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UNIVERSITY RESEARCH ... New series

The following article by Professor Enda O'Connell on hydrological research in the Department of Civil Engineering, University of Newcastle, is the first of a series in which we are inviting key academic groups to give us an up to date picture of their activities and the unique contributions they are making to our science.

The Department of Civil Engineering at Newcastle can claim a long-standing tradition for hydrological research as former staff members, *Vin Collinge*, *Phil Johnson* and *Paul Novak* have all made notable contributions over the years. Today, research continues to flourish, and the current hydrologists in the Department are pleased to have the opportunity to contribute the first article in this new BHS series.

Soon after **Enda O'Connell** took up the Chair of Water Resources Engineering in the Department in early 1984, the NERC Water Resource Systems Research Unit was established in collaboration with the Institute of Hydrology (IH). This initiative was taken in response to the need of Government to promote better interaction between Research Institute and University research, and **Jim McCulloch**, Dirctor of IH, and visiting Professor in the Department, acted as midwife in bringing this new hydrological research infant into the world! Much of the Department's hydrological research effort is centred on the Unit, which has as its major objective the development and application of a comprehensive mathematical modelling capability for predicting the transport and fate of pollutants and sediments within the land phase of the hydrological cycle. Particular emphasis is placed on modelling pollution in the subsurface zone. This research theme recognises the increasing concern about major pollution threats to our water resources; these include nitrate pollution of surface water and groundwater, the mobilization and transport of toxic metals in the soil through leaching by acid rain, salinization of groundwater and pollution from hazardous waste disposal. In addition, land-use changes related to agricultural and forestry practices have led to large scale soil erosion, the products of which are causing rapid siltation of reservoirs, particularly in the Third World. The spatially distributed nature of many of these problems is such that the traditional, empirical, hydrological approaches, based on spatially lumped descriptions of flow processes only, form an inadequate basis for their description. Instead the successful implementation of remedial measures to protect water resources must be based on a sound understanding of the physical, chemical and biological processes involved and of their interactions. In establishing this basis, mathematical modelling has an important role to play in integrating existing knowledge into a means of predicting the movement of pollutants and sediments in time and space and assessing the cost-effectiveness of various remedial measures.

During 1984/85/86, four members of staff have been recruited into the Unit: **James Bathurst** (on long-term secondment from IH) and three Research Associates, **Trevor Cooper**, **Rae Mackay** and **Kermen Mok**, who between them combine expertise in hydrological and hydrogeological system modelling, numerical analysis and engineering applications. When James moved to Newcastle, he brought with him from IH the Système Hydrologique Européen (see Abbott *et al*, 1986a, b; Bathurst, 1986a, b) which is now undergoing further development within the Unit. James' interests in modelling and sediment transport research have been brought together in a PhD study which involves the development of an erosion and sediment transport component for the SHE. This simulates the erosion and transport of soil by rain splash, overland flow and channel flow. The problem of characterizing small scale effects, typically represented by point measurements, on the grid scale of the SHE is a problem which is central to this and other applications; these include joint work with the University of Bristol and the Ecole Polytechnique Fédérale de Lausanne. A joint project with the Danish Hydraulic Institute and Sogreah is being undertaken to transfer the SHE to India for use in assessing the effects of irrigation on the hydrological regimes of Indian catchments. The extension of the SHE to include solute transport modelling is also planned. Those who have relished James' past productivity on mountain river research will be pleased to hear that he escapes to the wilds of Northumberland from time to time and so the flux of Bathurst papers on this subject will continue!

Elsewhere in the Unit Rae Mackay is engaged in research on modelling groundwater pollutant transport. At a fundamental level, research is geared to quantifying the scale dependence of the dispersion tensor for various hydrogeological domains and scales. Currently available field and laboratory tests produce significantly different dispersivities from those derived by the inverse modelling of recorded aquifer-scale pollution plumes. By generating realizations of aquifer properties using Monte Carlo methods and then using a high density numerical simulator to model the propagation of particles through the aquifer media, it is hoped that a better understanding will be gained of the relationship between the scale dependence of the dispersion tensor and aquifer heterogeneity.

John Porter, 'New Blood' lecturer in Groundwater Hydrology, is conducting closely related research on the analysis of uncertainty in model predictions arising from the limited availability of site-specific data defining an aquifer's characteristics. Particular attention is being paid to the practical problems associated with the use of Kriging for the spatial interpolation of groundwater data; Monte Carlo studies are being conducted in an effort to identify statistically robust methods of estimating the variogram, which describes the spatial structure of the quantity of interest.

John and Rae's research is finding application in a research contract aimed at quantifying the uncertainties in the pathways and travel times of contaminants from a hazardous waste repository. Trevor Cooper, who has recently joined the Unit, is closely involved with this work and also with case studies of groundwater pollution currently being undertaken jointly with the British Geological Survey (Mackay *et al*, 1986) and the Anglian Water Authority (Little, 1986). A further area of contaminant transport research is a modelling study of pollutant migration in stream/aquifer systems which is being conducted through a NERC CASE studentship with Thames Water Authority.

Kermen Mok's research is focused on multiphase, multicomponent (i.e. combined gaseous aqueous and oleic phases with combinations of different chemical species) flow modelling, with particular emphasis on the movement of pollutants (including oil) through the unsaturated zone. Here, the object is to produce a realistic and useable model for practical application which incorporates local scale effects (such as the 'viscous fingering' phenomenon of unstable fluid displacement) and larger scale effects (such as migration of sharp fronts between immiscible fluids).

Apart from keeping a Director's eye on the research programme of NERC Unit, Enda O'Connell is pursuing research on some more traditional but unsolved hydrological problems. The impact of the spatial variability of rainfall on catchment response is one such problem; this is being tackled through a PhD study by generating stochastic moving-storm rainfall fields, propagating these through the spatially distributed SHE model to obtain a 'true response' and then exploring the impact of different sampling schemes on prediction error. A further PhD study is being pursued through an NERC CASE award with the Institute of Hydrology to explore the impact of flood plain storage on the flood frequency curve. The fact that flood plain storage can lead to EV3 flood frequency curves with apparent upper bounds has been observed by Archer (1981, 1987) and Benn (1984). A stochastic rainfall-runoff model has been developed based on FSR methodology; generated storms will be propagated through a hydraulic flood routing model within which the geometry of the flood plain can be varied and the effect on the downstream flood frequency curve quantified. This may lead to a different regionalization approach to the more traditional statistical methods. On the interface with hydraulics, a further PhD study has led to the development of algorithms for the real-time control of discharges and water levels in an irrigation canal. Yet another PhD study of algorithms for water distribution network modelling may have benefits for the solution of systems of finite difference equations in distributed models.

In collaboration with Andrew Metcalfe from the Department of Engineering Mathematics, **John Mawdsley** has undertaken a comprehensive study of the problem of estimating seasonal flood risk. Some of the earlier work which takes account of the variation of flood risk with catchment wetness, has just been published (Ettrick *et al.*, 1987) and a second PhD study is now extending the work to model winter flooding when snowmelt may be significant. John has also tackled the formidable problem of trying to quantify the economic value of streamflow data. This has been a contentious issue in the Water Industry in recent years, with virtually no methodology available for the objective assessment of the worth of data. The methodology developed by two of John's PhD students assumes that data have no value unless they modify design or operational decisions. For a variety of projects where the impact of data on decision-making has been explored the economic value of the data appears to be of the order of 3-5% of the project costs.

John Mawdsley has also been continuing a long-term programme of research on evaporation by focusing on the impact of aquatic plants (hydrophytes) on evaporation from open water bodies. This is an important factor in estimating water balances for swamps and small reservoirs, particularly in the tropics. Previous work has provided conflicting evidence on the impact of hydrophytes on open water evaporation; estimates range from an increase of 535% to a decrease of 45%. At the site of a small reservoir owned by the Newcastle and Gateshead Water Company, data for several seasons have been collected by PhD students. These data include weather station data and observations from floating pans and lysimeters designed specially for the study. The local plant studied (*Carex riperia*) appears to increase the evaporation over the open water rate by 15-20%, but this result has proved difficult to model without allowing for the effects of advection.

Apart from the above research, numerous MSc project studies generate research results which are of specific interest to the Water Industry; for example, work has been carried out on using rainfall time series in WASSP simulations, on the economic design of wellfields, groundwater modelling, flood estimation, estimation of spray irrigation demand, etc. These studies frequently sow the seeds for longer term research.

Looking to the future, this group of hydrologists foresees an increasing emphasis on multidisciplinary research to tackle those formidable pollution problems (e.g. acid rain, nitrates) and erosion and sediment transport problems where the hydrological cycle is the principle transport mechanism. This in turn implies that an improved understanding and improved physically based models of the underlying flow processes are required; here spatial variability, parameter estimation and scale effects are difficult problems which will keep us stretched for many years to come. Modelling systems such as the SHE may be perceived as complex beasts with large appetites for data and composition time; however, they are providing us with new research challenges to enable them to be turned into operational tools which can tackle some of our major unsolved problems. The use of expert systems at the front end of such models can be expected to lead to greater ease of use, as can developments in the post-processing of results.

We look forward to a fruitful research era ahead which will seek to establish a strong multidisciplinary research base at Newcastle through collaboration with Malcolm Newson in Physical Geography and colleagues in the Faculty of Agriculture. This multidisciplinary grouping constitutes the newly-formed 'Centre for Land Use and Water Resources Research' which will seek to tackle many of the problems created through man's intervention in the hydrological cycle at their core i.e. the land use-water resources interface.

References

Abbott, M.B., Bathurst, J.C., Cunge, J.A., O'Connell, P.E., and Rasmussen, J. (1986a). An introduction to the European Hydrological System — Système Hydrologique Européen, 'SHE', 1: History and philosophy of a physically-based, distributed modelling system. *J. Hydrol., 87(1/2)*, 45-59.

Abbott, M.B., Bathurst, J.C., Cunge, J.A. O'Connell, P.E., and Rasmussen, J. (1986b). An introduction to the European Hydrological System — Système Hydrologique Européen, 'SHE', 2: Structure of a physically-based, distributed modelling system. *J. Hydrol., 87(1/2)*, 61-77.

Archer, D.R. (1981). A catchment approach to flood estimation. *J. IWES, 35 (3)*, 275-289.

Archer, D.R. (1987). Flood wave attenuation due to channel and flood plain storage and effects on flood frequency. Paper presented at BGRG Workshop on 'The Hydrology, Sedimentology and Geomorphological Implications of Floods', University of Lancaster, 14-16 May.

