No. 66 August 2000

THE NEWSLETTER OF THE BRITISH HYDROLOGICAL SOCIETY

Circulation

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Circulation is published quarterly. It is free to members of the British Hydrological Society; £20 to nonmembers on annual subscription.

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Circulation is produced by the Institute of Hydrology and indexed in *Geosystems' Hydrotitles* & *GeoArchive* and *NISC HydroROM.*

BHS 2000 Newcastle Symposium 6th–8th September — see pp 6, 12 & 16!

Catchment processes and management

BHS National Meeting / Pennines Hydrological Group AGM
University of Salford
17 May 2000

Prof. David Collins (University of Salford) welcomed the participants and introduced the morning Pennines session, which was chaired by **Prof. Tim Burt** (University of Durham).

The meeting opened with a paper by **Prof. Bruce Webb** (University of Exeter) on river temperatures in the temperate zone. Variability in river temperatures relates to vertical, lateral and horizontal microthermal gradients present in the water column, and is affected by shading, bank characteristics and floating vegetation *en masse*. River temperatures are sensitive to incoming net radiation receipt and to groundwater contributions to flow. The role of impounding on thermal regime was discussed, as were the impacts of past and future changes on river temperatures. Monthly mean river temperature data from Austria over the period 1901-1990 showed a significant warming trend at seven out of ten measurement stations.

Dr Tim Stott (Liverpool John Moores University) then presented a paper entitled "Effects of plantation forest clear-felling on stream temperatures in the Plynlimon experimental catchments, mid-Wales." This work adds to a growing body of knowledge about land-use changes and stream temperature characteristics. Tim concentrated on clearfelling at the environmentally-sensitive timber harvesting plot-scale and resultant controls on stream water temperature. He gave a brief historical introduction and review of general afforestation impacts with relation to water temperature, in contrast to current research focussing on deforestation or clearfelling of British upland forestry as plantations reach canopy closure. Hourly data of air, ground and water temperatures were seasonally balanced in order to make direct comparison of

water temperatures before, during and after clearfelling. Temperature time series were balanced from October 1994 (pre-felling) to March 1997 (post-felling). The automatic weather station at Moel Cynedd provided a control of field temperature data over the same period.

Analyses of associations between mean, minimum, and maximum monthly temperatures showed steepening relationships after clearfelling between air and water temperatures. An example was decreased mean, minimum, and maximum summer water and air temperatures following deforestation of the harvesting plot. Mean maximum temperatures fell by as much as 5 to 6°C during summer months. Winter temperature between water and air also showed a decrease. On average from pre- to post-clearfelling water temperatures were generally lower by a mean of 2°C in comparison to pre-clearfelling water temperatures. These results are consistent with similar studies by Crisp (1997) and Weatherly and Ormerod (1990) where no clear elevation of water temperature in afforested sections was demonstrated.

Prof. David Collins discussed climatic variation and runoff from Alpine glaciers. Records for 1970-1999 for the Massa, which drains the Grosser Aletschgletscher, Berner Oberland, Switzerland, were analysed with a view to assessing overall variability of runoff and year-to-year fluctuations in flow, and to identify secular trends in discharge.

Precipitation and air temperature records from several stations in the region were also analysed in order to characterise the fluctuations in climatic conditions to which meltwater has responded. Total annual runoff was found to be generally lower in the 1970s than in the 1980s and 1990s, reflecting secular variations of summer energy inputs for melting (positively) and winter snow accumulation (negatively). The coolest summer during the period was 1978, which resulted in the lowest total annual discharge. Warmer summers followed relatively dry winters between 1982 and the late 1990s. The impact of the draining of the ice-dammed Gornersee on annual maximum daily total discharge declined during the 30 years. High annual total discharges resulting from warmer summers cannot continue indefinitely however, as glacier mass losses reduce glacier area.

Afternoon National session

Dr Peter Walsh took the chair in the afternoon. **Prof. Malcolm Newson** (University of Newcastle-upon-Tyne) discussed the role of hydrology in informing sustainable management. Sustainable water resource systems are designed to contribute to the objectives of society, now and in the future, whilst maintaining ecological and environmental integrity. Key concepts include an agenda for hydrology in the context of the 'squeeze' between land, water and development, with hydrology projects under sustainable management necessarily requiring the widest possible social and environmental impact assessment; the need for science to quantify the strengths of sustainability, and the question of environmental capital. The real problem is the world water crisis, with short-termism, although it appeals, being the antithesis of sustainability.

Joseph Holden (University of Durham) gave the second paper of the afternoon outlining experimental results for rainfall simulation in blanket peat catchments. The characteristic flashy and baseflow minimum hydrology of peat catchments has received little attention with respect to infiltration studies and its link with runoff production. A series of controlled field infiltration simulations were designed with four differing rainfall intensities and runoff production being sampled at three depths of 0, 50 and 100 mm. The model prioritised rainfall intensity and runoff production depth, whilst vegetation cover was deemed less important, even though simulation described decreasing runoff with increasing depth of surface cover, because peat density is controlled by different vegetation. Results indicate infiltration rate increasing with rainfall intensity, but with infiltration decreasing over time. Low intensity rainfall simulations of 12 mm h^{-1} appeared the most efficient for runoff production leading to flashy hydrograph responses. Further infiltration simulation after the 1995 dry period found runoff production at the peat surface reduced, but larger runoff volumes at a depth of 5 cm, indicating seasonally changing peat infiltration characteristics. Simulated laboratory results, in which dry peat was subjected to seven days of rainfall, found infiltration rates to be higher after drought. Tracers indicated that runoff production in the peat was more prolific along deeper runoff paths between 5 and 15 cm in depth. Runoff production was also sampled at depths of 20 cm. Dry peat may therefore, provided preferential macro-pore flow routes allowing deeper runoff production in the peat. Rainfall intensity coupled to infiltration rates helps to explain flashy responses to streams draining blanket peat catchments. Important wetting and drying cycles produces variable runoff production in the vertical plane, with the role of macro-pores being increasingly dominant under dry conditions.

Prof. Tim Burt (University of Durham) presented long-term rainfall, streamflow and river colour records for north central England, and discussed implications for water resource management. Records for the Moor House National Nature Reserve and sites close by in the northern Pennines. Rainfall records for the Durham Observatory since 1880 and streamflow for the River Wear at Durham since 1958 provide a regional setting within which the much shorter upland records can be assessed. In the last decade, the most notable event has been the drought of the 1995 summer, which followed one of the wettest winters on record. A strong tendency for increased hydrological volatility was noted, with the contrast between winter and summer becoming more extreme, both for rainfall and runoff. River colour was found to peak in autumn periods, and comparison of records of the North Atlantic Oscillation (NAO) and rainfall at Blackmoorfoot indicate a positive trend until the 1950s, but since then south-west to north-east flow has increased with a more positive NAO. Implications of these changes for water resource management and moorland



Participants in the Salford meeting: (left to right) Joseph Holden, Tim Burt, Malcolm Newson, Kevin Tilford, Peter Walsh, David Collins, Tim Stott and Bruce Webb

erosion were briefly discussed.

Dr Stephen Boult (University of Manchester) finally discussed water quality at Salford Quays and in the Manchester Ship Canal. The concern is that poor water quality, resulting from the accumulation of contaminated sediment, has led to high carbon content and low oxygen saturation, resulting in algal blooms. URGEN (Urban Regeneration Programme) was discussed, which aims to develop a model to predict oxygen and metal fluxes across the sediment-water interface, and changes in these fluxes in response to changes in water conditions.

Oliver MacDonald and John Harrison
Division of Geography
University of Salford

New members

We welcome the following new members to the Society:

Corrina Abesser	Dept of Geography, University of St Andrews
Ahmed Ashfaq	University of Birmingham
Owen T. Bramwell	East of Scotland Water, Edinburgh
Catherine Durr	School of Civil Engineering, University of Birmingham
Joseph Holden	Gateshead, Tyne & Wear
Rachel A. Keogh	Severn Trent Water, Birmingham
Dr Pascal Lardet	Bo'ness, West Lothian
Dr John W. Pomeroy	University of Wales, Aberystwyth
Elizabeth A. Price	Northumbrian Water Ltd
Abigail H. Rees	Swindon, Wiltshire
Caryll D. Stephen	Foundation for Water Research, Marlow, Bucks.
Matthew J. Travis	University of Southampton
Claire L. Walsh	Water Resource Systems Research Lab., University of Newcastle

Flood forecasting: what does current research offer the practitioner?

