

two days later during the general festival of scientific films. Two of these were "Netzbau der Kreuzspinne" and "Pervitinwirkung bei der Kreuzspinne"; both were made by Prof. H. M. Peters (Zoological Institute, University of Tübingen). The second of these two was particularly noteworthy, as it allowed the quantitative evaluation of the action of benzidrine on the spider *Aranea diadema*; this was achieved by plotting against time the intervals along the radial threads of the web. "Biologie des Hamsters", Parts 1 and 2, were produced by Dr. I. Eibl-Eibesfeldt (Department of Animal Behaviour, Max-Planck Institute for Marine Biology, Buldern, Westphalia) and showed some remarkable instances of mating behaviour of hamsters as well as of their young. These four films were lent by the Institut für den wissenschaftlichen Film, Göttingen, through the courtesy of its director, Dr. G. Wolf.

There can be no doubt that this first collective presentation of research films from many disciplines at a meeting of the British Association was a great success, as the frequent and often lengthy applause by the audience amply demonstrated. The hope can only be reiterated in this article that, at the meeting next year in Sheffield of the British Association, all those who have made research films in the meantime will use the opportunity to present their results; the films should be submitted to either the Scientific and Technical Group of the Royal Photographic Society or to the Scientific Film Committee of the British Association.

A. R. MICHAELIS

## RADIOCARBON DATING CONFERENCE IN CAMBRIDGE

THE second conference on radiocarbon dating held in Europe took place in Cambridge during the week July 25-30. Dr. H. Godwin, head of the Cambridge dating laboratory at the University Sub-department of Quaternary Research, Botany School, was the host and inspiring organizer of a most successful and instructive symposium. He assembled a small group of scientists representing almost all the dating stations in Europe, plus a few physicists who are in the process of setting up dating equipment. Thanks to a generous grant from the Wenner-Gren Foundation, New York, it had also been possible to invite a few of the leading Americans in this field. Thus, the conference was a first step towards the goal set in Copenhagen a year ago, where the establishment of closer personal contact with American colleagues was considered essential for future discussions—in Europe—of the implications of radiocarbon dating.

The Cambridge conference was devoted almost exclusively to the discussion of new methods, which have undergone rapid development in the past two years. The classical Libby method of 'counting' solid carbon in the screen-wall counter is being abandoned, mainly because the widespread contamination of the atmosphere with radioactive dust—although probably too low to be of significance as a health hazard—represents a serious menace to accurate low-level assay. This is particularly true in the case of 'black carbon' samples with their extremely large surfaces and high adsorption capacities.

In the United States and in Europe, a number of new approaches to the measurement of natural radiocarbon have been made simultaneously; for

example, gas counting of carbon dioxide, acetylene and methane, and scintillation counting in which the sample to be dated is incorporated into the scintillator. Each of the methods mentioned was discussed in detail at the Cambridge conference, and a comparison of the merits of various techniques was attempted, especially as regards the ease and speed of operation, the accuracy achieved within a given counting time, the relative sample sizes, etc.

Just as at last year's conference in Copenhagen, the question of errors of radiocarbon ages was the subject of lively discussions. In the solid carbon method, the statistical error of the net count represents the largest contribution to the error of the final result. As this error is being suppressed by improving the ratio  $S^2/B$  (sample over background), other factors such as isotopic fractionation during processing of the samples, variations in the natural isotopic constitution of the unknown and the reference sample, and the uncertainty in the half-life of radiocarbon, etc., begin to play an appreciable part in estimating the accuracy of radiocarbon measurements. Different errors have been combined in a variety of ways, and very few publications contain a concise statement as to how the errors listed have been computed.

A solution of this problem acceptable to all participants could not be found during the Cambridge meeting; but it was agreed that the manner in which the error is calculated should be stated explicitly in future publications.

Moreover, the standardization of the form of publication of dating results was discussed. All investigators present agreed that dating results should be collected at regular intervals for publication in either *Nature* or *Science*. They should preferably appear in the form of date lists similar to those issued by Libby, containing only a brief description of the sample, its current laboratory number and the station's identification prefix letter (cf. below). Obviously, publication of date lists will not replace presentation of the same results in their proper context in any other scientific journal; however, it will make the dating results of various stations more readily accessible to those interested in any one of the widely differing fields of application of the radiocarbon dating method. Also, the results of inter-laboratory cross-checking and standardization, as well as of mass-spectrometric monitoring, are of interest to many workers in this and related fields, and all data should be made available to the widest possible circle of readers. A list of the dating stations in operation or close to completion, and the identification prefix letters used or accepted for use by these stations, is given in Table 1, and additional information will be appreciated.

Table 1. DATING LABORATORIES

BM	British Museum, London	P	Philadelphia
C	Chicago	Q	Cambridge, England
GRO	Groningen	R	Rome
G	Gothenburg	GL	Royal Institution, London
H	Heidelberg	S	Stockholm
K	Copenhagen	T	Trondheim
L	Lamont (N.Y.)	W	Washington
M?	Michigan	Y	Yale
?	Manitoba	?	New Zealand
		?	Poznan, Poland

In this connexion it may be mentioned that an informal exchange of scientific information between European dating laboratories has been in existence for almost two years, and an effort is being made to maintain and widen such contacts among scientists actually engaged in radiocarbon dating.