Bathurst, J.C. (1986a). Physically-based distribute modelling of an upland catchment using the Système Hydrologique Européen. *J. Hydrol., 87(1/2)*, 79-102.

Bathurst, J.C. (1986b). Sensitivity analysis of the Systeème Hydrologique Européen for an upland catchment. *J. Hydrol., 87(1/2)*, 103-123.

Benn, J.R. (1984). Frequency analysis of flood data from the Northumbrian and SW Water Authority regions. MSc Thesis, Department of Civil Engineering, University of Newcastle upon Tyne.

Ettrick, T.M., Mawdsley, J.A. and Metcalfe, A.V. (1987). The influence of Antecedant Catchment Conditions on Seasonal Flood Risk. *Wat. Res. Res. vol. 23(3)*, 481-488.

Little, R.H. (1986). Applications of a groundwater pollution model to a site near Cambridge. MSc Thesis, Department of Civil Engineering, University of Newcastle upon Tyne.

Mackay, R., Porter, J.D., Williams, G.M. Ross, C.A.M. and Noy, D. (1986). Modelling mass transport in the saturated zone — a case study. *Proc. Intl. Conf. on Water Quality Modelling in the Inland Natural Environment*, Bournemouth, UK. Organized and sponsored by BHRA, The Fluid Engineering Centre, Cranfield, Bedford, UK, pp. 259-275.

Rainfall and Drainage in the Middle East

BHS Southern Section Meeting
3 March 1987

This meeting was devoted to the presentation of a paper by *Dr H.S. Wheater* and *Mr A.P. Butler* on "Rainfall and Storm Runoff in the Arabian Peninsular".

In introducing the paper, Dr Wheater commented that our knowledge of arid zone hydrology is still extremely limited. Hydrological events are infrequent and highly variable. Raingauges and flow recorders may remain inactive for months or years and yet are required to detect highly intense rainfall or a steeply rising flood wave. Floods can be extremely damaging for the instrumentation and can significantly alter channel cross-sections, adding complexity to the estimation of event characteristics. Storms are generally localised and of short duration, although occasionally severe events may be caused by widespread rainfall over relatively large areas. These problems, when added to the difficulty in operation of sparse hydrometric networks in hostile climatic conditions, explain a general lack of good quality data. As a result, hydrological design in developing areas of the Middle East is generally based on minimal information.



Siap raingauge, SW Arabia.

The problem of flood estimation can be approached in three ways.

(i) Regional flood frequency analysis
The effect of limited spatial occurrence of storms and wadi bed infiltration are integrated in flood observations and hence regional frequency analysis is an appropriate tool for arid zone flood estimation. However, available flood records, although increasing, are generally limited, and it has been found necessary by some to transpose other regional relationships, e.g. from SW Arizona, for Middle East application.

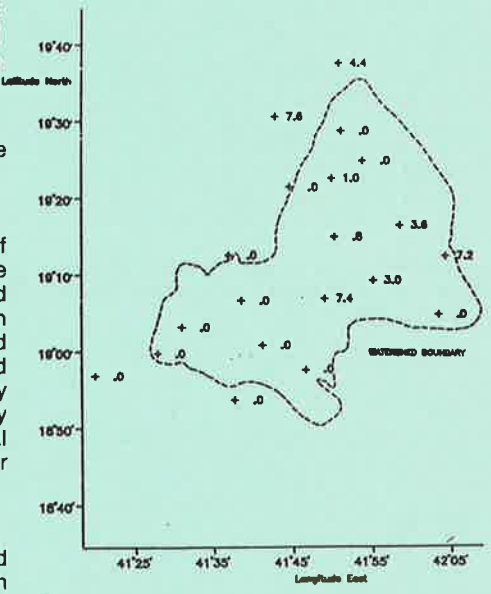
(ii) Morphometric relationships
Relationships between discharge and channel characteristics have been postulated, but with substanial changes of channel geometry often occurring after severe floods and a general lack of validation, such methods cannot be considered reliable.

(iii) Rainfall runoff models
Although widely used in humid climates, lack of data in arid and semi-arid areas on the variability of rainfall, runoff generation and transmission losses has limited the application of such methods.

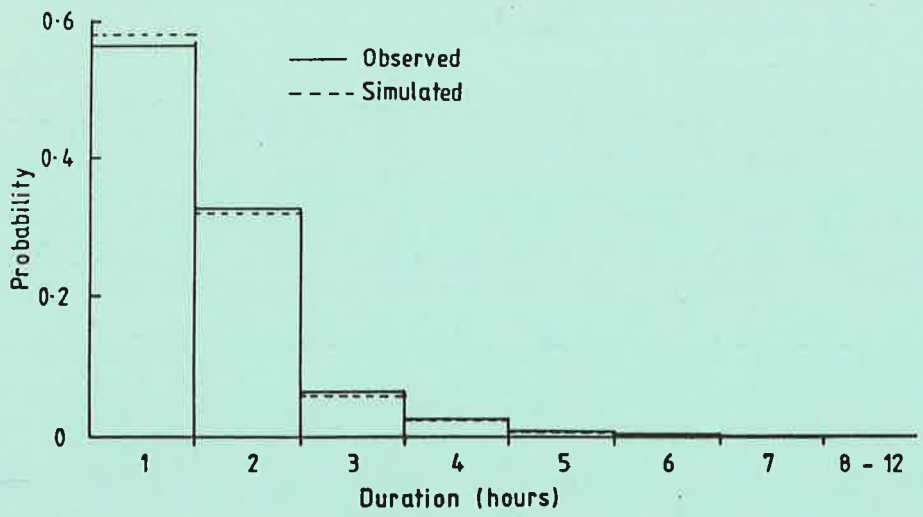
Examples of floods were given from SW Saudi Arabia and from the storm of 3 May 1981 in Northern Oman. This latter event has been studied in detail and a distributed kinematic-wave catchment model was successfully applied to reproduce the flood hydrograph. However, a major uncertainty in this model application was the spatial distribution of rainfall. Current work at Imperial College is addressing the problem of spatial rainfall variability for the SW Saudi Arabia and this aspect was described by A.P. Butler.

Five catchments in SW Saudi Arabia are being studied on behalf of Dames and Moore (Saudi Arabia) and the Ministry of Agriculture and Water, Riyadh. A 3000 m mountain range runs parallel to the Red Sea. Three of the wadis — Al Lith, Yiba and Liyyah — drain from the mountains to the Red Sea, while two — Tabala and Habawnah — drain to the interior. Catchment areas range from 500 to 5000 km^2 and the catchments typically have 20-30 autographic raingauges; gauge elevations range from 10 to 2600 m.

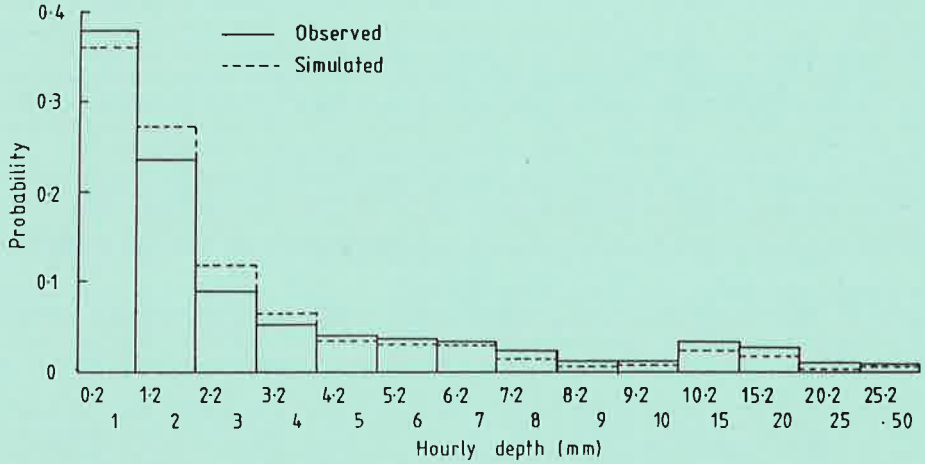
A rainfall model of the spatial and temporal variability of the predominantly



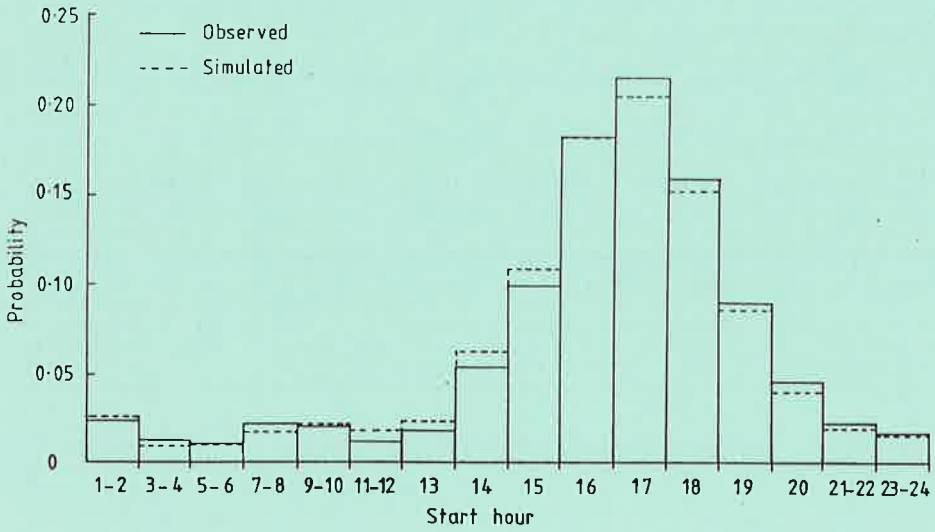
Rainfall amounts in Wadi Yiba simulated by the occurrence model for a rain day in September: simulated daily rain totals (mm).



Probability distributions of the duration of rainfall events derived from real and simulated data.



Probability distributions of rainfall depths produced by events of one hour duration derived from real and simulated data.



Probability distributions of the start time of rainfall on days when only one event occurs, derived from real and simulated data.

convective rainfall has been developed on an hourly time step to provide input to a rainfall-runoff model for water resource evaluation. The general characteristics of this rainfall are that it:

- occurs in late afternoon or early evening
- is of short duration (typically 1-2 hours)
- consists of individual raincells of localised extent.

Rainfall models can be classified into three groups.

Point models generate time sequences of rainfall at one location.

Multivariate models consider several discrete points simultaneously and preserve the covariance of historical data.

Multi-dimensional models characterise the rainfall phenomena continuously over the catchment area.

