THE NEWSLETTER OF THE BRITISH HYDROLOGICAL SOCIETY

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POLICY-MAKING AND THE PUBLIC PERCEPTION OF RISK

A four factor calculus for assessing the public perception of risk was put forward by Environment Minister Mr. William Waldegrave in a recent lecture at the Royal Society.

Comparing the scientists' and policy-makers' assessments of risk with the sometimes rather different views of the general public, he appealed to the scientific community to come closer to the policy-makers so that the public could be better informed about risk, bringing their views closer to reality.

Mr. Waldegrave was delivering the first Natural Environment Research Council lecture* to an invited audience of 200 people including Lords, fellow politicians, leaders of industry, conservation groups and eminent scientists.

He refuted the mistaken view that policy could be made by simply assessing "risk" of an activity against its "importance". He postulated two other important factors which could outweigh the others — "free will" (how voluntary is an activity) and "confidence" (the satisfaction that a risk is quantifiable and limited).

If it were just a case of "risk" balanced against "importance" motor cycling for example, would be totally unacceptable while nuclear fuel re-processing would attract "the thanks of a grateful nation" — but that was evidently not the public reaction. It was no use wringing hands at the views of ordinary people although this was a common reaction against certain kinds of scientists, he said.

"We need to understand the reasons for the public perception a little better. If we do not, we may waste scarce scientific and analytical resources either trying to prove propositions which people have already accepted, or in trying to change attitudes by arguments which do not address people's real reasons for holding those attitudes," he said.

He spoke of ways public perception could be changed but first it was necessary to find out exactly what opinions the public do hold. Opinion polls could be useful but needed to be done rigorously because sloppy polling was full of hazards.

He called for better integration of the consideration of science strategies in the environmental field with consideration of other aspects of relevant policy such as planning and certain aspects of social policy both nationally and in Europe, if the public's concerns were to be addressed effectively.

"Surprisingly often I think that the public has more reason behind its anxieties than a simplistic approach to risk analysis might lead some, and has led some, to believe," he said.

Some attitudes may have to change from scientists, politicians and administrators if they were to get the best from each other.

Chairman of NERC Mr. Hugh Fish said, in response, that the lecture should certainly make scientists think.

"We very much take to heart the comment and the suggestion that we should come a little closer to the many other aspects of environmental management and environmental conservation which are not wholly in the scientific field," said Mr. Fish.

*The NERC Annual Lecture has been sponsored for its first three years by the British Petroleum Company plc, and is intended to stimulate interest in the natural environment and the scientific research work associated with it, both in this country and overseas.

Minutes of the Third Annual General Meeting held at the Institution of Civil Engineers, London, 1st December 1986

Preliminaries
Apologies for absence were recorded from Professor M.J. Hamlin, Professor D.E. Walling, Dr. P.D. Walsh and Mr. L. Jack, and the minutes of the 2nd Annual General Meeting of the BHS were approved.

President's Introduction
The President, **P. Johnson**, recorded the Society's thanks to the Institution of Civil Engineers and to the Institute of Hydrology for their substantial support during the year, and singled out the administrative work undertaken by **Norman Tyler** on behalf of the Society as worthy of special thanks. Good working relationships had also been established with the Royal Society and the Institution's Hydrological Groups.

There were several indices of progress in the position of the Society at home and abroad, for example:
1. Copies of the Society's Newsletter were now being sent to the Chairmen of the Regional Water Authorities in order to keep them informed of the Society's activities, and a number of letters of support had been received in return.
2. During the year under review, the Society had responded to the Government's proposals for the privatisation of the water industry and to the green paper on "Environmental control: the next steps".
3. The Royal Society had invited the BHS to participate in its proposed survey of UK priorities in the Earth Sciences in the 1990s.

The Society will be arranging a programme of four National Meetings in 1987 which would include its First National Hydrology Symposium to be held at the University of Hull from 14th to 16th September.

The President concluded by noting that the Society membership was now in excess of 520.

Report of the Honorary Secretary
The Report of the Honorary Secretary, **Professor M.J. Hall**, was contained in issue no. 12 of the Society's Newsletter, *Circulation*. In summarizing this report, Dr. Hall noted that, with his retirement, the pattern of elections for Society Officers had been fully established. A major proportion of the activities of the Society was concerned with the mounting of meetings. On average, 20-25 meetings a year were organized by the Society in the form of National Meetings and meetings arranged by the Society's regional branches and the ICE Hydrological Groups. This situation compared very favourably with the number of 'hydrological' meetings which took place before the formation of BHS.

In the year under review, the Society had arranged four national meetings as well as a joint meeting with the Association of British Climatologists. A meeting on 'Hydrology in Scotland' organised jointly with The Royal Society of Edinburgh and the Scottish Hydrological Group had been a particular success.

The Main Committee had set up a Meetings Sub-Committee to expedite the arranging of National Meetings. This had permitted more time for the discussion of other matters and had helped the Main Committee to take on other activities, such as its work on privatisation of the water industry which had been particularly stimulated by the President. Progress had been made on the Directory of British Hydrology which was almost ready for publication.

In concluding his summary, the Honorary Secretary thanked all those members who had helped him during his three years of office. Adoption of the Honorary Secretary's Report was moved by the President, seconded by **Dr. J.C. Rodda** and carried without dissention.

