

the late Sir Edward Mellanby on the effects of excess of vitamin A on the conversion of a stratified epithelium to a mucous membrane, were all subjects arousing wide interest.

The botanical sessions revealed that, during the period under review, considerable attention had been devoted to refining and extending techniques and to critical re-examinations of the composition of standard culture media. Prof. H. E. Street's paper to the session on nutrition and metabolism emphasized both the importance of examining the availability of nutrients in existing media and the very limited state of our present knowledge regarding the growth requirements of isolated plant tissues and organs. Important progress in our understanding of the complex nutritive requirements of certain tissues seems likely to result in the near future from the extensive studies now being made of coconut milk and other complex supplements and from work on the physiological responses to kinetin and other pure growth hormones. Important progress in our understanding of morpho- and histo-genesis has followed from the increasing study of callus and organ cultures. This clearly emerged in the discussion which followed Dr. R. J. Gautheret's paper on "Histo-genesis in Plant Cultures". The important part played by callus cultures in the study of virus diseases and of plant tumours was also emphasized in the papers of Drs. L. Black and A. C. Braun. Work in these fields is not only contributing to current views on the nature of viruses but also enhancing our understanding of the control of cell division. Extensive comparative studies of the nutritive requirements, physiology and chemical constitution of normal as against tumorous plant tissues have added greatly to our knowledge of cell physiology and, in the context of the Woodstock Conference, enabled the botanists to make an important contribution to the general discussions concerning the nature of cancer.

Those of us from outside the United States who were privileged to attend the conference owe our American colleagues a great debt of gratitude for their generous hospitality. Particularly are we indebted to Dr. P. R. White, of the Jackson Memorial Laboratory, Bar Harbor, for the very happy choice of Woodstock as a meeting place and for his excellent and detailed organization of the conference as a whole.

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HYDROLOGY

DARCY SYMPOSIA

A MEETING of the International Association of Scientific Hydrology, which is a branch of the International Union of Geodesy and Geophysics, was held at Dijon during September 20-26. The place of meeting was chosen to honour the centenary of the publication of "Les fontaines publiques de Dijon" in 1856 by Henri Darcy, which has been considered to mark the birth of the scientific study of hydrology, and the Association therefore organized the 'Symposia Darcy'. The meeting was attended by one hundred and twenty delegates from a wide distribution of countries. It was agreed that papers should be

restricted to (a) evaporation, (b) ground water, and (c) a study of floods.

The subject of evaporation was included principally for the purpose of preparing a programme for the next triennial assembly to be held in Toronto in September 1957. Accordingly, in the six short papers which were presented most of the authors treated the subject generally and gave summaries of experimental and theoretical studies in various parts of the world.

Evaporation and the allied subject of evapotranspiration are important factors in the estimation of rainfall/run-off relationships, particularly by those methods which are based on physical rather than on statistical data. As stated by R. K. Linsley and others, in a paper describing research in the United States, "these phenomena are major factors in the hydrologic cycle and of vital importance in many fields of applied hydrology". Another paper from America, by H. F. Blaney, who has done much original work on this subject, discussed the importance of evaporation to the irrigation engineer. W. Friedrich, of Germany, in describing work carried out in the Federal Republic, stated that on average no less than 450 millimetres out of a total precipitation of 771 millimetres is lost as a result of evaporation, thus "it ranks high on the 'water balance-sheet'". From Switzerland came a description by P. Kasser of a 'water balance-sheet' study in the glaciated drainage basin of Mattmark in the Alps, in which the author suggested that, contrary to what is generally supposed, evaporation may increase with altitude in glaciated areas. G. F. Makkink, in a paper on "The Application of Research on Evaporation in Holland", expressed preference for methods for the calculation of evaporation which are based on radiation rather than on temperature.

C. F. Lapworth, from Great Britain, described experiments which have recently been carried out at a reservoir at Kempton Park, near London, to determine the amount of water loss due to evaporation. After correcting for rainfall and other factors, the derived evaporation over a period of twelve months beginning July 1955 is 660 millimetres, which compares well with a calculated value of 695 millimetres. A Working Committee was formed to prepare the programme for the Toronto Assembly. W. R. Rangeley (Great Britain) asked the Committee to consider the advantages of treating the subject on a broad basis, bearing in mind that evaporation as applied to hydrology is, as yet, an immature science; whereas V. Yevdjevic (Yugoslavia) expressed the view that attention should be confined to the role of evaporation in the hydrological cycle of a catchment.

The section concerned with underground water devoted most of the sessions to an appreciation of the so-called Darcy's Law and its application and validity over a wide range of ground-water problems under different flow conditions. J. Tixeront (Tunis) discussed the role of Darcy in the foundation of modern hydrology. The development of the fundamental flow equation under a series of specified conditions, as well as an extension to such problems as unsteady, unsaturated flow through porous media, was considered on a purely theoretical and mathematical basis by K. Hubbert (United States) and S. Irmay (Israel). In addition, G. de Josselin de Jong (Holland) analysed on a probability basis the path of an individual fluid particle as it passes through a porous medium.