Due to the localised nature of the rainfall and the input requirement of the runoff model, a multivariate model was developed. The model produces hourly rainfall at discrete points which maintain the statistical characteristics of the catchment. It takes several statistical decisions at its different stages.

The model seeks to answer three questions:

(i) Will it rain?
(ii) Where will it rain?
(iii) What hourly distribution of rainfall will occur during the day?

To decide whether it will rain, the model uses catchment monthly raindays frequencies and a random number generator. After deciding whether it will rain, the model seeks to identify the spatial distribution of rainfall. This is done using a weighting factor for each raingauge of the network. Again a random number decides the specific gauge(s). But rainfall in each station shows a dependency over one day. To incorporate this dependency, the weighting factor is increased by an arbitrary factor if in the preceding day rainfall occurred at that station. The hourly distribution of the rain at the selected station(s) is determined by a start hour time and a deviation from it which is determined statistically. Once the duration and the start hour time is known then the depth of rainfall is established.

The model produces excellent results for point rainfall characteristics, and reasonable results for areal distribution. Work is continuing to incorporate a small number of more widespread rainfall events.

Discussion from the floor reinforced the practical importance of arid zone floods and there was support for the use of Irish crossings in road design. It was suggested that large historic floods provided a useful source of data for extreme flood estimation. Work from the Institute of Hydrology was presented on a regional frequency analysis of SW Saudi Arabia based on regression of the 5-year flood on catchment characteristics and a regional growth curve. With respect to the rainfall model, it was pointed out that the empirical approach adopted was difficult to parameterise for other locations.

The authors agreed, and were working towards a more parsimonious representation of distributions for regionalisation.

M. Khan
P. Larentis

WATER PROJECTS: Engineering and Social aspects

Joint BHS National Meeting with Royal Geographical Society
9 April 1987

The first two sessions of this all day joint meeting were chaired by *Phil Johnson* (BHS President) who apologised for the absence of Mike Mansell-Moullin (abroad on business) and expressed his appreciation to Dr. Hemming (Secretary of RGS), for the use of their facilities. The timing of the meeting was considered most appropriate as the European Year of the Environment had started in March.

Introducing the first paper to an audience of about 80, **Kerry Turner** (University of East Anglia) divided his discussion of the Broadland Complex wetland in Norfolk into the pre- and post-1980 eras. During the 1970s there was an accelerated enrichment of the broads by sewage effluent (eutrophication) leading to excessive algal growth. Increasing tourism and boating activity gave rise to bank erosion and a loss of reed beds. On the traditional grazing marshes, generous land drainage subsidies encouraged high intensity arable farming with an associated increase in nitrate pollution. The lowering of the water table affected flora and fauna reliant on the shallow dyke habitat. In addition, the Broadland complex was subject to an increasing risk of salt water flooding as the defence system, upgraded after the 1953 flood, had suffered a gradual lowering of standards due to lack of maintenance. The Yarmouth barrier scheme was proposed to provide uniform, area-wide flood protection.

In the 1980s the barrier scheme was abandoned and a more selective and environmentally acceptable flood protection strategy was developed. The revised policy takes account of experimental results of Broads restoration schemes and recent examination of a clay soil destructuring problem in areas where traditional wetland grazing has been converted into intensive arable farming. Speculation that the 'greenhouse effect' may lead to a rise in global sea levels of between 0.2 and 1.4 m by the middle of the 21st century was queried at discussion time.

For the second paper, the scene changed to Welsh River catchments and the roles of recreation and amenity in Welsh Water's management of reservoirs and rivers. The theme throughout this presentation by **Keith Stokes** (Welsh Water Authority) was of consultation and compromise within the constraints of economic and operation priorities. Accompanied by some excellent slides we were shown a wide range of water recreation management problems and solutions. In the Bala area, river regulation for water supply and flood control has given rise to the creation of a white water canoeing and rafting centre. Conflict between canoeists and anglers on River Tryweryn, Llyn Brenig was deftly converted into compromise by advertising a public meeting to discuss prohibition of recreational activities. As the warring parties joined forces to meet the common enemy it was announced that the advert should have read promotion and not prohibition. A joint committee was subsequently formed and an old mill was converted into a Club House.

Near Rhyl in North Wales, revised control rules were devised for the Dolwen and Plas Uchaf reservoirs; the rules safeguarded supplies yet enhanced the attraction to anglers by maintaining adequate levels in the fishing season. In the Elan valley in mid-Wales, old workshops have recently been converted into an up-market Visitor Centre which attracted 80,000 people in its first year of operation. An Outdoor Pursuits Centre is soon to follow.

As a final example of recreation management, the speaker outlined the efforts of the Authority to act as an intermediary in the Wye valley between riparian owners and anglers on the one hand and navigators on the other. In discussion, the financial return to the Authority of the schemes was queried. By seeking grant aid from various sources, the schemes were often built at half cost, provided great value in public relations and substantial benefits for the local community.

The afternoon session began with a paper by Professor **Ken Gregory** (University of Southampton) on the environmental effects of river channel changes. Techniques developed over the last two decades such as mathematical modelling, project monitoring and remote sensing have demonstrated that channel changes are more substantial than originally thought. They can occur downstream of reservoirs, dams, river channelization and areas of land-use change. From 1930 to 1980, some 8,500 km of river in England and Wales were affected by capital works. Analysis of the results of about 200 research studies from different regions of the world has shown that in more than 25% of cases, channel change ratios exceeded a factor of three times. In the UK, regulated river flows from over 100 reservoirs have affected channel morphology for up to 10 km downstream or until the drainage area is three times that of the reservoir. More localised changes such as those occurring downstream of urban areas or in the vicinity of bridges have also been identified. However, the interrelationships between changes in cross-section, planform and channel networks are less well understood as are the costs that the changes might incur.

Geoff Petts (University of Technology, Loughborough) discussed the ecological management of regulated rivers. A review of the history of river regulation throughout Europe showed that dramatic changes have occurred since 1850. It is only in the last decade, though, that the ecological effects of regulation have been identified. The principal environmental impacts of river regulation are:

- — introduction of barriers to fish migration
- — isolation of the main river from the alluvial plain
- — the alteration of the flow regime and interstream habitats.

The ecological changes often require a long time (perhaps 100 years) to stabilise. Management tools to counteract adverse effects include the provision of fish passes, flood plain backwaters, secondary flow regulation and the introduction of biological controls. Attempts to preserve reaches of wild river on the Rhone were demonstrated. It was concluded that ecological management is dependent on improved scientific knowledge of species and the socio-political will to overcome the problems. However, widespread application of techniques to counteract the effects of river regulation will not be justifiable until pollution problems are overcome.

In discussion, **L.J.W. Wright** (Royal Geographical Society) talked of his work on the White Nile and observed that, although river cross-sections varied widely, width increases generally followed a parabolic distribution. Once the parameters were identified, substantial savings in river channel surveys could be achieved. Other discussion centred around the true definition of conservation and whether, at the end of the day, rivers would accept the impositions placed upon them. It was generally agreed that we must work with the river rather than against it and that environmentalists must come up with better design parameters or guidelines for engineers.

The final session of two papers was introduced by Professor **Des Walling**

(University of Exeter). In the first paper, Nigel Holmes (Nature Conservancy Council) described river corridor surveys which have played an increasingly important role following the 1981 Wildlife and Countryside Act. This charged the Water Authorities to further the enhancement of the environment rather than simply pay due regard to it (which in some cases, meant two minutes silence prior to destruction). Following pilot surveys in 1985, most Authorities would now execute a river corridor survey, as a matter of course, prior to any major river work such as dredging or new construction. The surveys, as recommended by the NCC, identify features such as riffles, pools and particular wild life habitats, both on the main channel and in the adjacent backwaters and floodplain. The skills of the river engineer and the ecologist may then be integrated into the most sensitive design which creates new habitats for flora and fauna or reinstates those unavoidably lost during the river works.

John Wright (Freshwater Biological Association) described the River Communities Project which has devised a biological classification system for the wide range of British rivers based on the invertebrate fauna. The data base comprised 370 unpolluted sites within 61 river basins. Nets and dredges were used to collect some 90 species of invertebrates at typical sites and up to 140 species at exceptional sites. A statistical procedure (TWINSPAN) was developed and the sites were subdivided into 30 groups. The relationships between these groups and the physical and chemical features of the sites were then examined. Results suggest that species predictions may be adequately modelled using only five site parameters such as the substratum, distance from source and the alkalinity, chloride and total oxidised nitrogen content of the river water. The site classification system is now programmed on a BBC micro computer. The principal uses of the research to date are:

- historical records for future reference
- knowledge of the occurrence and environmental range of about 800 species of invertebrate throughout the country
- prediction of the fauna at a given site from the environmental parameters
- identification of polluted sites.

During the final discussion, **Frank Kestner** (Hydraulics Research) showed some slides to demonstrate the natural beauty of the Morecombe Bay area and to illustrate the likely impact of the major bunded storage schemes studied in the late 1960s. Interest has now been renewed in a smaller scale project involving the estuary of the Lune which would not have such a major impact.

The need for re-surveys after completion of river works was highlighted but a call for more species-directed surveys was rejected on the basis that the habitat for a single species might be saved at the expense of a hundred. The water quality parameters used for the invertebrate studies were mean annual values; they provided a surprisingly good fit.

In summing up, the chairman, Phil Johnson, thanked Mike Mansell Moullin for his work in organising the meeting and the speakers for six excellent papers. He apologised that copies of the papers were not available for the meeting; these would be distributed later. As a water resources manager, he was pleased with the overall message and the way the Water Authorities are adapting. The meeting was rounded off with the question 'What is conservation?'. We have to maintain an even hand, for example, between the conservation of fish or heron and mink. Every day, the Authorities are asked to interfere with nature by preventing, for example, the natural erosion of river banks. A balanced view is essential.

John Wild

Future METEOSAT Satellites in Hydrology



An IH Cold Regions AWS operating at the British Antarctic Base at Faraday transmitting its data via Meteosat (antenna on right).

The European Space Agency (ESA) held a meeting in Santiago de Compostela (Spain) from 25-27 May this year to discuss the next generation of Meteosat satellites. This particular meeting, the last of several, concerned the dissemination of images and of data collection platform (DCP) data.

The Institute of Hydrology has been operating ten DCPs for about two years with its own receiving station. This number of DCPs makes the Institute one of the largest single users in Europe, in the UK second only to the Meteorological Office, with stations transmitting from the Welsh uplands, Scottish highlands, and Antartica. As the Institute representative at the meeting in Santiago, I found I was the only one there with a hydrological background, the rest being meteorologists. Yet the decisions being taken will affect the hydrological applications of DCPs for decades. It is important, therefore, to get the hydrological requirements specified correctly now and known to ESA.