Report of the Honorary Treasurer
The report of the Honorary Treasurer, **Dr. H.S. Wheater**, was also circulated in issue no. 12 of *Circulation*.Dr. Wheater informed members that the Society's financial position at the beginning of the year had looked a little uncertain, but costshad been maintained at little more than the level of the previous year. Most members had renewed their subscriptions and there had been an inflow of new members. A surplus of £871 had been achieved by the end of the year, which brought the net assets of the Society to almost £2,000.

In the coming year, publication of the Members' Directory and the Directory of British Hydrology will generate additional expenditure, which coupled with ongoing cost items of post, printing and stationery has necessitated a rise in the Society subscription to £12. It is projected that the increase will meet expenditure and lead to a small increase in reserves.

Adoption of the audited accounts was moved by the President, seconded by **Dr. B.W. Webb** and carried without dissention.

Report of the Editor of the Newsletter
The Editor, **Mrs. C. Kirby**, reported that four issues of the Newsletter had again been produced during the year and thanked all the contributors. The inclusion of illustrations in articles continued to be welcome. It appeared that the present format of the Newsletter was acceptable, but any new suggestions from the membership would be sympathetically received.

In 1987, John Wiley and Sons Limited will be publishing the proceedings of the BHS Lancaster Symposium on *Weather Radar and Flood Forecasting*, and the appearance of this text could be regarded as a landmark in the activities of the Society. A small group of the Main Committee had been set up to consider other forms of occasional publications.

Retirements from the Main Committee
The following members retired from the Main Committee at the Annual General Meeting:

Professor M.J. Hall (Honorary Secretary);
L. Jack (Elected Member);
Dr. J.C. Rodda (Elected Member);
Dr. R. Wood (Rep. Midland Section);
Professor P. Novak (Rep. ICE).

The President called upon **M. Mansell-Moullin** to propose a vote of thanks to the retiring members for their services to the Main Committee and to the Society. Mr. Mansell-Moullin outlined the many tasks which had been accomplished by these members in the early years of the Society and explained how their efforts had been valuable in promoting the Society and establishing the position which it held today. He went on to highlight the contributions made by each of the retiring members, and made special mention of how Professor Hall, in his capacity of Honorary Secretary, had greatly assisted two Presidents of the Society. Mr. Mansell-Moullin hoped that the members retiring from the Main Committee would continue to play an active role in BHS, and he moved a vote of thanks for their outstanding service. The motion was seconded by the President and carried with acclamation.

Results of Elections to the Main Committee
It was announced that in a ballot to fill the vacancies on the Main Committee, 55% of the members voted and the following candidates were successful:

Dr. B.W. Webb (Honorary Secretary);
T.E. Evans (Elected Member);
R.J. Sargent (Elected Member).

The following two members had also been appointed as new representatives:

W.T. Bradford (Rep. Midlands Section);
Dr. R.H.J. Sellin (Rep. ICE).

B.R. May raised a point of information from the floor concerning the balance of interests of members on the Main Committee and in reply the President was able to reassure the membership that a full range of interests in Hydrology was covered by the new Main Committee.

There being no other business, the meeting, which was attended by 37 members, was closed by the President.

LAKE ACIDIFICATION

BHS Southern Section Meeting
19 November 1986

This evening meeting discussed the work of two researchers in the field of lake acidification. *Dr. Brown* of the CEGB presented a review of the work carried out for the Loch Fleet project while *Dr. Battarbee* of University College, London, showed us his work on the historical record of changes in lake acidity as inferred from sediment diatom analysis. The meeting was chaired by *Dr. Howard Wheater*.

The meeting was opened by Rick Battarbee (UCL) with a talk on diatom analysis of lake acidification and how it can help us to understand lake acidification patterns, both past and present. It is possible to analyse lake sediments, find out if any acidification has taken place, date the sediments to determine when acidification took place, and possibly the causes. The technique which is central to this work is diatom analysis.

Lake sediments have accumulated over a time span of 10,000 years since the last glaciation and are derived from materials in many parts of the environment, such as the atmosphere, catchment, soils, and the lake itself. The latter are most important and include the diatoms found in lake sediments. These are unicellular algae with siliceous walls. They grow in abundance and diversity in water. Some species, for example *Tabellaria binalis* and *Tabellaria quadriseptata* are typical of acid waters.