Although many papers were concerned to some extent with the presentation of theoretical aspects of ground-water flow, more than half the authors discussed the practical application and interpretation of a wide variety of pumping-test techniques. This aspect proved to be one of the most important contributions to the symposium and members from no less than twenty countries had an opportunity of presenting their own experience in aquifers of different lithological types and to compare their results with those in other fields. The numerical determination of 'permeability' by several different approaches was discussed, including the examination of random samples of the aquifer by R. Schad (Germany), the application of pumping-test techniques by M. J. Goldschmidt and M. Jacobs (Israel), W. Kollis (Poland) and V. Paavel (Germany), and more empirical and statistical methods by J. Ineson (Great Britain).

The validity of Darcy's Law evoked some discussion, and the apparent failure of methods concerned with the interpretation of both steady and non-steady state flow around a discharging well was shown by some authors, including G. Szilagyi and K. Ubell (Hungary), to be a function of such factors as the delayed yield by slow drainage from the aquifer and the distortion of flow lines near a discharging well, either where partial penetration of the aquifer occurs or where flow in an unconfined aquifer is under consideration. Interpretations of the form of the free surface around a discharging well were given by G. Nahrgang (Germany) and G. Schneebeli (France).

An important contribution to the broader field of underground water movement was made by E. Mosonyi and G. Kovacs (Hungary), E. Nemeth (Hungary) and D. K. Todd (United States), who discussed the use of laboratory models for the elucidation of flow conditions locally around either a source or sink and regionally in an aquifer. In some instances, the results of interpretation based on model studies compare favourably with observed conditions. The extended use of models can help materially in ground-water flow studies, which are now an integral part of many hydrological surveys.

R. Mugge (Germany), H. Schoeller (France), R. W. Stallman (United States) and G. Tison (Belgium) analysed the form of ground-water contours and fluctuations in ground-water levels, so that, under certain conditions, the formation constants of the aquifer, namely, hydraulic conductivity, transmissibility and coefficient of storage, could be determined. Problems relating to the recharge of an aquifer, particularly the determination of the aquifer characteristics, were dealt with by F. C. Mikels and F. H. Klaer (United States) and L. Schiff (United States). A comparison between predicted conditions, based on pumping-test determinations, and actual production figures confirms the theoretical approach. The increased use of ground water and the necessity to counter over-development of an aquifer, leading to both ground-water lowering and saline infiltration, by recharge projects, require more precise hydrogeological studies. Two contributions, by C. Schmid (Germany) and H. Tanaka and F. Yahagi (Japan), dealt with the application of Darcy's Law to oil production and to sub-surface flow near a dam, respectively. L. F. Ernst and J. J. Westerhoff (Holland) described some drainage problems in the Low Countries.

The discussion of the various papers confirmed the wide application of pumping-test techniques, based

on the fundamental flow equation defined by Darcy, to the interpretation of ground-water problems. It was apparent that a large number of contributors regretted that methods concerned with the assessment of permeability of a water-bearing formation by the examination of the physical characteristics of random samples of that aquifer are still in use. Only by an interpretation of flow conditions in an aquifer *in situ* could a real estimate of its hydraulic characteristics and ground-water potential be determined.

The thirty-five papers presented on the study of floods covered a variety of important subjects and revealed in their bibliographical references the valuable part played by the International Association in bringing the hydrological work of any country to the notice of other nations.

Four papers, by Y. Simaika and H. El-Sherbini (Egypt), Ven Te Chow (United States), M. E. Walser (Switzerland) and T. Dalrymple (United States), respectively, described the flood problems in their countries and the hydrometric and hydrological methods used in their study. W. E. Hiatt (United States) reported how radar is now being used by the U.S. Weather Bureau for observations of rainfall, and K. N. Rao outlined the extensive hydrometeorological studies of rainfall which India feels bound to make in the absence of numerous long-period records of run-off, to enable water utilization works to be designed. H. Kreps (Austria) discussed the problem of measuring flood discharges and offered constructive proposals in that respect.

Aspects of river morphology were dealt with in papers from the United States and Japan, while S. Henin and X. Michon (France) provided a study in the estimation of erosion effects from gaugings of the solids transported by a river system.

The remaining papers were of a more analytical character. River hydraulics has been studied by W. Laszloffy (Hungary), H. Strack (Germany) and H. Straub (Austria); the first examined the effect of icy conditions on the behaviour of a flood crest, the second the trend of the times of propagation of Rhine floods, and the third some aspects of stream-channel rugosity. V. Felber (Austria) discussed at length the influence of water below the ground surface upon flood run-off above, while R. Wind (Holland) at the other extreme reflected upon the interception of precipitation by vegetation.

Rainfall/run-off relationships were the subject of papers from Japan, Israel and Holland, and the employment of climatological observations in the evolution of flood discharge graphs was also discussed. The forecasting of flood flows was dealt with by J. Lambor (Poland) in two papers, by K. Szesztay (Hungary) and by T. Kinoshita (Japan). The determination of the amount of the probable maximum flood flow of a river during a given period also received attention from several authors.

Nearly all the papers are written in French or English, with a few in German. The three sections are published separately and are now available through the secretary of the International Association of Scientific Hydrology, Prof. L. J. Tison, 61 rue des Ronces, Gentbrugge, Belgium, at a price of 550 Belgian francs for the complete set or 100 francs, 250 francs and 300 francs for the separate parts.

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