It was stated for example, during one presentation, that the anticipated number of DCPs for meteorology would be in the order of 2,000 but for hydrology it was placed at 5,000. This figure was based largely on guesswork, since the number of questionnaire replies from hydrologists, was very small. Perhaps they went to the wrong people or perhaps there is a great caution about the use of DCPs.

A specific example of the incomplete understanding of those making the decisions was the view that while for meteorology transmissions would be required either hourly or three-hourly, once or twice a day, with allert condition transmissions, would be sufficient for hydrology. I pointed out that hydrologists are now using telemeter data to produce forecasts using models in just the same way as the meteorologists. Depending on the nature of the particular river, data updates would be required, sometimes as often as twice an hour, while on large, slowly changing rivers perhaps twice a day might be enough. This change was made to the recommendations of the meeting.

It would be of interest to hear from anyone who has any views on the use of DCPs in hydrology, either in UK or in overseas applications. Applications could include the use of DCPs as an alternative to logging, for basic research, or for real-time flow predictions. Please send any comments to me at the Institute of Hydrology and I will communicate them to ESA. Negative views could be as interesting as positive ones, such as reluctance to use DCPs for one reason or another. Provided there is a fair response, the conclusions can be presented in a later edition of *Circulation*.

Ian Strangeways
Institute of Hydrology

Modelling Developments in the Upper Tame Catchment

BHS Midlands Section Meeting
6 May 1987

Thirty members and guests attended a Midlands Section meeting kindly hosted by the Department of Civil Engineering at Birmingham University. Chaired by *Dr Ian Cluckie*, four speakers from Severn-Trent brought us up to date on a major area of modelling and engineering activity in the West Midlands.

Bill Laight (STWA) gave the background to the Upper Tame sewage and drainage schemes. The area had initially been the responsibility of three separate authorities whose amalgamation in 1975 presented an opportunity to reassess the provision of flood drainage and pollution control in the Tame basin. In the Black Country, the Severn Trent Water Authority had inherited 14 pre-war sewage works which were generally overworked and poorly maintained. In Birmingham the infrastructure was less dilapidated. A new trunk sewer had been installed and the Minworth and Coleshill sewage works had come into full operation in 1971. The reassessment of flood water and pollution control in the Tame basin involved the consideration of over 30 options. However, the spare capacity in the Birmingham area proved decisive and it was decided to retain the Black Country works at Walsall Road and Ray Hall, and to link the two systems, concentrating treatment at Minworth and Coleshill. In diverting flood water and sewage effluent away from the head of the basin the system could cater for changes in flow forecasts and for population migration.

The closure of some of the older Black Country works also released a considerable quantity of land which could be employed as controlled overspill sites. Storage potential in the head of the catchment was important because of a bottle-neck where the Black Country and Birmingham systems met at Perry Hall, at which point the maximum capacity decreased from 8.8 m^3sec^{-1} to 6 m^3sec^{-1}. Flooding was an obvious threat, and there was a need to control the input of storm water into the main sewer. Storage tanks, hydrobrakes, and penstocks were considered. Although the simultaneous development of electromagnetic and ultrasonic flow gauages at that period provided improved data on flow magnitude and frequency to reassess earlier flow predictions, the problem of when to initiate flood control still remained. In modelling the sewage and river systems it was hoped to answer some of these questions and to maximise flow to the sewage works at Minworth and Coleshill at the same time as avoiding flooding and controlling river chemistry.

Richard Douglas (STWA) spoke on rainfall-runoff modelling and flow routing. Fundamental problems included the piecemeal development of the Black Country sewage system and the flashy or peaky response of the catchment to rainfall events. High flows in the River Tame might dilute polluted water but if runoff were to enter the sewers, flooding would be likely as the system was only constructed to take between 2.5 and 4 times dry weather flow, of which as much as 75% may be taken up by sewage effluent alone. The flashy response is due to the impervious nature of the urban catchment and was largely out of the control of the water authority.

Faced with the likelihood of flooding, consideration was given to the options of diverting or retaining excess water before it reached the foul sewer system. Alternatively, flows could be increased although this may simply transfer the problem to the treatment sites. The size of the Tame basin (50000 ha) and the inability of WASSP to handle the natural river component, or to cater for more than three independent rainfall inputs, largely precluded its effective use. The speaker called for a blend of routing and rainfall-runoff models. Betweeen 20 to 25 rain gauges in the Tame basin provide detailed rainfall data but to model the response of the stormwater and foul water drainage system to a particular precipitation input, it is necessary to identify different land-uses — in particular impervious areas — and to know to what part of the system each area is connected. The routing part of the model is rather more simplistic as the sewer network is clearly defined and gauged sections may be used to calibrate the system. The simulation makes several assumptions, the most fundamental being that limited points of measurement accurately represent the system as a whole. Richard finished by stressing the need to always improve calibration.

John Martin (STWA) attempted to define strategy in terms of water quality. An important component was the classification of the network into various quality categories. Criteria included percent dissolved oxygen and ammonia concentration. It was hoped to improve the quality of the River Tame upstream of Lea Marston from category 4 to 3 and the downstream section from 4/3 to 2; a category 2 being capable of supporting a coarse fishery. Classifying the stream and river system helps direct attention to those areas of greatest need but problems arise when consideration is given to short-term fluctuations in river quality which may accompany storm events. Are standards to be observed at all times, and if they are, what provisions need to be incorporated into the sewerage system?

Chris Sedgewick (STWA) described how WASSP was used to simulate the five year 60-minute storm and to give an indication of the probable magnitude and quality of the overflow component at a typical sewer junction. Managing the overflow component presents several options. Water may be stored, treated, or returned to the system. These alternatives exist at numerous junctions throughout the network, and decisions made at one site have an effect throughout the catchment. In order to simulate complete catchment response there was a call for further data and for models to become more interactive.

After the main presentations there followed a lively discussion period touching on a number of problems. For example, the panel were asked whether consumers should pay directly for improvements in river water quality. There was no direct reply to this question, but it was suggested that Severn-Trent's objective was to continue improving river quality throughout the catchment, starting below Lea Marston and working upstream. However, it was suggested to the panel that much of the improvement in river water quality which had already taken place was due to the decline of traditional industry in the area. While the panel acknowledged the importance of industrial decline they also assured the audience that the authority had taken important positive measures to improve river water quality in the region.

R. Grew

Hydrological Research at Slapton

BHS South-West Section Meeting
27 May 1987

Some 35 members gathered in pleasant sunshine at the picturesque setting of the Slapton Ley Field Centre near Kingsbridge for the start of a field meeting organised by *Tim Burt* (Oxford) to illustrate the wide range of hydrological research which has been conducted at the Centre in recent years. *Keith Chell*, the Warden of the Centre, welcomed South-West Section members and pointed out that not only did the Slapton Nature Reserve constitute a Site of Special Scientific Interest, but also that the catchments feeding into the Ley (Fig. 1) had been, and continues to be, a focus for hydrological investigations by a large number of different institutions.

The party then moved via a steep climb to the first site of the Eastergrounds experimental slope (Fig. 2), situated in the Slapton Wood catchment, where **Dave Butcher** (Huddersfield) explained the work which had been completed in the last few years on hillslope hydrology and especially on the mechanisms of subsurface flow generation. A relatively long flow record for this catchment has shown the importance of secondary delayed flow peaks generated by subsurface runoff, and the opportunity has been taken at Eastergrounds of studying in detail the distribution of soil moisture in relation to topography for a small section of the Slapton Wood catchment. Data from tensiometers and piezometers revealed that the area of saturated ground in storm events grew as a wedge up the centre of a subtle hollow situated in the experimental slope, and there was a good correlation between the distribution of soil moisture and the topographic index as $^{-1}$. Better correlation was evident with plan curvature of the hillslope, which also has the advantages of being more readily calculated and better suited to characterising the distribution of topography in large catchments. However, static measures of topography cannot account for conditions which vary during storm events, and it was noticeable in the wetting-up phase, for example, that the area of saturation was deflected towards the downstream spur. Soils at this site exhibited declining hydraulic conductivity with depth, which was attributed to the effects of compaction through agricultural activity, and a revised estimate of soil depth has also led to more successful modelling of delayed flow peaks.

Tim Burt also indicated that work in the Slapton Wood stream has emphasised the links between the production of subsurface runoff and the removal of nitrate from the catchment. Highest nitrate-nitrogen concentrations are associated with the generation of delayed throughflow peaks, and the pattern of nitrate leaching is strongly biased to the winter period when most of the delayed flow hydrographs occur; for example, 79% of the total nitrate load transported in the