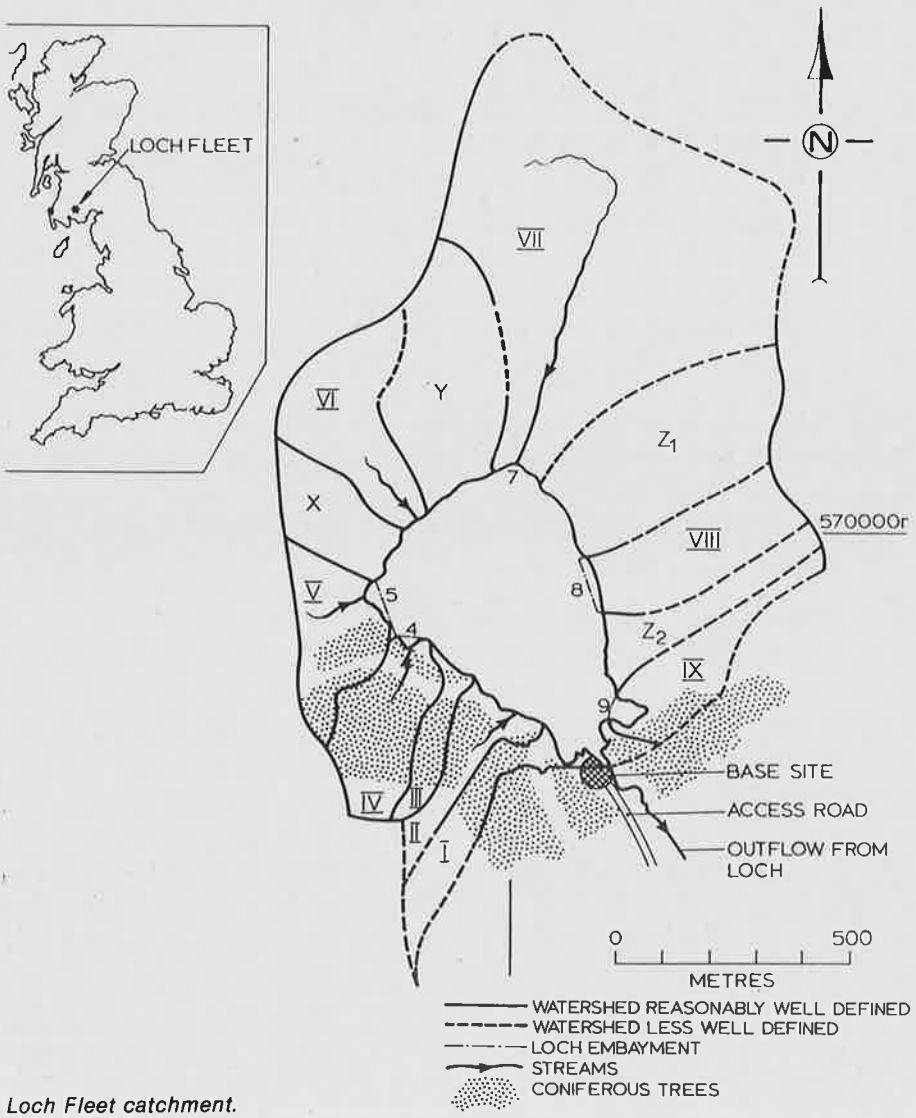
Work was carried out on 33 lakes in Galloway of which some were acid and some were neutral. The sediments from the bed of the lakes were sampled using cores carefully taken so as not to disturb the sediments. The diatoms from these cores were classified into species groups and their associated pH measurements. Using today's distribution of diatoms and known pH environments it is possible to group historic diatoms to particular pH situations. The cores also included the mud-water interface so that a record of recent changes could be derived. In general the top 1 cm represents approximately 10 years of sediment deposition.

In Galloway the lake sites were situated on granite intrusions. Some of the lake catchments were forested while others were not. It was found that Loch Dee had a forested catchment which comprised of Sitka Spruce and had a pH of 5.5, while Loch Enoch which was exclusively on granite and was not forested had a pH of 4.5. Loch Enoch was also situated higher in altitude. The diatom analysis of a 70 cm core from Loch Dee produced sediments from 1850 to present day which demonstrates a fast accumulation of deposits. For Loch Dee there was a rapid change in the diatom assemblage at the end of the 19th century with a decline in diatom species adapted to neutral waters and a gradual expansion in acid-loving diatoms. In essence there has been a gradual acidification since the turn of the century. Loch Enoch has always been more acid as acid-loving diatoms were present at all times represented by the core. However, since 1850/60 there has been a decrease in pH of one unit from about 5.5 to 4.5 and this has been gradual to the present day.

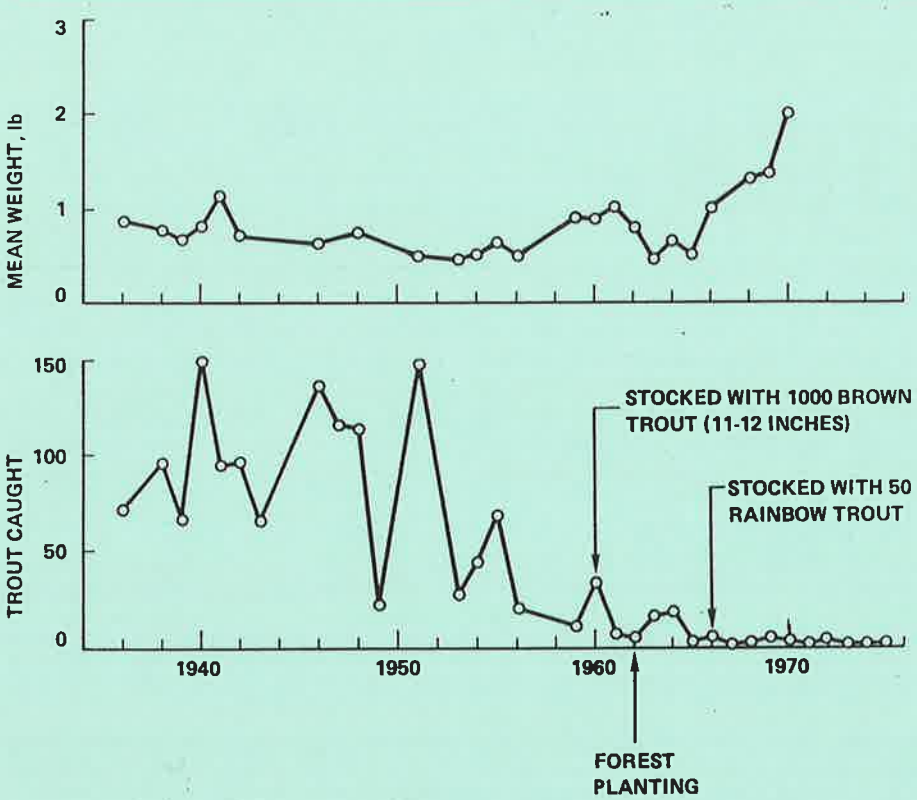
Investigations into Loch Fleet were also discussed by Rick Battarbee. This lake is situated on a different type of granite. In 1963 the Forestry Commission ploughed the Loch Fleet catchment and at this time there was a great influx of peat to the sediments. The cores obtained from the lake gave records of sediments from the past 100 years. The diatom assemblage changed at 1963 as ploughing and physical disturbance to the environment wiped out planktonic diatoms. In the 1970s there was a decrease in circumneutral non-planktonic diatoms, followed by increase in the acid-loving Tabellarias. The controlling factors seemed to be different, however. The acidification seems to be related to the afforestation of the catchment and especially to the closing of the canopy.