BHS National Meeting
University of Bristol
28 March 2000

Dr Peter Walsh (Bullen Consultants) welcomed 75 delegates from government agencies, industry and academia to a full day of presentations and thanked Dr Dawei Han (University of Bristol) and his colleagues for the local arrangements. To quote Howard Wheater in his closing comments, the meeting provided an "enjoyable, instructive and fascinating day."

There were four talks in the morning session, chaired by **Peter Walsh**. In the first paper on "Developments in weather radar and weather services", **Stewart Wass** and **Malcolm Kitchen** (The Meteorological Office) explained how the UK weather radar network expanded rapidly during the 1980s to reach the current total of 11 operational installations. The main limitation in its use has been the uncertainty in the derived quantitative estimates of rainfall. Ongoing investment in the radar network by the Met. Office and the Environment Agency will enable some important developments: they will improve the ability of the radars to detect rainfall and will dramatically improve the timeliness of radar products received at flood warning centres.

The commissioning of the new Cyclops radar data processor has begun, with the first system installed at Chenies. Leading on from this, the Met. Office plans to introduce a 2 km composite radar product covering the whole of England and Wales. Agreements with neighbouring countries will allow the composite image to be extended to cover parts of Holland, Belgium and France. Other developments under way include using GIS to present GANDOLF and NIMROD data (allowing images to be easily superimposed on any chosen background map), improving the resolution in time – and, in the longer term, space – of the MORECS soil moisture data. Stewart Wass also presented some preliminary results from an experimental severe weather impact model, which has successfully predicted the number of properties likely to be affected by a forecast severe weather condition.

Vicky Bell (CEH Wallingford) then presented the joint paper with **Bob Moore** (also CEH) and **Vic Brown** (Environment Agency) on "Snowmelt forecasting for flood warning". She reported that only three of the eight regions responsible for flood warning in England and Wales operate forecasting systems that incorporate explicit monitoring and modelling of snowmelt; in Scotland there are none that do. Current models take a simple lumped form, are based on temperature excess melt principles and, because of a lack of data for model calibration, use literature-derived parameter values. The research programme encompassed field monitoring together with model development and evaluation. Vicky pointed out that many extreme floods are caused by snowmelt, for example the January 1992 flood in Scotland.

The model she described partitions the catchment into elevation zones, and has been tested with three different melt equations, each with different input data requirements. The model gave convincing results: in particular it could follow the advance and retreat of the snowline. The use of snow pillows, to try to reduce the need for manual measurement of the snow pack, was also mentioned. So far snow pillows tend to alter the melt behaviour of the snow, but they might be useful after further development. Results from the research have already been applied to improve an operational flood forecasting system used in Yorkshire.

Prof. Ian Cluckie, assisted by

Dawei Han (University of Bristol), gave a highly interactive presentation entitled "Future opportunities for real-time flood forecasting systems". He demonstrated forecasting and display systems developed by the Bristol and Salford groups. The key words were integration and coupling: flood forecasting and warning systems that are truly integrated are required, and the use of coupled meteorological/hydrological/hydraulic models has the potential to improve our forecasting ability greatly. These integrated approaches can be particularly useful in upland catchments, where rainfall is critical in forecasting river levels, and in the estuary, where tides and wind have a major influence.

Prof. Peter Young (Lancaster University) talked about "Data-based mechanistic modelling and adaptive flow forecasting." Suggesting the benefit of coming to the problem of rainfall-runoff modelling without any theoretical preconceptions, Peter described the process of finding a model that fits the data, and only then attempting to provide a physical justification for the model structure. The model developed in a test application of this technique had non-linear and linear components, which were justified as representing the transformations of total rainfall into effective rainfall and effective rainfall into flow, respectively. The linear element of the model, a transfer function, could also be decomposed into quick and slow flow components, which have clear physical analogies in surface flow and base flow. In answer to a question, he argued that models should be sufficiently complex to be consistent with the data, but no more.

Prof. Keith Beven (Lancaster University) made the journey from Belgium by Eurostar to speak about "Mapping the probability of flood inundation (even in real time)," on behalf of co-workers **Barry Hankin** and **Renata Romanowicz**. He made the case for generating probabilistic forecasts of flood water levels and inundation. In the University of Lancaster's GLUE method and software *(http://www.es.lancs.ac.uk/hfdg/hfdg.html)*, the idea of a single optimal set of model parameters is rejected. Instead, numerous sets of model parameters are used, and a measure of likelihood for each is calculated. The results of running these models and their likelihood values are used to develop a map of probability of inundation. The use of simple (computationally efficient) models and fast computers allows this approach to be applied in real time. Keith finished with a request for interesting data sets to which to apply the methods: offers would be gratefully received.

Prof. Howard Wheater chaired the afternoon session and introduced **Dr Matthew Lees** (Imperial College), who brought the delegates up to date with a talk about "Advances in transfer-function-based flood forecasting". Expanding on the work described by Peter Young, he explained that the main advance has been to extend linear transfer function models to a non-linear form, which is better able to characterise the inherently non-linear rainfall-runoff process. A physical interpretation of the (physically realisable) transfer function demonstrated that transfer function models are not necessarily "black box". The use of a non-linear loss function to add non-linear characteristics to the transfer function model was explored, and Matthew reiterated that past flow can serve as a convenient Catchment Wetness Index. He discussed the Box-Cox method for transforming the confidence intervals obtained from the Kalman Filter to remove their dependence on flow magnitude and described a case study was from Galway, Ireland.

Bob Moore gave an interim report of the Environment-Agency-funded project on "Inter-comparison of rainfall-runoff models for flood forecasting" on behalf of joint authors Vicky Bell, **Dawn Carrington** (CEH) and **Owen Wedgwood** (Environment Agency). The Agency (responsible for operational flood warning in England and Wales) commissioned research aimed at giving guidance on the choice of model for different types and sizes of catchment and for different meteorological situations. Bob explained that choosing a rainfall-runoff model for use in flood forecasting is not straightforward, and indeed may involve selecting more than one. Model intercomparisons are difficult at the best of times, and in the case of real-time operational modelling applications they can be particularly limited.

The study began with a literature review of models, focussing first on those in operational use by the Agency, but expanded to include models developed elsewhere. Following this a subset of the models was chosen for inter-comparison. The inter-comparison considered eight models across nine catchments of varying size, land use, relief and lithology. For three of the catchments weather radar data were used to obtain "best estimate" rainfalls as an alternative to raingauge estimates. The data record for each catchment, up to ten years in duration, was split into calibration and evaluation datasets. Models were evaluated in simulation mode and in updating mode. The range of models included different updating methods based on error prediction, state correction and parameter adjustment. Performance was judged using a range of statistics (R^2, skill scores on threshold crossings), scatter plots of observed and forecast peaks, and hydrograph plots. The results will be used to draw up guidelines on model choice for different catchment situations.

Jim Haywood (Manager, Environment Agency's National Flood Warning Centre) described the Agency's "Current practice and planned developments" in flood forecasting and warning in his joint paper with **Bob Hatton** (Consultant). The Agency had reviewed current practices in flood forecasting and warning. These related to operational issues and the R&D programme in the aftermath of the Bye Report on the Easter 1998 floods, the Agency Action Plan, and the MAFF/Agency Advisory Committee Report on Flood and Coastal Defence R&D. Flood forecasting capabilities, tools and techniques currently vary widely between regions.

The Agency's Area and Regional flood defence functions are being restructured to deliver consistent regional flood forecasting. The National Flood Warning Centre aims to provide support, advice, guidance and direction to regions to drive national consistency and convergence towards best practice. It will also act as a focus, both for external bodies and within the Agency, for flood forecasting and warning practices. This will include developing the flood forecasting R&D programme and ensuring implementation of results into practicable solutions, which improve the overall flood warning process. Key issues to be solved by researchers and software developers are presentation of uncertainty information in forecasts, improvement of model performance, improving the accuracy of incoming data, and identifying conditions that give rise to extreme events. Jim finished by introducing the new Flood Warning Codes (Flood Watch, Flood Warning, Severe Flood Warning and All Clear), which will replace the existing colour codes in September 2000.

Lively discussion followed, ensuring a good exchange of opinions (sometimes frank) on the merits of different approaches to flood forecasting modelling. Howard Wheater summed up and thanked all the speakers. The presentations will be published as a BHS Occasional Paper, edited by Matthew Lees, later in the year.

David Harvey (University of Bristol)
Peter Walsh (Hon. Secretary)

Public recognition

Several in BHS will know (or know of through his UNESCO/IHP publications, **Tony Falkland**, the Canberra hydrologist in Australian government service. He has just been awarded the AM, the Australia Medal, "For service to engineering and hydrology, particularly the management of fragile water resources in Pacific island countries."