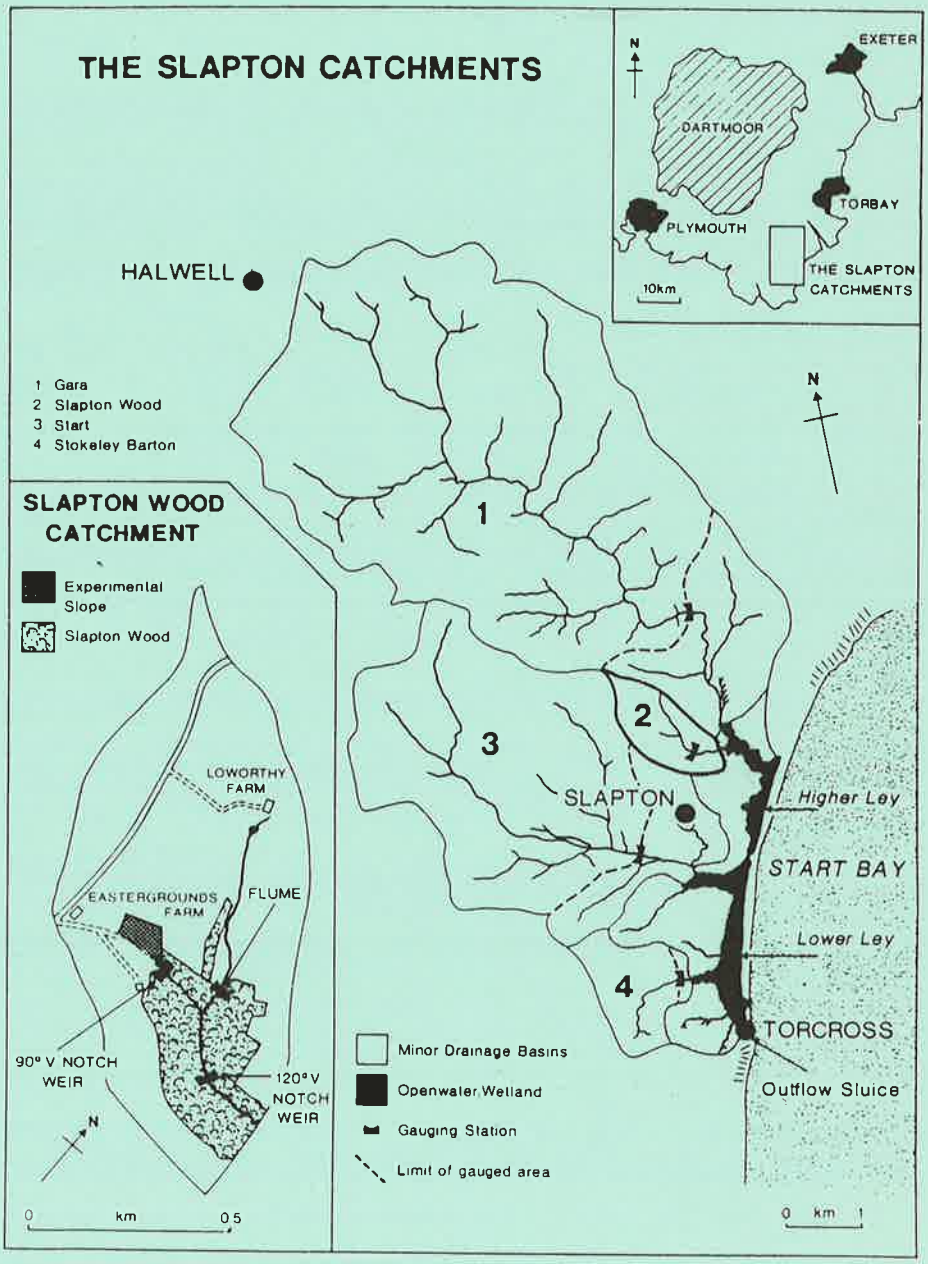


Figure 1 The Slapton catchments



Figure 2. Members of the South-West Section traversing the Eastergrounds experimental slope.

1984 water year was exported in the period from December to February inclusive. Runoff generated from footpaths and tracks lying at some distance from the riparian zone has also been seen to contribute flow, sediment and solutes to the main channel of the Slapton Wood catchment, and it is also clear that substantial volumes of subsurface flow occurring in some storm events in the plateau areas, which lie above the steeper valley sides and carry a considerable amount of arable land use, are routed through large hillslope hollows to the main stream and are important in generating the delayed hydrograph peak.

The group then moved on to get a view over the Carness tributary of the Slapton Wood stream where **Louise Heathwaite** (Oxford and Slapton) outlined her current investigation of sediment and solute production and delivery. This study is part of a continuing investigation of the hydrological consequences of changes in land use and agricultural practice in the Slapton catchments and follows on from a farm survey and stream water sampling programme conducted by **Penny Johnes** (Oxford). It focuses on the variation of hydrological and chemical inputs from predominantly grassland and predominantly arable source areas. It is envisaged that the investigation would include study of hillslope plots located on different land-use types as well as investigations at the catchment scale. In the latter context, the Gara which drains into the Higher Ley from an area dominated by permanent grassland would provide an interesting contrast with the Start which feeds the Lower Ley from an area carrying much more arable land. It is also hoped in this study to analyse nitrogen and phosphorus in their different inorganic and organic dissolved and particulate forms as a means of distinguishing nutrient inputs from different sources, and a sampling programme involving regular monitoring and more intensive storm-period collection is being designed. A major goal will be to link results gained from investigations at different scales, and study will also be made of the filtering and transformation effects which reed beds have on inputs to the Ley.

Following a descent to the main gauging station on the Slapton Wood stream, **Tim Burt** spoke about the long flow and water quality records which have been collected for this catchment and date back to the original research involvement of the University of Exeter in the late 1960s. Members of the Section had the opportunity of examining the gauging facilities and a bedload trap which had been known to collect as much as one tonne of material in as little as three days. In response to a question from **Rob Parkinson** (Seale-Hayne), Tim Burt explained that much of the rapid response to storm rainfall seen in the sharp 'first peak' of storm hydrographs could be attributed to flow in subsurface macropores which allowed rapid penetration of water to the base of the soil profile and on into the stream channel. Displacement of old soil water into the stream may be involved and there is further scope for the study of runoff processes generating rapid-response flow, although it has to be remembered that quickflow accounts for little more than 1% of runoff in this catchment.

On returning to the Ley, a short stop was made to examine the reed beds and distributary system of the River Gara below its junction with the Slapton Wood stream. At the bridge which divides the Higher and Lower Ley systems, **Paddy O'Sullivan** (Plymouth) explained how this largest freshwater body in South-West England is unusual because it has become very eutrophic as the result of agricultural inputs. Substantial blooms of blue-green algae have appeared in the last few decades and this shallow and turbid water body has suffered a spectacular reduction in fish numbers. Paddy O'Sullivan went on to describe how the Ley is being examined as a 'sediment catcher' to establish the pattern of sedimentation on its floor and, in turn, erosion rates in the contributing catchments. A multiple-coring approach has been adopted which involves the analysis of whole core magnetic susceptibility (K) for cores taken from all over the lake bed. The peak in K (Fig. 3), which is associated with a rising mineral content of the sediments, is used to correlate between cores, and the depth of sediment accumulated above this horizon has been calculated for the whole bed of the Lower Ley. An age of c. 9 years for the K peak has been established from ^{210}Pb dating on one core, and from this it can be calculated that on average c. 610 t of dry matter have been deposited on the bed of the Ley each year since the K peak. This represents a mean erosion rate for the Start and Stokeley Barton catchments of c. 47 t $km^{-2} yr^{-1}$, although this rate assumes negligible transfer of material from the Higher to the Lower Ley.

Paddy O'Sullivan also described how recent studies have shown a significant shift in the composition of the sub fossil diatom flora over the past 20 years as the Ley has become more turbid and more productive with increasing eutrophic status. Benthic and epiphytic taxa have declined and planktonic species of diatoms have increased. At the same time, macrophytes have died out, and it appears that a shift in the ecological status of the Ley occurred approximately 10 years ago. However, it is not clear whether this change was a response to a specific event, such as the 1976 drought, or whether it represents the culmination of a longer-term process.

En route to the last site of Deer Bridge, the party stopped off to view a recently installed monitoring station, where problems of ponding and a soft substrate complicates the establishment of a stage/discharge relationship. At Deer Bridge, **Ian Foster** (Coventry) explained an investigation of sediment yield, transport

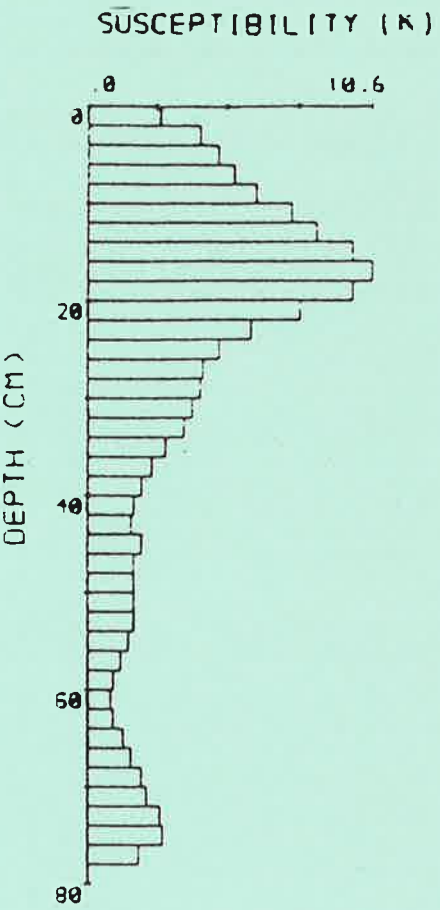


Figure 3. An example of a magnetic susceptibility profile from the Ley indicating a K peak at 16 cm below the sediment surface.

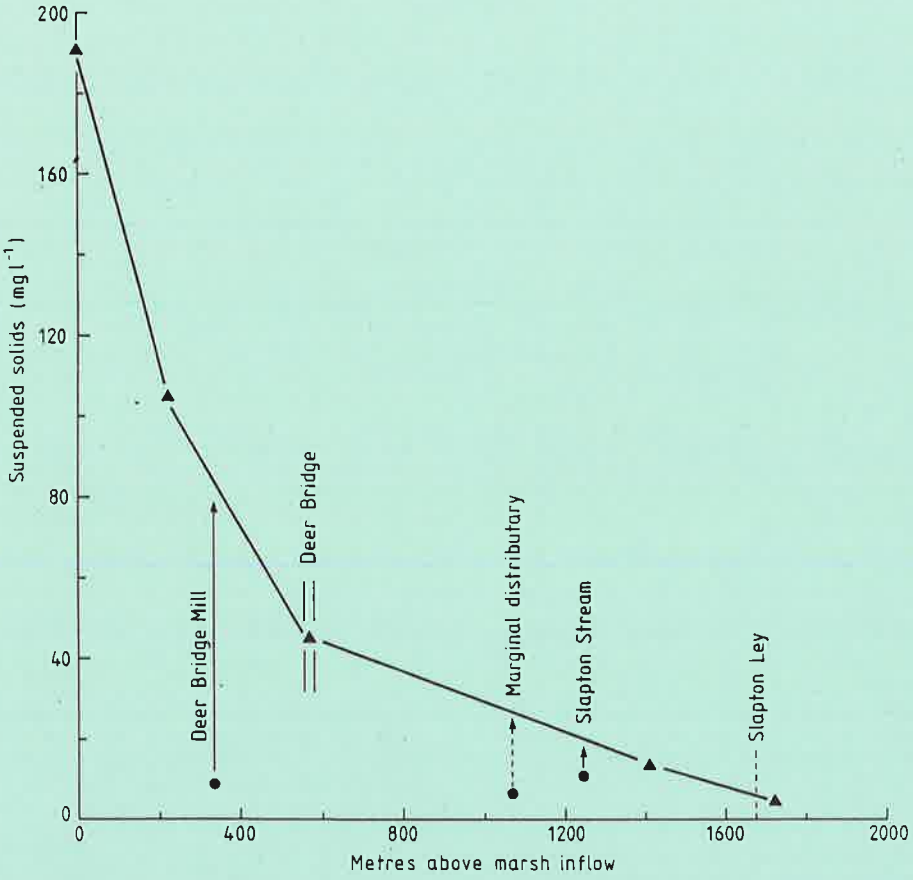


Figure 4. Transmission loss of suspended solids through the Start stream.

and storage in the Start basin which had been designed as a teaching exercise for students at Coventry Polytechnic. This catchment has a recent history of flooding and is of particular interest because of the substantial sediment accumulation which has taken place upstream of Deer Bridge in an area of traditional water meadow. The flood plain of the Start basin is currently acting as an efficient filter which causes significant transmission losses of sediment through the valley bottom (Fig. 4) and complicates calculation of erosion rates in this catchment. The contrast between a figure of c. 50 t km^{-2} yr^{-1} for erosion, based on sediment accumulation in the Lower Ley, and a rate of >2500 t km^{-2} yr^{-1}, recorded for a small active headwater gulley in the Start basin, emphasises the importance of sediment delivery dynamics, including the presence of significant sediments sinks, in the Start basin. Continuing studies of sediment accumulation above Deer Bridge are aimed at quantifying the mass of deposited sediment, which is at least 1.5 m in depth, at establishing land-use and vegetation changes on the valley floor from historical map evidence, and at determining the pattern of sedimentation since the mid-1950s using evidence from ^{137}Cs determinations undertaken in collaboration with Exeter University. It is hoped to establish whether siltation on the floodplain at this site is a consequence of interruption to the flow or a result of a ponding-up effect which has been enhanced by the presence of the bridge.