Dave Brown (CEGB) went on from this introduction to Loch Fleet to discuss the work carried out by the Central Electricity Generating Board, the South of Scotland Electricity Board, the North of Scotland Hydro-Electric Board and British Coal on Loch Fleet. This Loch has had fish, in particular Brown Trout, but since 1970 it has been virtually fishless. The main objective of the Loch Fleet project is to restore the water quality of the acid loch to a level suitable for a self-sustaining fish population. To achieve this the water quality is being altered by the application of neutralising treatments to the catchment. Dave Brown described the pre-treatment chemical and biological data that had been collected to date and the changes that followed the first set of treatments which were applied in Spring 1986.

Dave Brown opened with an explanation



Loch Fleet catchment.



Loch Fleet: brown trout fishery since 1935.

of how fish survival is a function of pH and calcium and added to this, the fact that the concentration of labile monomeric aluminium is also critical to the survival of fish fry. An explanation of how the toxicity of water can be reduced using organic chelators was given along with the problems associated with the technique. Having outlined the chemistry, he then gave a brief description of how the Loch Fleet catchment was managed for the purposes of the project. Basically the Loch has one major feeder stream and outlet so embayments were established which had semi-permeable curtains to separate the waters from different parts of the catchment in the loch. Flow was allowed from the embayments to the lake but not in return. Thus the catchment was divided into sectors for different treatments.

Brown Trout in the lake had been gradually disappearing since the 1950s and 1960s. The weight of fish declined from 1940-1950 and then some stockings took place. The weight of the few fish left in the 1960s increased dramatically and then they too died out.

Chemical analysis was carried out of rain and surface waters to determine the pretreatment concentrations of such elements as hydrogen, sodium, calcium, magnesium sulphate, chlorides and nitrate. Soil water composition was also monitored. The chemical constituent of water flowing through the soil 5 cm and 10 cm in depth did not fluctuate with rainfall. The pH and aluminium concentrations of the small amount of water flowing through the soil stayed fairly constant. However it has been found that the vast majority of the water entering the Loch does so via surface and immediate sub-surface flow.

Treatment of the loch was described next. Three different types of liming were carried out to determine their effects and these were slurry liming, dry liming and bog liming. The effect of the liming was to increase the pH and calcium concentrations and to reduce the labile monomeric aluminium concentration by 2-3 times so that toxicity was reduced significantly. Fish are now surviving. Since liming, however, the biomass of fish food organisms has reduced slightly due to the sudden change in pH. It is now a case of waiting for recolonisation or artificially introducing new biomass.

Following the results of this study a short video of the Loch Fleet project was shown to the audience. This and the nature of the presentations spurred much discussion which was both interesting and lively.

Jane Bliss

Meteorological Office Studies of Rainfall Observation and Forecasting on the Catchment Scale

BHS Southern Section Meeting
13 January 1987

This evening meeting was preceded by a conducted tour of some of the Office's departments — the Central Forecast Office, the Computer Complex where numerical forecasts are prepared and the Telecommication Centre which handles the worldwide weather observations required for forecasting. A video presentation of the Office's services was also given. This was a good day to see the Office at work coping with the dramatic weather — a daytime temperature of −5°C and snow in SE England, but it did not prevent 31 members and guests (including three from as far away as Warrington) reaching Bracknell.

The meeting was opened by Brian May who made some brief remarks about forecasting models, describing them as mathematical descriptions of the physics and dynamics of the atmosphere. These models specify the atmospheric state (temperature, humidity, pressure, etc.) at several levels in the vertical at regularly-spaced grid points on the Earth's surface. From an initial specification of the state the appropriate dynamical equations are integrated with respect to time to predict its state at later epochs. Although rainfall is not included as such in the model specification it is predicted when particular atmospheric conditions,

particularly humidity, reach critical values. At present the Office uses two models operationally. These are the "coarse mesh" model with a grid spacing of about 150 km covering the whole globe for forecasting up to five days ahead. The second is the "fine mesh" model with a grid spacing of about 75 km covering the North Atlantic and Europe for forecasting up to 36 hours ahead.

The Office has a requirement for a model to forecast on a finer spatial scale still and as a consequence was developing the "mesoscale model".

Forecast models require observations of appropriate spatial resolution for specifying the initial state of the atmosphere, for applying subsequent correction and finally for obtaining verification statistics. Radar observations of rainfall with their fine resolution in space and time are important for the development and future operation of the mesoscale model.

