and the unusually large number of members who were present. All the lec-