The presentations at all of the sites were of a high standard and stimulated much lively discussion. At the end of a very successful meeting, Section members repaired to the Field Centre to enjoy some generous local hospitality.

Bruce Webb

American Geophysical Union Meeting Baltimore, USA 18-22 May 1987

The Abstracts are in *EOS 68* (16), April 21, so I will not labour through the details of who said what but I report more on my impressions and what I saw as key points of discussion. The Meeting seemed to be an 'All American Affair', with few UK people there, but I was grateful to the Royal Society and the University of Sheffield for travel grants and so I can now bring some points to the attention of more UK hydrologists.

With a large number of different sessions, and some 2,500 people attending, it was not possible to see all the sessions, but the main ones of hydrological interest which I did manage to attend involved acid rain, surface water processes, wetlands and the main session on rapid and far-reaching hydrological processes in the vadose zone (or macropores by another name), organised by Peter Germann of the Department of Soils and Crops, Rutgers University, New Jersey.

In the 'macropore' session, three or four main themes seemed to emerge. Firstly, there was a great deal of reporting on the existence of rapid flow in soils, especially as illustrated by the use of dyes. Although much of the work was essentially of a descriptive nature, the key point to emerge was the wide variety of soil types and conditions involved in rapid flow, including clays, sands and loams. Secondly, the nature of the flow emerged as not just involving the more obviously visible macropores and root channels but also mesopores and preferential flow lines in areas of apparently uniform soil. Thirdly, the portions of the soil volume involved were extremely small. The terms 'effective macroporosity' or 'operational volume' were used and it was evident from at least two papers that an order of magnitude of 0.0001 cm^3 cm^{-3} soil volume was all that was involved in the rapid transport of water — but this volume carried a large proportion of the flow. The fourth point involved the wide variety of applications of the study of rapid flow phenomena. Included were the transfer of rainfall acidity to streams, the leaching of fertiliser nitrate to runoff and the leakage of clay liners. The full papers from the session are to be published in a special issue of the *Journal of Contaminant Hydrology* next year.

In the acid rain session, aspects under discussion included the significance of trying to distinguish between organic processes and inorganic processes, especially in separating the effects of humic acids from those of mineral acids. Also, many papers presented information on aluminium mobility and the difficulties of gaining good rainfall acidity data, free from local influences.

The wetlands session focussed on the interplay between hydrological and chemical processes, and especially on the possibility of deeper circulation bringing mineral-rich water to the surface. Another theme involved the close correlation between water chemistry and vegetation.

In the discussion of surface water processes, the links with groundwater were stressed. In the session, I had the impression that there was more monitoring than testing of hypotheses. Thus there seemed to be a lot of descriptive work and phenomenology — with possible inferences — rather than much experimental design to test old ideas and develop new ones. However, while some people appeared critical of this, no one was rude about it, indeed the whole conference seemed to be pervaded by politeness, friendliness and enthusiasm — it made a nice change!

Steve Trudgill,
Reader in Geography,
University of Sheffield

BOOKS

Groundwater: Occurrence, Development and Protection, Thomas W. Brandon (editor), Water Practice Manual No. 5, Institute of Water Engineers and Scientists, London, England, 1986, xiv + 615pp., £29.50 (for IWES members), £39.50 (for non-members), hardback, ISBN 0 901427 14 4.

This aim of this volume is to provide a pool of knowledge for the practising groundwater specialist and 'to lead the reader to an understanding of the best modern practices'. The diversity of groundwater related problems and projects necessitates an interdisciplinary approach: a groundwater specialist is expected to understand aspects of geology, geophysics, hydrogeochemistry, mathematical analysis and modelling, as well as be familiar with principles of design and methods of construction of groundwater abstraction works. A comprehensive book which tackles all these topics in sufficient detail is long-awaited. In drawing on the personal experiences of some 21 contributors a vast amoung of useful information has been assembled in this single volume.

Although this information is primarily related to groundwater development in Britain, according to the Preface the accumulated expertise should be equally useful elsewhere in the world. Indeed one senses that the overseas promotion of British hydrogeological expertise is the hidden agenda of the book, and this in turn begs two questions. Firstly, does our UK experience equip us to be useful overseas? Secondly, does this manual convey that impression and will it thereby prove useful in the overseas context? This overseas interest is probably directed towards the less developed parts of the world (although mention of the EEC reminds us that we must not fall behind our competitors and also that we must ourselves conform to EEC regulations).

One might ponder the first question by considering the general context of groundwater projects in Britain and in the developing countries. In Britain about two-thirds of water supplied from groundwater sources is for large reticulated public water supplies and one third for industrial supply. The 'modern approach to groundwater development' commonly involves joint management of surface and groundwater sources; *Figure 14.1* (which compensates for the omission of a map in an earlier chapter) shows the location of 16 such schemes. The main British aquifers are sandstones and limestones: the Chalk and the Permo-Triassic sandstones together account for some 75% of total groundwater water supplies. Unconsolidated aquifers are limited in extent and only locally significant. Britain's climate is such that precipitation regularly exceeds evapotranspiration so that the aquifers are recharged to some extent each year. Resource assessment is facilitated by an extensive hydrometeorological database.



Figure 14.1.
Outcrops of the Chalk, Jurassic limestones and Triassic sandstones showing the location of major groundwater schemes.

Less developed parts of the world present a contrasting picture. Some aquifers have been developed for municipal water supplies but there are also many small sources (including many hand dug wells) each supplying one or a few households: groundwater is playing an increasingly important role in the development of irrigated agriculture. Large amounts of groundwater are stored in extensive, unconfined, alluvial aquifers. In other areas weathered or fractured crystalline rocks may provide the only opportunity for groundwater storage. In arid regions shallow groundwaters are often saline and so ancient water is mined from deep, confined, hard rock aquifers. The climate is tropical, sub-tropical or arid with high average temperatures, hence high evapotranspiration rates. Problems of water shortage derive either from a dearth of precipitation or from a marked seasonal rainfall pattern. Low and unreliable rainfall renders aquifer recharge unpredictable. Many developing countries lack financial and hence technical resources: hydrological monitoring is rare so that decisions are necessarily based on sparse data. The most desirable skills and materials may not be available locally and the cost of importing them is often prohibitively high.

It is suggested that experience with Britain's diverse geology equips us to deal with projects anywhere in the world. But is this experience relevant to the needs and constraints of the Third World? Is the case rather that we have no experience of extensive alluvial aquifers, of developing groundwater to meet an irrigation demand, nor of technologies more appropriate to the developing world?

Hence to the second question and the role of the book. A recurring problem overseas is that yields of boreholes decline rapidly during operation so that many boreholes are soon abandoned. This is often due to poor design and construction standards. Yet a grave weakness of the British groundwater industry is water well technology and this is reflected by the emphasis of this book. The chapters 'Drilling and Construction Methods' and 'Borehole and Well Drilling Contractual Procedures' are very welcome, but that on the design of wells, whilst containing a good coverage of pumping equipment (hitherto often neglected), is sadly inadequate.

The wealth of the book is in the excellent and informative sections which reflect the authors' experience and interests. Certain chapters are destined to become standard references, such as

those on groundwater chemistry and geophysics which clearly summarize the state of the art, and others which are so openly helpful, for example in clarifying the complexities of hydrogeological investigations and contract specification.

However this book suffers from the usual problems of multi-author texts, notably an inconsistency of purpose. It is not really a handbook wherein all necessary information can be found. It cannot be termed a 'reference book' since the indexing is totally inadequate. But its sheer bulk would deter all but the most determined (or a reviewer) from ploughing through from cover to cover.

Perhaps if the promotion of British groundwater expertise had been the sole purpose it would matter less that the indexing is so poor, that the approach and styles of presentation are so inconsistent, and that references to other publications proliferate in some sections whilst in others are totally lacking. Authors need not have strayed from their own specialist areas and the omissions of groundwater abstraction works other than drilled boreholes and how to cope with sparse data could have been acknowledged without loss of face. An appended bibliography could have ensured that publications such as BS 6316, the British Standard Code of Practice for Test Pumping Water Wells, received at least a mention.

The conclusion to be drawn from the evidence of this manual is that whilst British groundwater specialists certainly have a role as trainers and advisers both in Britain and overseas, there is evidently still a great deal to learn.

Catherine Ward

River Response to Hydraulic Structures, by S. Raynov, D. Pechinov and Z. Kopaliany, edited by R.D. Hey. Technical Document in Hydrology, UNESCO, 1986, 115pp. Free from UNESCO. Softback.

This report results from a UNESCO sponsored initiative to study methods of assessing the influence of hydraulic structures on erosion and sedimentation processes in rivers, reservoirs and lakes. The note is divided into eight sections of which the first entitled 'Channel Instability due to Reservoir Construction' is the largest with almost half the text devoted to it. The remaining sections are much shorter and are concerned with such topics as channel instability due to river training, dredging and floods.

The authors have chosen to present their subject by briefly describing the effects of river regulation schemes on the erosion and sedimentation regimes of many rivers throughout the world. This approach has resulted in a document which will serve as a useful introduction to the subject for both students and practising hydrologists alike. Apart from a chapter which describes a number of numerical models to predict erosion and deposition the document contains very little theoretical material. However this is not a serious deficiency since over one hundred references are cited which will be more than adequate for the majority of readers to pursue their interest further. This reference list is, perhaps, the most useful part of the document.