The first of the main speakers was Mr **Tony Waters** of the Cloud Physics branch who first reviewed the development of weather radars from the Dee Weather Radar Project to the present operational network of six, at Camborne, Clee, Upavon, Chenies, Hameldon Hill and Shannon (Ireland), and onto future radars at Castor Bay (N. Ireland), Exmoor, SW Wales, Lincoln and three in Scotland. The impact of advances in microcomputers and VDUs in handling, processing and displaying digitised radar data was stressed. The radar data is an important component of the Office's short-period Weather Forecasting Project (particularly in the FRONTIERS* system) in combination with METEOSAT visual and UV image data. The useful features of radar data were next described — the future UK-wide coverage, high resolution in time (5/15 minutes) and space (2/5 km), automated data handling and quick availability, along with the problems — loss of sensitivity at large ranges, rain is observed above the ground so that low-level growth and evaporation can be missed, shadowing by hills, bright band, anaprop, etc.

Presentation and interpretation of sequences of radar pictures during some note-worthy rainfall events then followed. The cold front event of 7/8 November 1986 was of interest because of associated long-lasting lines of convective activity at its leading edge. A very active wave depression with convection on 20 November 1986 was next shown, notable because it caused tornadoes at Swindon and Selsey Bill. Finally a mesoscale convective system (an extended area of thunderstorms) on 10 August 1986 which brought flooding to Newbury was described.

Summarising, the speaker said that in spite of their imperfections radar observations had greatly increased our knowledge of the structure of rainfall and of weather fronts which could be incorporated in future numerical forecast models.

The second speaker was Miss **Olive Hammon** of the Forecasting Research branch who started by describing the essential features of the mesoscale forecasting model being developed which has a grid-point spacing of 15 km (to be reduced to 10 km when operational), with 16 levels in the vertical the uppermost one being at 12,000 m, to be used to forecast for up to 18 hours ahead. An important feature of this model is that orography is represented in considerable detail, although small valleys and their local effects on the weather of cities like Sheffield, for instance, cannot be resolved. Also processes leading to orographic rainfall and convective clouds over larger areas are modelled. Because of the small grid length there are problems with initialising the model with rainfall and humidity; at present only surface observations are used but in future radar and satellite data will be used routinely with upper-air soundings to identify cloud types.

In spite of these factors initial tests of the model are very encouraging; comparisons of monthly total rainfalls demonstrate that gross orographic effects are reproduced well, but from comparisons with radar and gauge observations over shorter intervals it appears that convective rainfall from very intense thunderstorms tends to be underestimated because they can in reality reach greater heights than 12,000 m.

Some examples of rainfall predictions were shown and, in particular, one of heavy orographic rainfall over Wales on 29th December 1986 which was also observed well by radar.

In answer to a question Miss Hammon noted that forecast fields from the fine-mesh model are used to initialise the mesoscale model but the operational timetable would lead to some delay in sending rainfall predictions from the mesoscale model to users. As a consequence the FRONTIERS rainfall predictions (based a simple pictorially-based extrapolation of the motion of rainfall observed between two radar pictures 30 minutes apart and without accounting for the generation of dying-away or rainfall), are likely to be more useful over the first few hours with the physically-based mesoscale product taking over after that.

Brian May

*FRONTIERS: Forecasting Rain Optimised using New Techniques of Interactively Enhanced Radar and Satellite data.

Hydrology is Mostly Soil Physics?

BHS Southern Section Meeting
18 February 1986

Some 80 people met in the excellent new facilities at Rothamsted Experimental Station with the aim of discussing the utility of soil physical principles in hydrology. The background to the discussion was laid in the first talk by *Edward Youngs* (Rothamsted) who gave a brief summary of the development of soil physics from ancient Sumerian cuneiform inscriptions via Darcy, Dupuit, Forchheimer, Buckingham, Richards and Philip to the present day use of scaling theory as a means of dealing with spatial heterogeneity. He noted the success of soil physics in applications to many areas of hydrology, and concluded with a summary of current fundamental research topics. These are the problems posed by spatial heterogeneity; swelling and shrinking soils and the development of cracks; two phase flow of water and air; combined heat and water transport; and combined salt and water transport.

A different perspective was then offered from the engineering hydrologist's viewpoint by *Ian Cluckie* (Birmingham). He claimed to know nothing about soil physics, and contrasted the need for knowledge for the purposes of scientific understanding, with that required for engineering applications. The engineer would utilise knowledge from different disciplines as required but a common view amongst hydrologists was that the soil was an irritant, complicating the business of engineering prediction. In reviewing methods of prediction of storm hydrographs he contrasted empirical methods in which the physics is represented by an index or a measurement of a past flow, with today's distributed models and soil/plant/atmosphere models which represent a convergence of the engineer and the soil scientist, but which have vastly greater data requirements and may yet not include some important physical processes such as the dynamics of surface crusting.

A discussion of methods of remote sensing of spatial patterns of inputs and surface soil responses then led on to the problem of what is the most appropriate scale at which to consider heterogeneity, particularly over catchments of thousands of square kilometres encountered by

engineers working overseas. Summarising problems that remain to be solved Ian pointed to the processes of surface crusting and shallow surface flows through vegetation. He raised some doubts as to the effectiveness of increased spatial resolution and knowledge of detailed soil physics in solving engingeering problems.