News from members

Mmebers on the move

After ten years as a lecturer in the Department of Civil and Environmental Engineering at the University of Salford, former BHS committee member **Dr Kevin Tilford** has left to work for WS Atkins (Consultants) Ltd. He is currently Chairman of the BHS Pennines Group, and his involvement in the Society remains very strong. Kevin is a Senior Engineer in the Water Division's River and Coastal Engineering Group at Warrington, working on project management (flood risk modelling for the Environment Agency), plus business development and leading hydrological and hydraulic technical studies. He can be contacted on 01925 622051; email ktilford@wsatkins.co.uk.

Meanwhile **Owen Bramwell** has moved from his post as Senior Hydrologist at WS Atkins in Warrington to become Water Resource Planner with East of Scotland Water (ESW). ESW is carrying out a major review of all its water sources and treatment works, and Owen's role includes input to strategic decisions on capital investment and operating regimes.

News from past Presidents

The influence and standing of British hydrologists – including past BHS Presidents – continues to expand.

Prof. Sue Walker had been appointed to the Board of Scottish Natural Heritage. It is good to see a hydrologist contributing to nature conservation in this way.

Prof. Michael Hamlin received an Honorary D Eng degree from Bristol University in July.

Congratulations to them both.

Farewell to Matthew and Lisa

Matthew Lees is due to leave Imperial College at the end of September, to pursue a career in IT. The President has thanked Matthew for his support on the committee, especially in developing and running the Society's web site. We hope he will stay involved in BHS and keep in touch with hydrology.

New people are urgently required to take over the web site role: please consider whether you can contribute to maintaining our high standard of internet output. The committee expects the work to be shared between two or three people, not all in the same place.

And farewell and many thanks to **Lisa Stafford** for her work as the BHS Secretary at the ICE over the past year.

Publications

The latest issues of the *Hydrological Sciences Journal* (Volume **45**, Numbers 3 and 4) contain the following papers:

No. 3, June 2000:

Md Monirul Islam & Kimiteru Sado: *Development of flood hazard maps of Bangladesh using NOAA-AVHRR images with GIS*

A. Rango, W.P. Wergin, E.F. Erbe & E.G. Josberger: *Snow crystal imaging using scanning electron microscopy: III. Glacier ice, snow and biota*

B. El Mansouri, Y. Loukili & D. Esselaoui: *Conservative identification of nodal transmissivities: theory, computational experiments and application to the Rharb coastal aquifer (Morocco)*

H.A.R. de Bruin & J.N.M. Stricker: *Evaporation of grass under non-restricted soil moisture conditions*

Xungang Yin, Sharon E. Nicholson & Mamoudou B. Ba: *On the diurnal cycle of cloudiness over Lake Victoria and its influence on evaporation from the lake*

A.J. Abebe, D.P. Solomatine & R.G.W. Venneker: *Application of adaptive fuzzy rule-based models for reconstruction of missing precipitation events*

R.K. Kachroo, S.H. Mkhandi & B.P. Parida: *Flood frequency analysis of southern Africa: I. Delineation of homogeneous regions*

S.H. Mkhandi, R.K. Kachroo & T.A.G. Gunasekara: *Flood frequency analysis of southern Africa: II. Identification of regional distributions*

Richard M. Vogel & A. Sankarasubramanian: *Spatial scaling properties of annual streamflow in the United States*

Mario Tomasino & Francesco Dalla Valle: *Natural climatic changes and solar cycles: an analysis of hydrological time series*

Theodor Landscheidt: *River Po discharges and cycles of solar activity.* Discussion of "Natural climatic changes and solar cycles: an analysis of hydrological time series" and reply by M. Tomasino & F. Dalla Valle

No. 4, August 2000:

K. Chikita, S.P. Joshi, J. Jha & H. Hasegawa: *Hydrological and thermal regimes in a supraglacial lake: Imja Khumbu, Nepal Himalaya*

Linda See & Stan Openshaw: *A hybrid multi-model approach to river level forecasting*

Xiaoliu Yang & Claude Michel: *Flood forecasting with a watershed model: a new method of parameter updating*

Maciej Radziejewski, András Bárdossy & Zbigniew W. Kundzewicz: *Detection of change in river flow using phase randomization*

András Bárdossy & Jan M.C. van Mierlo: *Regional precipitation and temperature scenarios for climate change*

C.K. Jain: *Application of chemical mass balance approach to determine nutrient loading*

V.S. Singh: *Well storage effect during pumping tests in an aquifer of low permeability*

Zekai Sen: *Non-Darcian groundwater flow in leaky aquifers*

E.D. Andrews & Leslie A. Pizzi: *Origin of the Colorado River experimental flood in Grand Canyon*

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Atmospheric Science Letters has been launched as an electronic journal to complement the *Quarterly Journal of the Royal Meteorological Society*. It offers a fast, high-quality, peer-reviewed route for shorter contributions. Papers are welcomed on topics including climate change and variability, hydrometeorology and land-atmosphere interactions. Authors' guidelines are at www.academicpress.com/asl. For subscription details please email asl@harcourt.com .

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Current, the newsletter of the New Zealand Hydrological Society, is produced as a small booklet. The May 2000 issue has a leading article about the legal and environmental battle over trading in bulk fresh water, something of particular concern now in Canada.

Documents from IHP, UNESCO

Proceedings of the Satellite Conference to the World Conference on Science: participatory processes in water management. Budapest, June 1999. *Technical Documents in Hydrology No 30*, UNESCO.

Canadian National Committee for IHP, 2000. Contributions to IHP-V by Canadian experts. *Technical Documents in Hydrology No 33*, UNESCO.

Mostert, E. (ed.) 2000. Proceedings of the International Workshop on River Basin Management. The Hague, October 1999. *Technical Documents in Hydrology No 31*, UNESCO.

Cosgrove, W.J. and Rijsberman, F.R. 2000. *World Water Vision: making water everybody's business.* World Water Council and Earthscan Publications Ltd., London. 108pp including index. The accompanying CD-ROM contains the complete set of background documents produced during the Vision exercise, comprising thousands of pages of regional and sector scenarios, special studies, newsletters and infosheets – a invaluable reference archive.

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Members wishing to refer to these or other publications should contact the National Hydro-Sciences library at CEH Wallingford *(tel 01491 692266).*

President's piece

September is approaching fast, and hopefully many of you will have registered for the major BHS event of the year, the Newcastle Symposium. If not, now is the time! There is a full set of high quality papers, and apart from a chance to catch up with current developments in the UK, we have the Penman Lecture. This year **Hoshin Gupta** from the University of Arizona at Tucson (arguably the top US hydrology group) will be speaking on new developments in hydrological modelling. Apart from being an excellent speaker, Hoshin has a thought-provoking message for hydrological practitioners, having developed a set of new methodologies for modelling which increase the value of data and provide powerful insights into model strengths, weaknesses, and prediction uncertainty.

The final session of the symposium will provide a forum for discussion of an exciting new UK initiative, a National Forum for Catchment Hydrology Research. Some of you will be aware of a major infrastructure grant, under the title National Infrastructure for Catchment Hydrology Experiments (NICHE), to consortia led by Imperial College (for a set of three lowland catchments) and Newcastle University (for a set of four upland catchments), and a new NERC Thematic Programme into Lowland Catchment Research (LOCAR). There will be updates on the progress of these initiatives, and a chance to discuss participating in them. We also have the pleasure of an after-dinner speech from **Professor George Fleming**, President of the Institution of Civil Engineers, an entertaining speaker with a wealth of hydrological experience, and a powerful advocate for the role of environmental specialists within the Institution.

Under George's leadership, the Institution of Civil Engineers is seeking to facilitate a broader base of chartered members, and in response to BHS members' responses to the BHS2000 review, we have opened up a dialogue with the Institution to clarify the routes to ICE chartered status for hydrologists. A number of members have kindly offered CVs for discussion, and **Peter Midgley** is leading a review of professional requirements and feeding comments to ICE in a move to define an appropriate set of core and specific training objectives.

The committee is continuing to work on the various other strategic themes raised by members' comments and will report later in the year. Other topics under discussion include our Internet strategy, publications (including electronic publication), membership, international links, regional activities, and other policy initiatives. An immediate outcome from the Internet group has been the registration of the following address for BHS web pages: *http://www.hydrology. org.uk/*. The committee foresees the need for some additional expenditure to support new initiatives, as well as increasing costs, and will therefore be recommending a modest increase in subscriptions (£2) at the AGM.