The overall impresion of the document, is that, although the descriptions of case studies are brief, a lot of work has been undertaken to produce a text which will provide a useful starting point for the study of erosion problems in rivers and lakes. However, in order to make full use of the material presented the reader will have to spend a lot of time searching through the refrences.

Ian Goodwill

NEWS FROM MEMBERS

MEMBERS ON THE MOVE

Alec Willis has recently left the Somerset Division of Wessex Water to join Hydro-Logic Limited as Technical Director. Hydro-Logic Limited was established in 1985 by ex-Thames Water hydrologist Rod Hawnt and offers specialist hydrological consulting services, particularly in the fields of instrumentation systems and computer applications. Alec will be concentrating on the development of a range of data retrieval and processing computer systems for handling data from telemetry outstations and field-based data-loggers.

INTERNATIONAL HYDROLOGICAL PROGRAMME

The third UNESCO/WMO International Conference on Hydrology and Scientific Bases of Water Resources Management was held at the International Conference Centre, Geneva, in March to review the results of the IHP and plan for the future. The Conference agreed that the present and prospective world situation in water resources was sufficient justification for the continuation of the IHP beyond 1990 (as IHP-IV).

Seven formal recommendations were passed by the Conference. Briefly, they were as follows:

1. Endorsing the establishment under Unesco's auspices of the International Research and Training Centre on Urban Drainage in Belgrade, Yugoslavia.

2. Requesting support to the WMO Hydrological Operational Multipurpose Subprogramme (HOMS) training activities.

3. Endorsing, within the framework of the Mar del Plata Action Plan, the increased emphasis within Unesco and WMO of certain programme activities related to their specific competence, and that the WMO/Unesco International project on water resources assessment be further implemented.

4. Recommending to Unesco and WMO to continue the close and effective harmonization of their respective programmes in hydrology and water resources at both the international and regional levels, and recommending to other international organizations that they take account of activities of the IHP and OHP in the planning and execution of their programmes.

5. Recommendations on future activities of WMO in hydrology and water resources, within the framework of its Second Long-Term Plan (1988-1997), including the reclassification by WMO Congress of the Commission for Hydrology with a view to its being classified as a "basic commission", and suggestions for additional specific activities.

6. Noting with satisfaction the results achieved during the second phase (1981-1983) and the first three years of the third phase (1984-1989) of the International Hydrological Programme and endorsing the current plans for the completion of IHP-III.

7. Endorsing the objectives, the scope of the programme and its sub-division into three sub-programmes for the fourth phase (1990-1995) of the IHP, including the acceptance of a list of specific themes and tentative activities as a basis for further planning.

HOMS

The Hydrological Operational Multipurpose System established by the WMO for the transfer of technical information on operational hydrology from developed to developed countries.

At the recent annual UK HOMS Steering Committee where we review the effectiveness of the HOMS initiative, it was agreed that while a satisfactory service operates from the UK office at Wallingford, there is scope for improvement.

Accordingly, we are considering how to promote the scheme to potential users and to find and incorporate more components. Initially we are planning a general HOMS information booklet to be produced at IH. This will be widely distributed through various ODA outlets and to consultants, universities and colleges involved in the training of overseas students.

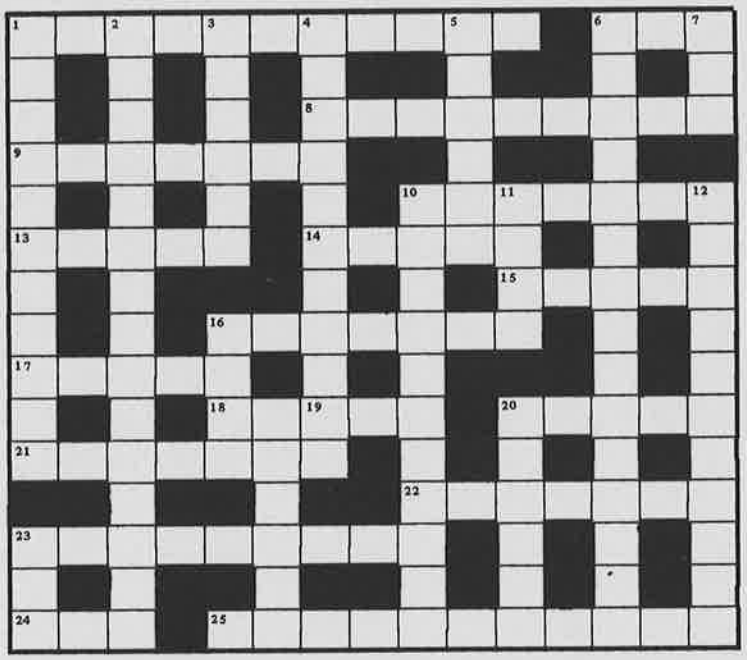
H.R. Oliver, IH.

☆ PRODUCT NEWS ☆

The GAUGEMASTER current-meter flow gauging system which operates on the rugged Husky Hunter field portable micro is now available from Hydro-Logic Limited of Marden, Hereford, who have recently been appointed distributor for Husky Computers. The system simulates the traditional paper gauging sheet on computer, and enables a current-meter to be connected directly to the Husky Hunter facilitating the automatic counting and timing of pulses without the need for a separate counter unit. The computer stores all the distance, depth and velocity readings in memory and calculates the result of the gauging on site at the end of the exercise, providing the facility to output the results to another computer or a printer when back at the office.

Hydro-Logic Limited has also recently been appointed UK and European distributor for the RORB runoff routing model which is a well-proven computer program operating on a variety of different computers including the IBM PC/AT micros. The package was developed in the mid-seventies by Professors E. Laurenson and R. Mein at Monash University in Australia, and has been applied on rural and urban catchments in the UK by the Institute of Hydrology, Imperial College London, and Thames Water among others. It can be used for general catchment modelling purposes, and flood estimation for river engineering design including the design of balancing ponds. Version 3.8 of the program, with screen graphics used for displaying hydrographs and hyetographs, is now available. Hydro-Logic are organising a series of 2-day workshops on the use of the RORB program, the first of which is at Imperial College, London on 8/9th September. A few places are still available on this workshop.

For further details of both the GAUGEMASTER and RORB systems please contact either Rod Hawnt or Alec Willis at Hydro-Logic Limited on 0568-84439.



ACROSS

1. Surrounds revolver magazine (11).
6 and 7 down. Hat damage as flower turns corner (3, 3 or 5).
8. Turbulent river rose to flood valley (9).
9. Folding cheque up before French friend (7).
10. Cracked chair leg loses height on arctic mountain (7).
13. Chose to take exercise in dictionary (5).
14. Tear open as only Dracula would! (5).
15. A king enters plea and bathes (5).
16. Stick nose in, e.g. salt? (7).
17. Give in on 8 or 10? (5).
18. In meander, red herring went wrong either way (5).
20. "If we do meet again, why, we shall . . ." (Julius Caesar) (5).
21. Real aim of cowboy quitting Fort Collins? (7).
22. Chief chopper? To the hydrologist, Wookey Hole (7).
23. Unwise to be cheeky about river (9).
24. See 23 down.
25. Ten vermin on mixed surroundings (11).

DOWN

1. Sounds like this green stuff might purify chairman? (11).
2. Aural and printed media. Yes, communication! (5-10).
3. Ground swell, but not in the South East (6).
4. A fashion, linking reactor to river, is growing (11).
5. Eyes seen in reflection of krill ecosystem (6).
6. Possible killer produced by endless sci-fi writer in parallel repose (8, 7).
7. See 6 across.
10. Hidden resource in rude town rag (11).
11. Recess from processed peas (4).
12. Dazzling writer, loan within, support without (11).
16. Cate leaves treat but turns up just the same (4).
19. Saddled by drought, for instance? (6).
20. Trample over animal ban (4, 2).
23 and 24 across. Doctrine might send Muslim round bend (3, 3 or 5).

NEW MEMBERS

We welcome the following new members to the Society:

D. Hyde ..... Consultant
C.R. Roberts ..... Lecturer, School of Geography, St. Pauls and St. Marys
D.A. Stewart ..... Technician, Highland Purification Board
J. Jaronne ..... Lecturer, Israel
Dr. A.N. Harvey ..... Lecturer, Dept. of Geography, Liverpool
J.L. Gardiner ..... Development Manager, Thames Water Authority

FORTHCOMING EVENTS

FOURTH INTERNATIONAL SYMPOSIUM ON REGULATED STREAMS

Second Announcement and Call for Papers

FISORS II is the fourth in an ongoing series of International Symposia devoted to scientific research on rivers modified by large dams, weirs, channelisation and flow diversion schemes. Under the auspices of the Permanent Organising Committee, Symposia have been held in Erie, USA (1979), Oslo, Norway (1982), and Edmonton, Canada (1985). The aim of the series is to foster an exchange of ideas and stimulate research involving scientists, academics and engineers. The objective of FISORS II is to advance the development of environmentally sound management policies and strategies for regulated rivers.

Contributed papers are invited on the following topics:

- Effects of dams, weirs, channelisation or inter-basin transfers on plankton, macro-invertebrates, periphyton, macro-phytes and fish.
- Effects of river regulation on estuarine, wetland and floodplain ecology.
- Water-quality of river-reservoir systems.
- Instream flow methodologies.
- Fisheries management.
- River restoration.
- Conservation of river systems.
- Water management and river regulation in the Third World.
- River regulation and integrated basin management.

Authors should submit an abstract (500 words) by 30th November 1987. All papers will be in English. Selected papers will be published as special issues of *Regulated Rivers* within six months of the Symposium.

Special Symposium Fees for BHS members only:

A) Registration — 4 nights full board accommodation, tea and coffee, Symposium Dinner, before 1st March 1988: £150.00

B) Day Registration — Day 1 (River Regulation in the UK) free*, one extra day £20.00, two or more extra days £30.00.

(*There will be a charge of £1.50 for the tea and coffee.)

FISORS II will be held at the University of Technology, Loughborough, UK. Accommodation will be adjacent to the Conference Centre in the School of Engineering. A number of optional trips of scientific and cultural interest will be available as will a range of recreational facilities. A post-symposium field excursion to northern England and Scotland is offered.

Abstracts and requests for further details should be sent to: Dr. G.E. Petts, Department of Geography, University of Technology, Loughborough, Leicestershire, LE11 3TU, UK.