A third viewpoint, applying soil physical principles in the field, was then offered by *Martin Hodnett* (Institute of Hydrology). Field measurements are used to assess runoff, evapotranspiration and groundwater recharge, and to provide both calibration and validation data for mathematical models. Measurement techniques used in the field and their limitations were then reviewed. The time-consuming nature of some experiments (such as hydraulic conductivity measurements) was stressed. These points were illustrated by a case study which was carried out in the Betwa catchment in India. The utility of soil physical measurements in assessing the seasonal variation in soil moisture for different profiles was demonstrated. Actual evapotranspiration rates had been successfully estimated using the zero flux plane method and had been shown to be at their lowest when 'potential' rates were at their highest. The soil moisture measurements had provided the basis for a simple conceptual storage model of the catchment that had been used successfully for hydrological predictions.

After lunch it was then the turn of the mathematical modellers to demonstrate how soil physics could be incorporated into predictive models. *James Bathurst* (Newcastle) gave an overview of the SHE model and the way in which the subsurface flow predictions were based on Darcian flow principles. The non-linear unsaturated zone calculations take up the greatest part of the computer run times for the full model. Example predictions were shown for the Wye catchment in Wales and the Braunshweig catchment in Germany. In the former case surface runoff is predicted as resulting from areas of soil saturated to the surface, in the latter from an infiltration excess mechanism. Some deficiencies in predicting the recession limb of the Wye hydrographs may be due to the fact that the model cannot predict flows through subsurface pipes. The distributed nature of the predictions was stressed, allowing use to be made of measurements at points within a catchment in the calibration process. Sensitivity analysis plays an important part in calibration, which should include as wide a range of conditions as possible. Successful simulations of soil moisture profiles over a two year period, with and without irrigation, were demonstrated for a site in Denmark.

Finally, *Andrew Binley* (Lancaster) talked about an investigation of the effects of spatial variability of soil properties on hillslope responses. A three-dimensional model of a hypothetical hillslope was used (at a scale less than one grid square in the SHE model), again based on Darcian principles. The model was run using different random patterns of soil characteristics on the Cyber 205 supercomputer at Manchester. Under conditions of relatively high hydraulic conductivity, for which the responses are predominantely subsurface, the results showed comparatively small variation between different patterns of soil characteristics taken from the same underlying distribution. However, for low conductivity soils producing infiltration excess surface runoff, there was marked variability both over the slope for any single pattern and between patterns. These results were reflected in an attempt to calibrate a single homogeneous slope to represent the spatially variable hillslopes. This was relatively successful for the hillslopes dominated by subsurface flows, but unsuccessful for the low conductivity hillslopes. This raised some doubts about the possibility of utilising effective parameter values for large areas in models based on soil physics, such as SHE.

Following these presentations, the discussion started by addressing the problem of the scale at which it is appropriate to apply soil physical principles and in particular Darcy's law, which underlies the whole of macroscopic soil physics. Darcy's law has the appealing feature that given some data on flux rates and hydraulic gradients it is always possible to back calculate a hydraulic conductivity without questioning the validity of the underlying relationship. However, faced with the heterogeneity of soil characteristics, the effects of vegetation on patterns of input rates, and the effects of structural pores on water flows, is it appropriate to apply Darcian flow principles at the scale used by hydrological models when it may be impossible to measure an appropriate grid scale parameter or hydraulic gradient?

Edward Youngs suggested that Darcy's law will apply at any scale for flow through a porous matrix with properly defined boundary conditions. Measurement techniques for hydraulic conductivity should, however, reflect the scale at which it is wished to apply the flow law. Heterogeneity of soil characteristics or the presence of by-passing flow in structural pores do not invalidate Darcy's law, but may limit the scale at which it may be applied with effective parameters. *Guy Towner* (Rothamsted) gave the responsibility for finding a more appropriate flow relationship for use in distributed hydrological models to the hydrologists.

Mike Kirkby (Leeds) argued for a network model for flow through soils in the field that would, through statistical averaging, allow for the occurrence of channelling flow at all scales, including that of the channel network. The crucial difference between such a description and a Darcian description was in taking account of the continuity of larger flow pathways. *Peter Leeds-Harrison* (Silsoe) suggested that Darcian flow principles had been successful in modelling flow through networks of cracks in clay soil, while the flow remained laminar. The discussion also addressed the calibration of soil physical parameters at the grid scales used by hydrological models.

James Bathurst pointed out that sensitivity analyses had shown that for the Wye simulations, the results were not particularly sensitive to hydraulic conductivity; porosity and initial phreatic levels being more important. *Howard Wheater* (Imperial College) raised the problem that several different sets of parameters, or even model structures might give equally good fits to observed data. Soil physical parameters are naturally interacting and this might be expected to lead to some problems of identifiability. There was some feeling that this might become less of a problem when it was possible to include a wide range of conditions in the calibration data.

In retrospect there were other areas of overlap between soil physics and hydrology that merit discussion, for example soil water controls on evapotranspiration, and the engineering hydrologist's common assumption that storm hydrographs result from surface runoff when chemical analyses suggest that a large proportion of the hydrograph may be pre-event water from soil water storage. Clearly, in humid temperature areas such as Britain, nearly all the incident precipitation enters the soil and hydrology must be mostly soil physics. On the basis of this meeting, however, the question of whether current soil physics theory is appropriate for use in large scale hydrological prediction remains open.

Keith Beven

Changes in the Society's Statutes

The recent ballot on changes in the Society's Statutes approved the amendment of Statutes 1, 3 and 13 proposed by the Main Committee. The Voting was as follows: votes for — 100; votes against — 0.

Hydrology in the 1990s

Further to the note in the last issue of *Circulation*, we now learn that the Royal Society and the NERC have decided to sponsor a joint survey of priorities in the Earth sciences, but are to exclude the fluid phase, i.e., the survey will not cover hydrology, oceanography, meteorology or atmospheric science except to the extent that aspects of these disciplines are inexorably linked to solid Earth physics, chemistry and biology.