Other committee news includes a change in representation for the South-West regional Section. After a relatively quiet period, a new committee is being formed, with **Samantha Green** as secretary and Section rep, so if you have suggestions for activities or would like to be involved, please contact Sam *(sagreen@south-west-water.co.uk, tel 01392 443774)*. And sadly **Matthew Lees** has resigned from the Committee. His contribution to BHS activities has been much appreciated, particularly in developing internet policy, running the web-site, and in organising national and regional meetings. His last contribution will be as editor of the latest Occasional Paper, based on the papers given to the March Flood Forecasting meeting in Bristol. We wish him every success with a new venture in IT. Matthew's departure creates an additional committee vacancy, and at the time of writing, we eagerly await your nominations for the BHS committee positions to be filled this year.

See you in Newcastle!

Howard Wheater

Water-related data collection in Africa

Last autumn I returned from Katsina State, northern Nigeria, where the new Water Master Plan still awaits our proposals for water-related data collection. The UNESCO/WMO recommendations are for about one river discharge station per 10000 km^2. That is only about three for Katsina State and only 50, say, for all of northern Nigeria, half of which would also be expected to collect data on sediment transport.

Since the end of the 1970s almost no river discharge stations have been successfully maintained in northern Nigeria, and none in Katsina State. Partly this is because of underfunding, but principally it is because data collection based on the US Geological Survey procedure is extremely difficult and demanding, especially for low rainfall areas in the tropics.

After a few personal successes with water balance calculations in Nigeria and in Tanzania, where daily records at dam sites were available, I have come to believe that there is a better alternative to the USGS procedure. Taking the whole of northern Nigeria as an example, the alternative for catchment runoff data collection, as a continuous time series over the next decades, is to install staff gauges and standard daily raingauges at two dozen large dams and at about 70 selected small dams. The staff gauges would be read daily during the dry season and at shorter intervals during spillage to monitor flood discharge. Water use data from the operation of the dams is also required for the subsequent spreadsheet computations (although, in effect, many dams in Nigeria are unused). In addition a periodic hydrographic survey, say every five years, is required of the selected reservoirs using a GPS and an echo sounder. These periodic hydrographic surveys give an indisputable record of sediment transport from the catchment of the reservoir.

For water resources engineering applications, this proposed method of collecting data is robust. The estimates of evaporation loss and water consumption are the doubtful entries in the water balance spreadsheet. However, the same systematic errors will appear in any application of the resultant runoff series to the design or management of water impoundment projects, thus tending to a correct outcome.

When selected dam sites are set up for this alternative procedure, there are no requirements for technical equipment at the selected sites other than a set of staff gauges, a standard raingauge, a notebook and a pencil. The immediate requirements – manpower and materials – are locally available, so that the procedure can be put in place, starting from the end of any chosen rainy season, without significant delay. Such a level of sustained hydrometric activity would make northern Nigeria a top performer in water-related data gathering among the countries of tropical Africa. The initial set-up requires activity both during the wet

season (when the reservoirs are full) for the hydrographic surveys and in the dry season (when they are empty) to install staff gauges. Once the set-up is complete, no dedicated vehicles are routinely required for data collection. It is a lack of transport that always leads to the collapse of the presently adopted procedure.

With a view to providing for the whole of northern Nigeria, I contacted Ian Curtis, the Senior Water Resources Adviser at DFID. He replied very promptly, enclosing an evaluation of my proposal – cautious but positive – from an external adviser. A cost estimate for this proposal involves some set-up costs (which can be contracted out), but there is very little extra running cost in Nigeria: the gauge readers and supervisors are already on the payroll – usually with no active gauges left to read. An extra activity would be the assembly, evaluation and processing of the raw data and the dissemination of the computed water resource data to all interested parties. This requires a suitably equipped office run by a hydrologist.

The DFID external adviser reckoned that "*the general procedure described has been applied in many instances to generate synthetic river flow sequences ... examples of past application include Narmada Dam in India, Tarbela Dam in Pakistan and Gaborone Dam in Botswana.*" If it has often been used where past records have been available, why then has this robust and cost-effective procedure for collecting historic hydrometric data not been adopted in preference to the USGS procedure for the collection of future records?

My own experience suggests that the fun associated with the periodic shopping sprees required for the USGS procedure has had a powerful effect on decision making in Africa. There are also the following considerations:

- In the early 1930s, as a component of the US New Deal, the USGS and the US Soil Conservation Service became active in providing inputs for river basin development authorities so that dams would be constructed; the institutions were established prior to dam construction;
- The evaporation pan of the 1930s was an unsuccessful attempt to tackle the evaporation problem head on; only since the 1950s has the Penman method provided the required estimates to establish a water balance;
- It is only in the past dozen years that spreadsheets have become widely available to perform the numerous calculations required.

This note is contributed in the hope that interested readers, especially those with practical experience, may get in touch with me in order to present a more complete and authenticated proposal on the lines described. This would be an outcome very much in line with the advice given by DFID. Please contact me by telephone on 020 7357 9457 or by email to jasper@newkent.freeserve.co.uk.

Jasper Tomlinson

Reviews

Books

Principles of Hydrology – Mk 4

Principles of Hydrology (4th Edition), R.C. Ward and M. Robinson, McGraw Hill Publishing Company, 2000. ISBN 0 07 709502 2. Price about £25.

Roy Ward and Mark Robinson continue to take hydrological processes and our understanding of them as the basis for their new edition of this book. As a result it follows the layout of earlier editions, with chapters on each major component of the hydrological cycle – precipitation, interception, evaporation, groundwater, soil water, runoff and water quality. A new concluding chapter on "The drainage basin and beyond" is a welcome addition, made we are told in response to 'popular request'. Its inclusion is a timely reminder that water does not respect political boundaries as it is an all embracing and integrating medium in its relationship with man's activities. Another new feature is the inclusion of brand new problems and exercises at the end of each chapter.

The text includes quotes from the BHS Research Strategy (1994) and reference to the Exeter Statement produced at the Society's First International Conference there in 1998. It finishes with the proposal that hydrology needs to develop as a scientific discipline *in its own right* and to integrate more closely with other disciplines. It should not remain as a fragment in disciplines such as civil engineering, geography and others: this should be relegated to history. BHS provides a forum for disciplines to interact, indeed its formation was a recognition that non-engineer hydrologists were poorly served by professional and scientific learned societies over 20 years ago. Perhaps the book's concluding remarks could also be taken as a pointer for the Society. Does it adequately foster the move to one discipline or is it only serving separate interest groups that mix infrequently?

The authors have excelled themselves in ensuring that the text is up-to-date by including references to and extracts from the *Flood Estimation Handbook*, which was published after this book! Another indication of the authors' efforts to make the book relevant at the start of the 21st century is that the vast majority of the references have been produced since the 1st edition appeared in 1967. A remarkable 46 pages of references will enable both students and professionals to explore many topics in considerably more depth. But, as the authors acknowledge, this is still a minute fraction of those available, and they encourage readers to seek out more via CD-ROM, the Internet and other abstracting and indexing services. Nevertheless there are some valuable historical references going back almost two hundred years. The earliest I found was a paper by Dalton in 1802, and one with more hydrological content was by Stevenson in 1842, on placing a raingauge in a pit.

The writing is clear and concise, which makes it particularly easy to read and understand. But this does not mean that the authors have not covered the subjects in depth. Discussion of fundamental processes and of the research studies is interspersed with some interesting comments and data. Many UK hydrologists express concern about reducing networks. Did you know that the UK has one of the highest densities of raingauges in the world (one per 60 km^2), but their total area is still less than a standard football pitch? By comparison, pity the person who wants rainfall data in Mongolia, with one gauge per 47 420 km^2.

This is a book that all hydrologists will value. It will be a first class and effective text for undergraduate and postgraduate studies. But it should also have a place on the desk (not the bookshelf) of experienced and professional hydrologists to give them a well prepared and balanced view of recent developments in hydrology, set in the context of the primary elements of hydrological processes.

Peter D. Walsh

Software

Model*Maker* 4.0

Model*Maker* 4.0 is a software package developed by ModelKinetix.com, a division of Cherwell Scientific Ltd. (see http://www.modelkinetix.com/) for building mathematical models. The user-friendly interface and extensive functionality enables users to develop complex mathematical models relatively easily with little or no programming experience.

The first stage in constructing a model is to create a schematic representation of the model in the "Diagram View". Equations governing the behaviour of each of the

compartments and variables are edited in dialog boxes, opened simply by double clicking on the relative component. Parameters are defined in a separate view and can be calibrated to produce an improved model fit against measured data, using the optimisation feature with a choice of objective functions including least squares, weighted least squares, and extended least squares. The optimisation feature searches the parameter space using either the Maquardt or Simplex gradient search methods after an initial search using a grid or simulated annealing search.