UK Steering Committee: Dr. G.E. Petts, University of Technology, Loughborough; Mr. M.T. Greenwood, University of Technology, Loughborough; Dr. P. Armitage, Freshwater Biological Association, Wareham; Dr. J. Hellawell, Nature Conservancy Council, Huntingdon; Dr. R. Wood, Severn Trent Water Authority.

HYDROLOGY 2000

Over the last four years a Working Group of young hydrologists, 'Hydrology 2000', has been considering the prospects for hydrology in the period leading to the end of the twentieth century and beyond. The Group was set up during the IUGG General Assembly in Hamburg, August 1983, by the International Association of Hydrological Sciences (IAHS) in co-operation with UNESCO and WMO. It has members from nine countries and includes hydrologists working in universities and research institutes who have a range of academic backgrounds from engineering and mathematics to geography and environmental science. Britain has had an input to the Group through **David Collins** (University of Manchester) and **Bruce Webb** (University of Exeter).

The Group has had meetings at Jablonna, Poland in 1985, Budapest, Hungary in 1986 and Oslo, Norway in 1987, and its main task has been to prepare a report for submission to IAHS at the IUGG General Assembly at Vancouver in August 1987. This report considers present trends, barriers to progress and future directions of research in several 'sub areas' of hydrology, such as surface water, groundwater, water quality, snow and ice hydrology, erosion and sedimentation, and water resources systems, as well as providing a perspective on hydrological sciences in the year 2000 and discussing developments in the fields of modelling and data acquisition.

It is hoped that the report of the Hydrology 2000 Working Group will be published later this year.

Bruce Webb

PRIVATISATION

— What are *your* views?

A new Green Paper on Privatisation has emerged recently. Members views will be sought on this topic at the BHS Symposium at Hull (yet another reason why you should attend — see opposite).

COURSES

The Royal Meteorological Society organises residential field study courses on various aspects of weather.

Topics include:

- Weather for mountain activities.
- Weather and plant ecology.
- Mountain weather.
- Weather under sail.
- Understanding weather.
- Weather science and forecasting.
- Weather and bird movement.

Further details from: Executive Secretary, Royal Meteorological Society, James Glaisher House, Grenville Place, Bracknell, Berks RG12 1BX.

★ FIRST BHS NATIONAL HYDROLOGY SYMPOSIUM ★

Hopefully, all of you will have received — and thoroughly absorbed the contents of — the provisional programme and reservation form for the Society's first National Symposium at the University of Hull, 14-16 September.

In case not, let us try to entice you to come with the following bits of good news:

★ Virtually all the papers have been received and will be available, printed and bound, before the meeting.

★ Attendance is looking good but we can cope with late reservations, so don't hesitate to send in your form NOW. In case you have lost the form, it is reproduced below for you to make a photocopy (rather than spoil *Circulation*).

★ Day attendance rates are now available — see form.

★ Two (alternative) short (1½ hour maximum) but interesting visits will be free options immediately after lunch on the Wednesday. One is to the Tidal Barrier; the other to the proposed National Water Museum just down the road at Anlaby. It's well worth visiting one of these before dashing off down the motorway. Full details available at Registration.

★ The trade exhibition is going ahead so there should be plenty to interest hydrologists of all flavours.

★ There are quite a few extra poster presentations not announced in the provisional programme — some of these will feature micro-computers. We can cope with more of these so, if you would like to demonstrate your favourite system, contact Celia Kirby at IH (0491-38800) or Mike Hall at Middlesex Polytechnic (01-368 1299).

★ AUTHORS PLEASE NOTE THIS ONE — there will be facilities to demonstrate computer programs during the course of presentations. Please advise Nick Bonvoisin at IH (0491-38800) which micro (IBM PC family preferred).

BRITISH HYDROLOGICAL SOCIETY — NATIONAL HYDROLOGY SYMPOSIUM
University of Hull — 14th-16th September 1987

RESERVATION FORM

Name .....

Address .....

.....

Sponsoring Organisation ..... Telephone .....

Please make the following bookings:

Symposium		
Fee and full accommodation for ..... persons *(includes lunch on Monday to morning coffee on Wednesday, the symposium dinner on Tuesday evening and a copy of the symposium proceedings)*	at £75.00	.....
..... persons	at £55.00	.....
Sunday 13th September		
Bed and breakfast for ..... persons	at £14.50	.....
Dinner for ..... persons	at £7.00	.....
Wednesday 16th September		
Packed lunch for ..... persons	at £3.00	.....
Restaurant lunch for ..... persons	at £4.00	.....
Alternative day rate (no overnight accommodation) *(includes proceedings) 1 'day' £20, 2 'days' £30, 3 'days' £40 (a 'day' means if you wish to attend and take available meals on any one of the three days)*		.....
	Total Remittance	.....

Please book ..... persons for the post symposium visit to (a) the Tidal Barrier (visit limited to 35 persons), (b) the proposed Nahal Water Museum.

Signed ..... Date .....

Cheques should be made paybale to "British Hydrological Society". Please return the form, immediately to: Mr. N. Tyler, British Hydrological Society, c/o Institution of Civil Engineers, Great George Street, Westminster, London SW1P 3AA, or, if it is already past 25th August, telephone its contents to him on 01-630 0726.

National Water Museum.

Meetings

ICE CONFERENCE ON CRUCIAL PROBLEMS ENCOUNTERED IN THE EXECUTION OF OVERSEAS PROJECTS
27 April 1988
The London Hilton Hotel

The aim of this meeting is to discuss the issues involved in the management of international projects at the highest level. The programme will include speakers representing consultants, contractors, merchant banks and the government, covering the following topics: Coping with a political problem; The impact of a technical problem on a project; Financial problems.

Further details: Conference Office, Institution of Civil Engineers, 1-7 Great George Street, London SW1P 3AA.

INTERNATIONAL SYMPOSIUM HYDROLOGY OF WETLANDS IN SEMI-ARID AND ARID REGIONS SEVILLA, SPAIN
9-13 May 1988

This Symposium aims to present a state-of-the-art review on hydrology of wetlands in semi-arid and arid regions, provide a forum to discuss the needs, values and possibilities for research, and determine the relationship between man and wetlands, mainly the impact of different anthropic activities on these ecosystems.

Topics include: Surface water-groundwater interaction; Evapotranspiration; Geological and hydrogeological controls on the occurrence of wetlands; Water quality controls and impacts; Predicting the impact of man on wetlands.

Further details from: Prof. Dr. Pablo Arambarri, Instituto de Recursos Naturales y Agrobiologia, Apartado 1052, 41080 Sevilla, Spain.

INTERNATIONAL SYMPOSIUM HYDROLOGY OF WETLANDS IN TEMPERATURE AND COLD REGIONS JOENSUU, FINLAND
6-8 June 1988

Main subject is hydrology of inland wetlands, including peatlands, alluvial areas and littorals. Methodology and results of preventive measures against harmful effects are to be discussed with objective of practical benefit; focus on water quality, ecology and economical aspects of wetlands.

Topics include: Hydrological characteristics of wetlands in natural state; Climatological and microclimatological aspects of natural and developed wetlands; Groundwater recharge-wetland relations; Conservation and multipurpose utilization of wetlands in natural state; Hydrological consequences of wetland changes (forestry, agriculture, peat production, etc); Water quality changes and ecological consequences of wetland development; Preventive measures against harmful effects caused by wetland utilization; Benefits and cost of wetland utilization.

Further details from: Ms Leena Rantajärvi, Box 436, SF-00101 Helsinki, Finland.

INTERNATIONAL WORKSHOP HYDROLOGY OF MOUNTAINOUS AREAS CZECHOSLOVAKIA
6-11 June 1988

This workshop aims to provide a wide exchange of research results on hydrological processes and water management problems in mountainous areas in various regions of the world.

Topics include: Integral data networks, collecting and processing of data hydrometeorological data; Hydrological balance as a basis for water resources assessment and water management; Surface water-groundwater interaction and runoff in mountainous catchments; Study and modelling of hydrological processes including impact of man.

Further details from: Dr. L. Molnar, Czechoslovak Committee for Hydrology, Trnavska 32, 826 51 Bratislava, Czechoslavakia.

INTERNATIONAL SYMPOSIUM ON SEDIMENT BUDGETS PORTO ALEGRE, BRAZIL
December 1988

Topics include: Physical process of sediment generation, transport and deposition; Monitoring of sediment variables including the selection and operation of experimental and representative basins; Strategies for computing sediment budgets and the use of simulation techniques.

Particular emphasis will be placed on the practical application of sediment budget computations in studying impact of land use change and the potential for implementing corrective measures within the framework of existing socio-economic conditions.

Further details from: Local Organizing Committee, International Symposium on Sediment Budgets, Instituto de Pesquisas Hidraulicas, UFRGS, CP 530, Porto Alegre-RS, Brazil.

Diary

14-16 September 1987
British Hydrological Society.
National Hydrology Symposium — University of Hull.

14-17 September
IWES/IWEM Meeting — Blackpool.

16 October 1987
Scottish Hydrological Group.
'Water Supplies for Central Scotland' — W.C. Sprott (R.H. Cuthbertson and Partners).
Royal Society of Edinburgh, 22-24 George Street, Edinburgh. 6 for 6.30 p.m.

18 October 1987
BHS Southern Section.
'Flood estimates in S.E. Asia' — evening meeting, Imperial College.

21 October 1987
BHS South-West Section.
'Resources and Monitoring in the South-West' — Plymouth Polytechnic (further details of this meeting will be supplied at a later date. Contact: Bruce Webb, Exeter University).

9 November 1987
BHS Southern Section.
'Simple stochastic models of rainfall' — evening meeting, Imperial College.

2 December 1987
BHS Southern Section.
'Dowsing' — lecture, video and social evening, Imperial College.

4 December 1987
Scottish Hydrological Group.
'Nature conservation and hydrology' — D.M. Bayne, Nature Conservance Council.
McCance Building, University of Strathclyde, Glasgow. 6 for 6.30 p.m.

7 December 1987
BHS Annual General Meeting. 11 a.m. — University of Aston followed by BHS National Meeting 'Remote sensing applications for water management'.

15 January 1988
Scottish Hydrological Group.
'Recent contrasting summers in Scotland and historical perspectives' — Miss M.G. Rory, Superintendent of Met. Office, Edinburgh.
Royal Society of Edinburgh, 22-24 George Street. 6 for 6.30 p.m.

Circulation is the quarterly newsletter of the British Hydrological Society. It is issued free to members but is also available on an annual subscription of £12.00. Please address all correspondence to the Editor, Celia Kirby, Institute of Hydrology, Wallingford, OX10 8BB. Telephone: 0491 38800 extension 2224.