International News

Under the auspices of UNESCO's International Hydrological Programme, a hydro-geological map of Africa is in preparation. The first draft of Sheet 1 (NW Africa) at a scale of 1:5,000,000, has been approved, based on the UNESCO legend for hydrogeological maps. The preparation of the next sheets of the map are in hand as well as the initial steps in producing more detailed groundwater availability maps at larger scales (1:1,000,000 and 1:500,000).

There is also a draft hydrogeological map of the Arab States currently being assessed prior to printing.

BOOKS

Water Demand Forecasting, by V. Gardiner and P. Herrington (eds). Proceedings of a workshop sponsored by the Economic and Social Research Council. Geo Books, 1986, 139 pages, £19.50 ($32.25), hardback only. ISBN 0 86094 214 7.

Pick a number, double it . . .

Many people think of water demand forecasting in terms of some sort of quasi-mathematical jiggery-pockery. This slim volume of papers shows that while that opinion may have been justified in the days when total consumption was simply plotted against time and then a trend extrapolated, it is certainly unfair today.

Much of the impetus for the developments in demand forecasting has come from within the industry itself rather than from academics. This is reflected to some extent in the backgrounds of the authors — eight academics and eight from industry.

Clear presentations are made of the disaggregated or component approach to forecasting. This technique divides total demand into its major elements which are then modelled individually. Often the forecast provided is not a single value but a range including maximum, minimum and most probable values. The timescale of the forecast may vary from decades, in the case of resource planning, to detailed diurnal patterns of domestic and industrial water use.

It is interesting to contrast the level of sophistication of water demand forecasts with that of the demand forecasts used in the electricity supply industry (McGowan, this volume). Despite the advances of recent years, the understanding of water demand still has some way to improve before it matches that achieved in the electricity industry. However, the progress is praise-worthy and much could be achieved with continued, detailed monitoring and analysis, including the use of well calibrated simulation packages.

David Rees

also received . . .

Guidelines for planning community participation activities in water supply and sanitation projects, by Anne Whyte. WHO Offset Publ. 96, 1986, 53 pages, Sw.fr.10. Available through HMSO.

A sensible — almost commonsense — booklet listing the questions to consider when trying to start community projects. Will be of value to anyone getting involved in planning or implementing projects, and can be transposed to irrigation, erosion control or many other schemes that depend upon community support.

Technology for water supply and sanitation in developing countries, Technical Report 742, WHO, Geneva, 1987. 38 pages. Sw.fr.7.

Not useful.

Scenarios for the preparation of guidance and audio-visual material for planners and decision makers, by Gunnar Lindh. Technical Document in Hydrology, UNESCO, 1986, 19 pages. Free from UNESCO.

I feel no better able to present material to planners having read this.

Socio-economic aspects of water resources development in the USSR, by G.V. Uoropaev. Technical document in Hydrology, UNESCO, 1986, 53 pages. Free from UNESCO.

Readable national survey with a variety of statistics on water resources and use: the city of Funze uses 2,056 litres of water per head per day — is this a world record? Annotated bibliography.

Energy policies and strategies for water resources development, edited by ACT Holtz. Technical Document in Hydrology, UNESCO, 1986, 68 pages. Free from UNESCO.

A good introduction to the effects of energy development on water resources. Suitable as a first read for those consultants starting to prepare a master plan, or for teachers.

NEWS FROM MEMBERS

MEMBERS ON THE MOVE

Steve Seabury has left Southern Water and is now with Thames at Reading.

Ian Rowbottom, initially with **David Pilgrim** and then with the Water Resources Commission, New South Wales, has joined the Sydney Office of Binnie & Partners. Ian is starting work on a new study that Binnies have been awarded to locate new water supplies for the Port Macquarie district of north coast New South Wales.

UNIVERSITY NEWS

Dr. M.A. House was awarded her PhD at Middlesex Urban Pollution Research Centre in December 1986 for her study on Water Quality Indices. This work was conducted in collaboration with the Water Industry and provides a working methodology (with applications) for the use of indices in surface water classification. There are sub-indices for toxic substances. A further Internal Research Report No. 5 "The Selection of Determinands for Water Quality Classification" is now available and No. 9 "The Development of Rating Curves for Water Quality Classification" will be available shortly.

Research Report No. 8 "Speciation Studies on Natural Waters: A Review" is also available from the Research Centre.

The Proceedings of the International Symposium on "Highway Pollution" held at the Urban Pollution Research Centre in July 1986 have been published by Elsevier Press and are also available from the Research Centre. The volume contains a number of articles of interest to hydrological and water quality issues in the urban environment.

RESOURCES

NORTHERN NEW RIVER INVESTIGATION

The Northern New River well field consists of one borehole and seven adited shafts. The wells were sunk between 1848 and 1901 with the purpose of supplementing the flow of the New River — an open aqueduct completed in 1632 for the purpose of providing Central London with a wholesome supply from the Chadwell and Amwell Springs.

The eight sources have been in regular use since their commissioning and aggregate licensed abstraction of 97.7 Ml/d constitute the largest group source in the Thames Catchment. One source feeds directly into supply, the rest discharge into the New River.