Model*Maker* offers a choice of five numerical integration methods for solving the differential equations, including the commonly-used Runge-Kutta method, and the Gear method that is especially well suited to solving stiff systems of equations. Model predictions can be displayed in both tabular and graphical form, which can be copied and pasted into both Word and Excel.

A new feature in this version is the ability to perform Monte Carlo simulation. Parameter values are defined as random distributions (choosing one of 14 distributions) and the repeat run facility is then used to assess the sensitivity of the model outputs to varying parameter values and to estimate output uncertainty. Stochastic models can therefore be developed using Model*Maker* 4.0. However, the uncertainty estimation output of the Monte Carlo feature is limited to a histogram of the number of occurrences of a particular compartment output at one point in time. If the cumulative frequency of the model output could be determined at each point using the Monte Carlo feature, confidence limits could also be included in the model predictions. One limitation, common in most similar packages, is that there is no method of estimating the parameter probability (or possibility) distributions during calibration. This problem is currently the subject of considerable research effort that hopefully will lead to generally acceptable methods in the near future (see **ewre-www.cv.ic.ac.uk/hydrohome.html** and **www.es.lancs.ac.uk/hfdg/hfdg.html** for examples of this research, and to download the GLUE and MCAT software packages that calculate parameter possibility distributions using Monte Carlo sampling).

Having not used any of the previous versions of Model*Maker*, it is difficult to comment on improvements to the user interface. However, we can say that we found the current version to be well thought out, and with the clearly presented user manual we were quickly able to develop relatively complex storage models. Additional desirable functionality would include the ability to convert models developed using Model*Maker* 4.0 into programming code (C++, Fortran, etc.), as the current package is unable to link directly to GIS, database and spreadsheet packages. However, Model*Maker* 4.0 can be linked to external DLL modules, which in turn can be linked with external data handling packages.

Model*Maker* 4.0 is well suited as a teaching aid. Complex mathematical models can be quickly developed and optimised irrespective of programming ability. Model sensitivity can be clearly demonstrated, as can parameter optimisation. Comparisons can also be made between the accuracy of different numerical integrators. The software is also a useful tool for more experienced modellers in initial model development as models can be built quickly in a very pleasant environment.

One of us (RS) certainly intends to use it in his research into modelling phosphate transfer from non-point agricultural sources in lowland river catchments.

Russell Smith and Matthew Lees
Department of Civil and Environmental Engineering, Imperial College

Travel grants

Travel grants are available to help members whose travel expenses are not met by an employer to attend scientific meetings. The amount of an award will normally depend on the nature and location of the meeting and the case put forward by the applicant.

The scheme is primarily intended to help younger members, who will be given priority, but it is open to all. Successful applicants will be expected to write a short report for *Circulation*.

The Exeter Fund, looked after by BHS, also pays travel grants. These are specifically to help British hydrologists (living in the UK) to participate in the activities of IAHS and its related organisations in the UK and abroad.

Anyone wishing to apply for money from the Exeter Fund or a BHS travel grant should contact the Hon. Treasurer, **Terry Evans**, 107 Ely Road, Littleport, Ely, Cambridgeshire, CB6 1HJ *(Tel. 01353 862723, email TEEVANS100@AOL.com).*

Celtic hydrology II



As part of the Second Inter-Celtic Colloquium, held in Aberystwyth in early July, a field visit was arranged to the Plynlimon catchments, run by the Institute of Hydrology since the 1960s and now in the care of their successor, the Centre for Ecology and Hydrology.

A small but energetic party was led by **Frank Law*** (third from rght) to see the headwaters of the Wye and Severn. The picture is at the Cefn Brwyn weir on the Upper Severn.

A report by **Aly Walsh**, who attended the Colloquium with the help of a BHS travel grant, appears on page 14; the papers are in *BHS Occasional Paper No. 11.*

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*Frank Law has just retired as Deputy Director of CEH Wallingford. At an informal tea party hosted by Frank and his wife Ruth, colleagues presented him with a flood risk map of the area around his home in Wallingford, a Royal Historical Society CD-ROM and sufficient money to add several books on hydrology and history to his library.

Hydrology in Scotland – what the delegates thought

Hydrology in Scotland 2000: that was some meeting! We planned it for almost three years. Almost 150 people attended. Senior figures from across the hydrological community in Scotland helped us identify the questions, target key speakers, get the timetable right and put funds in place to make this meeting tick. The press asked us questions and wrote about it.

The meeting took place on 21st-23rd March. **Hayley Fowler** provided a personal account of the meeting in *Circulation 65*, giving a sense of the scope of the proceedings and highlighting some of the key issues to emerge from the sessions. A team of rapporteurs took notes of the sessions and, due to limitations of space, these have been published on the web, to provide a record of the oral presentations and the discussion that followed them. They are on the Scottish Hydrological Group web pages – at **www.dundee.ac.uk/geography/shg/** or via the BHS site, **www.hydrology.org.uk**. Soon the final output of the meeting will be available too, with the publication of a special issue of the journal *Hydrology and Earth System Sciences* (HESS), containing the refereed papers which underpinned most of the oral presentations.

But Hydrology in Scotland was not about those oral papers alone. A major priority was to provide a forum to discuss the role of hydrology in 21st-century Scotland. This article sets out to give some account of the discussions of key issues at the meeting. The final session provided the opportunity to do this, and two methods were pursued:

- Delegates were asked to complete a questionnaire before the session began, addressing some key questions identified by Mike Hamlin and Frank Law.
- Keynote speakers were asked to outline the priorities for hydrology in Scotland that they gave highest priority for the coming decade.

In the questionnaires, delegates were asked for *yes/maybe/no* responses to six proposals, and were given opportunities to make further comments of their own in a less tightly controlled way. Scores for the six proposals were as shown in the table.

These scores, and the written comments, indicate that the strongest consensus of the meeting was in relation to hydrometric monitoring (Proposal 3), followed by the need to work on an inclusive basis for sustainability in water issues. Many written comments encouraged the need for more cross-boundary education on water topics, and encouraged informed debate on water issues. Least certainty was expressed over Proposal 2 – almost half the delegates marked 'maybe' responses, and some suggested that it was problematic to suggest the 'imposition' of any method. SNIFFER (The Scotland and Northern Ireland Forum for Environmental Research) and the water authorities have been sponsoring a programme to develop a new standard yield method for Scotland and Northern Ireland, with results due later this year.

Through the questionnaire and orally, the meeting also heard many calls for attention to the practice of flood risk estimation in Scotland. Planning authorities were widely seen as being disadvantaged by the current system, in which SEPA will make available information on flood risk, but do not undertake a fuller advisory role. Several delegates called for enhanced funding to allow SEPA to become more proactive in assessing and managing flood risk.

The keynote speakers were asked to give *personal opinions* on priorities in the research and/or policy areas for the next decade. **Robert Bone** (West of Scotland Water) felt that the water authorities' most pressing research needs were in the flooding and water resources areas. He anticipated that funding issues would place heightened pressure on data collection activities, and aroused interest by suggesting that the invasion of Scotland's Munros by climbers and walkers each weekend offered the solution to maintaining raingauge measurements in the uplands.

James Curran (SEPA) emphasised the importance of collecting data fit for purpose, indicating that more needs to be done in relation to groundwater and hydromorphological status needs. He noted that the intended purposes for data use were not always clear and suggested that, in relation to flooding, there is a need to clarify roles between agencies. He demonstrated the scope for new legislation to establish duties where, currently, great ambiguity exists.

Phil Boon (Scottish Natural Heritage) focused on the interaction between hydrology and ecology, with examples of situations in which existing science seems inadequate for management needs. He touched on flood issues, suggesting that more should be done to tackle the causes of problems rather than their symptoms.

David Crichton (Association of British Insurers) continued the flood theme. He put UK flood costs to insurers in perspective, by comparing the £300 million losses since 1990 with £3300 million due to subsidence. However, this balance might shift under climate change, and the industry is very keen to work with Government to manage flood risks better.