The meeting in Cambridge has given ample evidence of the great need for and interest in small conferences, where experience and progress within this rapidly developing field are discussed informally. The method of radiocarbon dating is still new, and further technical improvements are likely to come. On the other hand, its wide range of applicability has not yet been fully understood and appreciated. Therefore, joint meetings of physicists and chemists with archaeologists, geologists and other users of dating results are bound to be mutually instructive and stimulating, provided the groups can be kept small and scientists with as remotely related interests as atomic physics and history of human cultures can discuss the essentials, each making an effort to understand the others' problems. HILDE LEVI

## ANIMAL PRODUCTION FROM GRASS

THE theme of "Animal Production from Grass" proved a most successful choice for the fifth 'study meeting' of the European Association of Animal Production, which was held at Reading during July. Representatives of seventeen countries were present, and all stayed in two of the University's halls of residence; this contributed on the social side towards the success of the meeting.

As a preliminary to the meeting, most of the visiting European delegates took part in a tour beginning with a visit to the Royal Show at Nottingham, where the Council of the Royal Agricultural Society extended its hospitality to the visitors. Particular interest was shown in the display of British breeds of livestock. Afterwards, visits were made to the research farm at Thurgarton and the Veterinary Research Unit of Messrs. Boots, and to Mr. Maurice Passmore's farm at Wormleighton.

At Reading, the theme for discussion was introduced by two main papers, each being followed by shorter reports on current research in the various countries. On the first day, Prof. M. M. Cooper, of King's College, Newcastle upon Tyne, delivered the chief contribution on "Animal Management for Intensive Production from Grass". This comprehensive review of the present position in farm practice and in the experimental field was both stimulating and provocative and delivered with characteristic vigour. Prof. Cooper directed attention to the discrepancies that exist between the recorded output from grassland under experimental conditions and that obtained on most farms, even those under more progressive management. For this the farmer must not be judged harshly. Many lack the capital to ensure better utilization, while generally there is a lack of the technical knowledge of how to produce grass with "the composition of a watered concentrate for eight or nine months of the year in sufficient quantities to meet the nutritive demands of high-producing cows"; and there is no simple recipe the adviser can give the farmer to enable him to do so.

In Britain the well-distributed rainfall and the fact that eighty acres is the size of the typical farm have made the higher efficiency of the dairy cow a dominating factor, and she is the pivot of a system of mixed farming. The meat-producing sheep is important on large arable farms and on the large, preponderantly grass farms of the north, where cattle

may be merely mowing machines to keep the grass in good condition for maximum mutton production. One of the current problems is the extent to which sheep can be integrated into dairy farming. Some sheep on a typical large dairy farm are a necessity for proper pasture management; and in establishing a directly re-seeded pasture, they are invaluable in effecting consolidation and controlling weeds in the early stages. Used sensibly, they can augment the quality of grazing for the dairy herd; but in such circumstances, they are essentially scavengers, which is also their proper role on a large arable farm with limited grass.

Prof. Cooper also discussed systems of grazing, pointing out that trials in New Zealand gave better live-weight gains, carcass weights and lamb grading from rotational grazing where the stocking-rates were high than from non-rotational grazing, but that at low rates of stocking the reverse was true. On conservation of grass we have much to learn from Continental countries. Though we should aim at maximum use *in situ*, with the reduced conservation losses, lower handling costs and better return of animal excrement to maintain fertility, conservation is also essential and is a means as well as an end in intensive pasture management.

Finally, Prof. Cooper appealed for a better assessment of nutrient off-take from pasture. It is absurd to credit full value to concentrates and other foods of known analysis, leaving grass and grass products to carry all the errors of estimate. Such a system, now current, discounts the value of grassland under a system where both grass and concentrates are fed, and makes intensive grassland management appear less efficient than it actually is.

The first of the subsidiary papers was by Dr. W. Holmes and D. S. MacLusky, of the Hannah Dairy Research Institute. They reviewed the effects of pasture management methods on the production and feed consumption of dairy cows in trials on the Institute's farm. Production per acre was in many cases the final objective, and for this purpose maximum herbage consumption per cow might not be the best policy, as it might be obtained at the expense of efficient food conversion. Possibly slightly more mature herbage than the ideal may sustain more cattle per acre with only negligible reduction in yields per cow. Provided weather and good management ensure a constant supply of good grass, the strip-grazing method without cutting the grass or providing supplementary feed appear to give the most satisfactory results.

In a report of "A Comparison of Systems of Sheep Grazing Management" carried out at Wye College, Kent, H. Cornforth dealt with two sheep-grazing trials. Where nitrogenous fertilizers were used, rotational grazing gave the best utilization. Three days appeared to be the maximum that fattening sheep should remain on each plot. Gang-mowing had an advantage under continuous grazing where no nitrogenous fertilizer was used, but not where nitrogen was applied. Rotational grazing of a sward treated with nitrogen gave almost 700 lb. live-weight gain per acre, which is 27 per cent better than from a continuous grazing treatment on the same light chalk soil.

Other papers in this section were from Yugoslavia, Germany, The Netherlands, Austria, Portugal and Switzerland. That from P. B. De Boer, a Netherlands farmer, outlined his methods of intensive grassland farming, designed to try to eliminate the estimated