All the wells take their supply directly from the Chalk aquifer which is thought to be in hydraulic continuity with the overlying flood plain gravel deposits. In all its long history, the well field has never been properly assessed either in terms of its full potential reliable yield or the origin of the pumped supply. Thames Water has decided therefore to carry out a comprehensive investigation of the well field, the two primary objectives being:

(i) to evaluate the reliable and maximum yields from the well field under the full range of operating conditions.
(ii) to determine the hydrogeological origin of the groundwater abstracted and assess the implications for water quality.

ALLEVIATION OF LOW RIVER FLOWS

Thames Water has commissioned a major environmental study by Halcrow to look into the extent to which low flows in chalk streams in six catchments have been caused by groundwater abstraction and what could be done to alleviate the problem. In three major cases, the Ver and Misbourne in the Chilterns and the Darent in the North Downs, licensed abstraction

is between 80% and 100% of aquifer recharge and whole rivers are affected. In three smaller cases, the effects are restricted to short stretches in the headwaters of the streams.

The first part of the study has looked at present conditions, their hydrogeological background and environmental consequences. Targets for possible restoration of flows have been proposed and a short list of realistic solutions identified.

The second part of the study will cover the outline design, costs and environmental consequences of these options.

THE GATEHAMPTON GROUNDWATER SOURCE

One of the largest groundwater sources to be constructed in the Thames catchment has recently been test pumped. The 22 hectares site lies in the Goring Gap adjacent to the River Thames at Gatehampton Farm, Goring, South Oxfordshire.

The abstraction works comprise seven boreholes each 740 mm in diameter drilled through Alluvium and Flood Plain Gravel into Middle and Lower Chalk to a depth of 65 m. Individual test pumping of each borehole indicated yields in excess of 20,000 m^3/day. The combined pumping test of the entire site was carried out for 18 weeks without a single pump failure during the Autumn and early Winter of 1986/87, mainly at a rate of 90,000 m^3/day with the last two weeks at 105,000m^3/day. The water was discharged via nine weir tanks directly to the River Thames. After 16 weeks pumping of 90,000m^3/day, drawdowns in the pumped boreholes were between 7.8 m and 13.0 m.

Data from five observation boreholes drilled into the chalk aquifer and 17 tubewells driven into the gravels indicate that the gravels and the chalk are in good hydraulic continuity and that a large proportion of the yield was being derived at the expense of the river. Geophysical logging of the boreholes has shown that the Middle Chalk immediately below the gravel is extremely open and well fissured resulting in boreholes of high efficiency.

Initially, the source will be used to meet growth in demand in South Oxfordshire but this will require only about 15,000m^3/d over the next 25 years. The source clearly has much greater potential than this local use and a much wider ranging strategic use is now being considered.

RIVER LEVEL DATA PROCESSING SYSTEM

Work on this project continues, but it is now nearing completion. Recent additions include the ability to calculate flows under drowned conditions, and processing of Munro charts and Sarazota (ultra-sonic and electro-magnetic) data loggers.

Cathy Glenny
Thames Water, Reading

NATIONAL HYDROLOGY SYMPOSIUM

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IT'S NOT TOO LATE!

If you would like to make a poster presentation of a particular piece of work, or of some recent research advances which you think are particularly relevant to the subjects under discussion, please contact:

Celia Kirby, Institute of Hydrology, Wallingford (0491 38800)

If you are interested in making some microcomputer-oriented demonstration or in using the video lecture theatre facilities, please contact:

Professor Mike Hall, Department of Engineering Science, Middlesex Polytechnic (01-368 1299)

If you would like to mount a small "trade" exhibition (e.g. of instruments), please contact:

Ann Matthews, Institute of Hydrology, Wallingford (0491 38800)

- DON'T HESITATE. Reserve your room now by completing the form on the back of the symposium leaflet, two copies of which are enclosed with this *Circulation* (one for you and one to pass on to a non-member).

This is our first UK-wide national symposium designed to be of interest to as large a proportion of our members as possible. It has the full support and backing of the Institution of Civil Engineers and the Institute of Hydrology. Help us set a good pattern for the future by giving it your support as well.

Peter Cloke from Australia has sent us the following clip from the *New Straits Times*:

Water pills cause major floods in African city

Kissimoush (Central Volta), Tues. — An army tanker carrying a secret consignment of dehydrated water capsules caused major floods in this central African city when it crashed into a river, it was reported today.

Official Volta Radio said the accident occurred four days ago while an army convoy was transporting the capsules to the main military base along the Kayendi river which runs through the centre of the city.

No further details of the accident were released by the radio.

However, military sources said almost the entire load of capsules had spilled into the river.

Within hours the Kayendi had overflowed its banks and caused major flooding, they said.

The military government of General Walter Matawa imposed a news blackout after the incident and only released official details of the accident after pressure from the opposition.

The military sources said there had been no casualties although widespread disruption to electricity and telephone services was reported.

At least 4,000 people living along the river had been evacuated and the army has been called in to help with relief work.

The sources also said an entire village of pygmies four kilometres south of the city had ben inundated.

They said the sudden flooding had forced tribe members to higher ground with some seeking shelter in trees until their rescue three days later. — AF News.

As the article appeared on the 1st April 1987, he hopes the date was not coincidental!

Diary

27 May 1987
BHS South-West Section.

Field Meeting at Slapton Ley led by T.P. Burt, University of Oxford, and including consideration of subsurface runoff processes, nitrate leaching, sediment delivery and pesticides, eutrophication, and lake sedimentation.
14.15h at Slapton Ley Field Centre.
Contact: Bruce Webb (University of Exeter).

Copy Deadline for Issue No. 15 — 3rd July 1987

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