Sue Walker (Aberdeen University) gave a wide-ranging presentation, drawing on experience from north and south of the border. She urged

Table of key priorities and delegates' responses

	Proposal	Yes	Maybe	No
1.	Develop a common method of creating a long flow record at an ungauged Scottish site	43	17	7
2.	Impose a standard water supply source yield method which produces a graph of yield/probability of shortage	25	29	8
3.	Invest significant new money in hydrometric network improvement (quantity/quality/data access) above and below ground, to anticipate Scots community needs under the coming Water Framework Directive	57	6	4
4.	Develop and prove catchment water quality and habitat models suited to Scottish natural heritage issues, and capable of handling scenarios of future change	46	19	1
5.	Agreeing that Scottish climate change and decade-scale variability is of concern, invest in measures to reduce environmental hazards, including flooding	42	15	9
6.	Work for sustainable solutions to water problems, using positive participation with community groups and the public to explore workable options	54	11	2

delegates to think of their work as managing the environment for the benefit of all, making the case that this is the ultimate purpose of stakeholder involvement in decision-making processes. She raised the prospect of competition legislation changing the approach of Scottish water authorities to many aspects of their businesses.

Mike Hamlin then attempted to review the symposium as a whole, in the space of just ten minutes – no small task! His summary will be drawn on more fully in the forthcoming HESS volume, but three of his most resounding themes are worth special mention here. He drew attention to the problems of water supply and sanitation in developing countries, and asked Scottish hydrologists to consider the contribution they could make. He emphasised the importance of managing water resources and the environment on a stakeholder basis, and suggested that Scotland is a small enough country to allow this to be achieved with great success. And finally he urged delegates to be mindful of the contribution that hydrology can play in relation to legislation being brought forward at all levels, urging us all to make our voices heard.

The last part of the symposium allowed delegates to raise points neglected in the preceding sessions. **David Howell** emphasised the value of Scotland's many and varied lochs in water quantity, quality and habitat terms, suggesting that hydrologists must not overlook this characteristic element of Scotland's hydrology. **Alan Werritty** suggested that the programme had largely neglected the progress being made with Sustainable Urban Drainage Systems and (separately) highlighted the role of the traditional Scottish 4-year degree, and Geography in particular, in educating generalist graduates who might be well placed for careers in water management. **David Price** drew attention to the overwhelming volume of material needed in postgraduate environmental management courses that seek to prepare students for such careers.

Alvin Barber pressed for local authorities (tasked with most flooding responsibilities) to be given more of an opportunity to engage in national policy development, while **John Stowell** encouraged council planners and roads officials to 'talk more'. **Jim Blackie** made the case for land users of all sorts to be included in catchment management discussions, because of their important role and, finally, **Ruth Robinson** reminded everyone of the important links between catchment hydrology and sediment processes.

Discussion in and around the sessions added greatly to *Hydrology in Scotland 2000*. The organisers hope that everyone who attended found themselves able to take away from Dundee much food for thought.

Andrew Black
University of Dundee

Taming the Tame

BHS Midlands Section site visit 24 May 2000

A party of 24 people assembled at Minworth Sewage Treatment works for an afternoon field visit to examine work under way in the Tame catchment to rehabilitate the urban rivers. **John Martin** described a £90 million investment programme that Severn Trent has recently completed to upgrade the Minworth Treatment works, which processes much of the effluent from the Birmingham conurbation and discharges into the River Tame. **Angela Gurnell** then outlined the nature of a number of parallel projects that are in progress on modelling urban river corridors in the area, and which illustrate the need to link studies of water quality, quantity and ecology. This work is funded by NERC under the URGENT programme and involves local universities, councils and CEH Wallingford.

After the introduction, and braving more than usual traffic congestion in the area, **Paul Webster** led visits to a selection of sites within the Tame catchment. These began with a canalised section beneath Spaghetti Junction at the confluence of the Tame and the Rea, where Paul described the hydrological characteristics of the Tame and the 'first flush' phenomenon. From here, the group travelled to the River Cole where river and wetland habitats have been improved as part of 'Project Kingfisher'. **Angela Davenport** and **Karen Fisher** described their work on river corridor assessment and hydraulic modelling of flows. The afternoon concluded with a stop at the Lea Marston Purification Lakes on the Tame, where **John West** described how these lakes have successfully reduced BOD, Cu and Zn, thereby improving the quality of the river downstream.

All-in-all, the afternoon provided a very good and interesting introduction to the work under way in the Tame catchment, which has significant implications for the restoration and management of urban rivers generally.

Chris Bradley
University of Birmingham



Paul Webster leading the party along the channel of the Tame running under a section of motorway near the Hockley Brook confluence

IGU study group on environmental change and extreme hydrological events

The International Geographical Union Study Group was established in 1998 to increase understanding of the effects of atmospheric and land surface change on the frequency and severity of floods and droughts. It has held two successful conferences (in Lisbon and Aberystwyth) and is holding two more – in Seoul (August 2000) and in Zaragoza (2001). Selected papers are due to appear in special issues of international journals and a book is being planned. The Group has over 100 corresponding members and the Aberystwyth meeting in 1999 attracted over 45 delegates from a dozen countries, including Argentina, Australia, Brunei, Canada, China and the USA, as well as Europe.

The inaugural lecture was given by **Sir John Houghton**, former head of the Met Office and chairman of the Intergovernmental Panel on Climate Change's Scientific Committee. Sir John gave a very clear and balanced assessment of the latest scientific evidence for global warming. Speakers followed this with assessments of recent changes in river flows and water resources around the world, particularly from **Tom McMahon**'s Australian team, and of the future situation that global warming might create, especially from the (then) Institute of Hydrology team of **Nick Reynard, Christel Prudhomme** and **Sue Crooks**.

The meeting included a joint session with members of the Fluvial Archives Group (FLAG) devoted to palaeohydrology and methods of reconstructing records of past extreme events. A number of speakers used evidence from sedimentary deposits to estimate changes in flood frequencies in the past few centuries as an indication of the natural variability of climates. Session 3 (landuse and landsurface effects) included memorable papers from **Harriet Orr** (Lancaster) separating land-use and climatic effects on flood frequency, and on modelling the effects of landsurface changes from **Marleen Stam** (Amsterdam) and from **Heinz-Theodore Mengelkamp** (GKSS, Germany). The Methodology session included **John Rodda** (IAHS) giving a critical review of methods of detecting signals of climate change in records of hydrological extremes, and **Hok Woo** (Vice-chair) on Canadian contributions to GEWEX. A couple of sessions covered extreme rainfall and flood events, including a bold paper from **Pierre Hubert** (Paris) offering a way forward beyond Gumbel through multifractal mathematics, suggesting that algebraic statistical rules link normal and extreme events rather than traditional exponential ones.

Techniques for estimating the effects of global warming/climate change scenarios were again covered, with notable papers from **Xia Jun** (Wuhan) using a Grey System and mesoscale atmospheric model for rainfall and from the Lancaster/IH team of **David Cameron, Keith Beven** and **Pam Naden** using a stochastic rainfall model to drive TOPMODEL. Sirinanda (Brunei) and Waylen (Florida) covered tropical effects from El Niño and hurricanes.

Anyone interested in participating in this study group should contact **Dr Tony Jones** on jaj@aber.ac.uk.

Landslide-generated floods in the Karakorum Mountains

In *Circulation 44* (1995) I described visible 'walls of water' generated by intense rainfall on catchments in northern England. Since then I have become aware that such wave fronts occur widely but infrequently in Britain. They pose a particular hazard for river users such as fishermen because of the rapid rate of rise. The Environment Agency does not yet appear to have developed warning procedures for such events.

In a recent visit to northern Pakistan, I had occasion to encounter 'walls of water' of a different origin. The River Indus and its tributaries flow in steep mountain gorges with the valley side sometimes rising several thousand metres from the river. Great sweeps of alluvial fan spread out from tributary gorges (nallahs) and where irrigation water is available, these fans are terraced and intensely cultivated. (The Hunza valley, a tributary of the Indus is well known for its dried apricots and nuts.) Elsewhere the valley floor of the Indus in the Karakorum Mountains is arid (less than 150 mm annual rainfall) with scattered scrub vegetation. At higher altitudes precipitation falls as snow during the winter months and spring floods are generated by snow and glacier melt from April onward.

Summer monsoon rainfall is infrequent, but is sometimes localised and intense. It can generate severe flooding in tributary rivers and, occurring at a time when snowmelt runoff is still high, often results in the annual maximum flood. More significantly it can cause landslides into the river, blocking the flow for a period. Then, breaking out from this natural dam, the flood discharge may be an order of magnitude greater than that generated by rain or snowmelt.

Historically devastating events have occurred. In 1841 the main stem of the River Indus was blocked at the foot of Nanga Parbat for about six months and formed a lake stretching 55 km upstream. When it broke out, it swept away complete villages and towns and a force of 500 Sikh soldiers encamped by the river instantly perished. '*The waters were seen by those who were there encamped to be coming upon them, down the various channels and to be swelling out of these to overspread the plain in a dark muddy mass which swept everything before it*' (Fairley, 1975). In 1885, the release of water from a dambreak, probably on the Gilgit River, caused the downstream water level to rise by nearly 30 m in one day.

More recent examples of such events occurred on the Ghizer/Gilgit River near the town of Gupis in the early 1980s where the flow was held back for a period of 36 hours, causing a lake 8 km long to form. The consequent dambreak flood caused extensive damage and loss of life. In a similar event in the same neighbourhood in the mid-1990s, the blockage lasted for 12 hours.

Winter and spring landslides and avalanches are less common and less severe. However, during my recent visit, I observed and photographed such an event on the upper Hunza River between Sost and Dhee at approximately 3500 m. A predominantly snow avalanche had blocked the river (Plate 1), but because of the steepness of the channel the lake formed behind was of limited extent. The barrier had already breached on our arrival and the drawdown zone is clearly visible. Travelling two kilometres downstream on the Karakorum Highway, we observed that there was only a trickle of clear water in the channel. We stopped and awaited the arrival of the flood wave, which came in less than five minutes (Plate 2). In this case the visible 'wall' was less than 0.3 m in height but was followed by a further rapid rise over the following minute with highly turbid and sediment-laden water (Plate 3).



Plate 1 *Ice and snow dam above Sost on the Hunza River*



Plate 2 *Arrival of flood wave 2 km downstream from the ice and snow dam*



Plate 3 *The same view one minute after arrival of the flood wave*

Such natural dambreak floods appear to be of sufficient frequency on some rivers to warrant inclusion in design flood estimation. A regional analysis separate from normal floods might be possible with an associated topographic vulnerability index for different rivers. However it is unclear how floods of the magnitude of those experienced on the Indus in 1841 and 1885 could be incorporated into the design of flood protection. A recurrence now is likely to be even more disastrous.

David Archer

Reference

Fairley, J. 1979. *The Lion River – the Indus.* Brothers Publishers, Lahore, Pakistan.

Hydrology and the relief agencies

There is an increasingly effective series of web page reports at **http://www.reliefweb.int** under the clickable subheading of *Natural Disasters*. So, for example, in July this year, just before the lower Mekong floods took hold, there was already coverage of the following events in 2000:

Floods (not including cyclones): Guatemala, Chile, China (Gansu Province), Bangladesh, Argentina, Colombia, Indonesia, Hungary, Romania, Bolivia, Zambia, Botswana.

Droughts (showing a striking regional impact): Tajikistan, Madagascar, India, Iran, Pakistan, Afghanistan, Uruguay.

Frequently now specific hydrometric measurements are mentioned, and even probability interpretations (although always unattributed, it seems). The archive coverage left on the web goes back to 1981, and so there begins to be a new resource in depth that will warrant attention by future students of society's ability to handle extreme events.

Frank M. Law

Last bus to Newcastle!

With the BHS Newcastle Symposium now only days away, why hesitate any longer? If you have mislaid the form, just call **Prof. Ian Calder**, Hydrology Symposium Office, CLUWRR, Newcastle upon Tyne, NE1 7RU *(tel/fax 0191 222 6563, email cluwrr@ncl.ac.uk).*

Erosion and sediment transport in nutrient & contaminant transfer

IAHS Symposium
Waterloo, Canada
July 2000

The International Symposium on 'The Role of Erosion and Sediment Transport in Nutrient and Contaminant Transfer' was organised by the International Commission on Continental Erosion (ICCE) of the International Association of Hydrological Sciences (IAHS) in Waterloo, Canada in July this year. With the support of a travel bursary from the BHS, I was able to attend the conference and present some of the results from my PhD research. The subject of the conference was directly applicable to my own research and the trip was therefore an excellent opportunity to meet with other hydrologists currently engaged in research on many different aspects of the subject.

My own work has focused on the role of fine fluvial sediment as a vector for heavy metal transport in the highly contaminated River Aire, Yorkshire, UK. The keynote address at the beginning of the symposium, given by Arthur Horowitz, summed up many of the problems faced by myself and other researchers in obtaining representative sediment samples for subsequent heavy metal analyses and in the calculation of sediment-associated heavy metal fluxes. The work that he reported was based on large North American rivers, which provided an interesting comparison with the relatively small river on which my own work in the UK is based.

The Symposium programme included many interesting papers covering areas including suspended sediment characteristics and transport processes, terrestrial transfer of sediment, sinks and sources of nutrients and contaminants, and the modelling of nutrient and contaminant transfer. A particularly interesting debate arose concerning the value of buffer strips in the prevention of contaminated sediment reaching rivers from surrounding farmland, with Brian Kronvang, from Denmark, stressing their value and Hossein Ghadiri, from Australia, suggesting that they may channelise flow and therefore *increase* flow velocity and thus the transport of sediment and nutrients. A wide range of nutrients and contaminants featured in the papers presented, but of particular interest to me were those dealing with the transport and storage of sediment-associated heavy metals, as this is the focus of my own work. Lucie Levesque, from Canada, gave a particularly interesting presentation concerning the differences in heavy metal concentrations associated with bed sediment coatings upstream and downstream of a large urban area. This ties in with my own work, but concerned a small reach of a large river, rather than the catchment wide approach employed in my study. It was interesting to see the different scales used in different studies, ranging from the flume and plot studies, right up to the catchment scale. However, the prize for the most entertaining presentation must go to Martin Thoms, from Australia, for his description of the 'bath tub ring concept', representing the scum of organic matter left behind by receding flood waters.

During the symposium, there was a visit to the hydraulic laboratories at the National Water Research Institute, which made for an extremely interesting afternoon. The tour provided an insight into both the application of hydrological knowledge for solving real problems and the development of novel research facilities such as the impressive circular flume, demonstrated by Krish Krishnappen, which enabled the deposition and remobilisation of fine sediment and floc formation to be studied. Of particular interest was the scale model of the beach at St. Kitts, which was being bombarded with waves to determine the point at which the sea defences would fail.

This was the first international conference I have attended and it was a great opportunity to present my work to the wider community. I found the atmosphere friendly and I received a great deal of encouragement, constructive feedback and ideas from a number of participants. It was also good to meet many of the people whose work I have read during the past three years of my research, and to set my own work into the broader overall field. Although Waterloo itself is a little off the beaten track, there was an opportunity to sample the sights and attractions of nearby Toronto and Niagara Falls and the Canadian culture in general. Canada is a fantastic country and the people were always friendly. The trip was a great experience and I am very grateful for the BHS sponsorship which enabled me to attend.

Julie Carton
School of Geography
University of Exeter

Ecology: achievement and challenge

British and American Ecological Societies joint meeting
Florida, USA
April 2000

This symposium was jointly organised by the British Ecological Society and the Ecological Society of America.

A wide range of topics was addressed by key ecologists. I found the talk delivered by **Dr Stephen R. Carpenter** on 'Thresholds and Continua in Lake Ecosystems: Patterns, Implications and Questions' particularly interesting and relevant to my research interests: it was also informative and inspiring.

Dr Carpenter discussed the presence of alternative stable states in shallow lakes: clear-water versus turbid-water states, with examples drawn from Lake Krankesjon and Lake Taken. With long-term data from Lake Mandota, Wisconsin (USA), he demonstrated the specific ecological niche of phytoplankton and zooplankton with respect to space and time dimensions and suggested the importance of long-term time series data in ecological research. It was intriguing to see Dr Carpenter's perspectives on the implications of

alternative stable states (and thus the associated loss of certain species) in the context of the resilience of the system to environmental change. This supports the notion that understanding the direct impact of human beings upon freshwater lakes is important, whereas information about how eutrophied lakes respond to long-term environmental change is crucial.

My own presentation 'Lake eutrophication dynamics with respect to seasonality and macrophyte availability' was well received.

I am very grateful to the British Hydrological Society for financial assistance to attend this symposium.

Sam Lau
University of Cambridge

Water in the Celtic world: managing resources for the 21st Century

Second Inter-Celtic Colloquium
Aberystwyth
3-7 July 2000

The Second Inter-Celtic Colloquium on Hydrology and the Management of Water Resources was held in Aberystwyth, Wales, between 3rd and 7th July 2000. The theme of the meeting was *"Water in the Celtic World: Managing Resources for the 21st Century"*. The topic was chosen as it has become increasingly apparent since the first colloquium (held in Rennes in 1996) that changing climate, environmental and societal pressures on water resources are occurring. The Celtic lands are particularly susceptible to these pressures because of their climatic location and their geological environments.

The conference brought together people from a wide range of backgrounds, both in terms of subject area and workplace. I was able to attend this conference through the generous support of the British Hydrological Society (BHS). I found the meeting especially interesting since, although I now work in a hydrology research group, my previous academic background has been biologically and ecologically based. I believe that it added to my knowledge and has given me a more holistic perspective of hydrological processes and their immediate importance.

The conference covered many aspects of water management and resources, with the major themes entitled: Public water supply – resources and demand; Environmental Protection and Restoration; Climate change; Vulnerability, risk management and extreme events – drought and floods; Environmental processes and modelling; Water quality and aquatic ecosystems; and Social history of water use in Celtic lands. A total of 51 papers* were presented orally and there were also a small number of poster presentations.

Among all the interesting material presented there was, from my perspective, a number of particular highlights. **Ian Barker** (Environment Agency) was the first session speaker. He discussed the role of the Agency in attending to both the human and environmental demands on water resources. **Bob Vaughan**, also from the Environment Agency, followed this by stressing the need to confront the continually increasing demand for water. He spoke of how imbalances between demand and supply are currently being assessed through a method termed "Total Water Management". This attempts to close the gap between supply and demand by considering a range of options to provide and conserve water. I felt that these talks highlighted the significance of water resources, making a powerful start to the meeting.

Colin Neal (Centre for Ecology and Hydrology, Wallingford) challenged the hydrological and environmental science communities with some interesting questions. He discussed how, even after thirty years of research on the Plynlimon catchment, two issues remained a mystery. Firstly, "How does a drop of rainwater pass through catchments to the river?" And secondly, "How does the chemistry of the drop of rainwater evolve on its way to the stream?" These unanswered questions demonstrated the fact that some natural processes are very complicated, and can be difficult to model.

My PhD research involves using a computer model to predict future river temperatures in the UK and, in turn, assessing the implications of these temperatures for the aquatic life. Therefore the climate change session was of particular relevance and interest to me. It was useful to hear about the effects of climate variation, on a range of natural water sources, other than changes in temperature regime. Since all hydrological processes are intrinsically linked, it is important that, in my research, I am aware of the potential effect that climate change may have on all aspects of the water cycle. For example, future river temperatures will be highly dependent upon precipitation and, in turn, flow-regimes.

I was also interested to hear about river and wetland restoration strategies, such as the talks given by **Anne Powell** and **Loveday Jenkin**. With the clear message that most of our ecosystems are now so unnatural that management is not enough for sustainability. The only way forward is to restore these habitats.

I felt that Aberystwyth was a very appropriate setting for the conference, with a magnificent view, from the University, of the sea down below. The busy schedule of the meeting not only provided a stimulating environment to hear about and discuss others research, it embraced the culture of the place. Many events were organised, which left me with a real feel for the town. I especially enjoyed listening to a male-voice Welsh choir at a reception, held in an old university building, by the sea. I was quite surprised at myself, since I was completely transfixed and found the experience quite moving.

I found the week both thought-provoking and informative, and I am very grateful to the BHS for providing the funds and making the trip possible.

Aly Walsh
Geography Department
University of Exeter

* The papers presented at the Inter-Celtic Colloquium are available as BHS Occasional paper No. 11 from Dr Andrew Black, Dept of Geography, University of Dundee *(tel 01382 344433, email a.z.black@dundee.ac.uk).*

Obituary

Professor J. E. Nash, universally known as Eamonn, died on 17th April 2000 in Galway, Ireland, aged 73.

He was a pioneer in the application of scientific principles to the emerging subject of hydrology in Europe, and contributed greatly to the development of the subject and to the education of hydrologists from many parts of the world.

Eamonn Nash studied engineering at University College, Galway, and his M.E. thesis on "The relation between streamflow and rainfall" indicated one of the main themes of his research. He joined the staff of the Office of Public Works, Dublin, working on the problems of estimating discharge frequencies from ungauged basins and relations between unit hydrograph and catchment characteristics. He moved to the Hydraulics Research Station, Wallingford, as a Senior Research Fellow, and continued research on predicting runoff through unit hydrographs and other models. He set up the Grendon Underwood experimental basin to provide accurate measurements for flow forecasting, and also developed statistical methods of flood assessment.

After a period in Nigeria, he was involved in the establishment of the Hydrological Research Unit at Wallingford and was its first Head. This later became the Institute of Hydrology (recently renamed the Centre for Ecology and Hydrology).

In 1963 he returned to Ireland, to lead the International Hydrology course at University College, Galway, where he was appointed Professor. Many overseas hydrologists were trained there and at Dar-es-Salaam where courses were also held. He continued to take an interest in the Institute of Hydrology, for instance in its collaboration with the Irish Office of Public Works to produce the *Flood Studies Report* (1975). He was also an editor for many years of the *Journal of Hydrology*.

Eamonn was noted for his humour, his interest in colleagues and his incisive comments on new research. When his illness became known, he was overwhelmed by letters from all parts of the world, and his friends were often asked for news of his progress.

He was awarded the International Hydrology Prize in 1989 for his outstanding contribution to the science.

John Sutcliffe
Goring-on-Thames, Oxfordshire

This obituary was first published in the *IAHS Newsletter 69*, May 2000. We are grateful to IAHS Press and Dr Sutcliffe for permission to use it here.

Centenary celebrations

Victor Appleby, our oldest active member (featured on the front of *Circulation 65* celebrating his 100th birthday) is in fact the same age as the University of Birmingham, as well as being its oldest graduate. At the University's centenary celebrations in May he was presented to Her Majesty The Queen by **Mike Hamlin**, a former BHS President.



Professor Michael Hamlin, Honorary Professor of Civil Engineering and former Vice-Principal, introduces Birmingham's oldest graduate, Victor Appleby (1st Class, Civil Engineering, 1923) to The Queen

New PhD thesis in hydrology

Estimating flood frequency by continuous simulation

David Cameron's thesis (University of Lancaster, January 2000) explores several important hydrological modelling topics surrounding the use of continuous simulation methodology for flood frequency estimation.

A continuous simulation methodology suitable for flood frequency estimation is developed. This features a rainfall-runoff model (TOPMODEL, *e.g.* Beven, 1997), a new profile-based stochastic rainfall model (developed in the thesis), and an uncertainty estimation procedure (Generalised Likelihood Uncertainty Estimation – GLUE, *e.g.* Beven & Binley, 1992).

By explicitly accounting for a catchment's soil moisture conditions, allowing the direct simulation of long return period flood events (via the coupling of TOPMODEL with the stochastic rainfall model), and quantifying the uncertainty associated with the simulated flood estimates, this methodology is am attractive alternative to the more traditional statistical and event-based techniques available for flood frequency estimation.

It is tested successfully using data from five gauged UK catchments. As well as exploring the possible consistency between flood peak and continuous flow rainfall-runoff model parameterisations, the methodology is used to examine the potential impacts of climate change on flood frequency.

Two further issues are addressed: the choice of stochastic rainfall model (for use in continuous simulation studies) and the modification of a pulse-based stochastic rainfall model for enhanced extreme rainfall simulation.

Future research could incorporate direct extensions of the work presented in the thesis, and further exploration of the components of the existing methodology could also be conducted.

Copy deadline for *Circulation* No. 67 2nd October 2000

FORTHCOMING EVENTS

Meeting

Irish National Hydrology Seminar
RIVER BASIN MANAGEMENT
21 November, 2000
Tullamore, Co. Offaly, Ireland

The Irish National Committees of the IHP and ICID, in association with IEI, ACEI, IAH, CIWEM and BHS are holding a one-day hydrology seminar to be held in Tullamore, Co. Offaly, Ireland, on *21st November, 2000.* This seminar will comprise the presentation of papers and discussion on a variety of topics, including the EU Water Framework Directive, which will have a significant impact on the way in which many aspects of Europe's river basins are managed in the future. Other topics include flood risk mapping, urban river management, low flows and water supply, groundwater recharge, wetland habitats and a number of selected case studies and project reviews.

For details contact **Mark Adamson**, Office of Public Works, 17-19 Lower Hatch Street, Dublin 2, Ireland *(tel: +353 1 647 6734, fax: +353 1 676 1714, email: mark.adamson@opw.ie)*

Diary

4th–5th September 2000
Tenth BHS Postgraduate Symposium
Venue: Newcastle University
Contact: Dr Geoff Parkin, WRSRL, Cassie Building, University of Newcastle upon Tyne, NE1 7RU *(tel 0191 222 6146, fax 0191 222 6502, email: geoff.parkin@ncl.ac.uk)*

6th–8th September 2000
7th National Hydrology Symposium
Venue: Newcastle University
Contact: Prof. Ian Calder, Hydrology Symposium Office, Centre for Land Use and Water Resources Research, Porter Building, St Thomas Street, Newcastle upon Tyne NE1 7RU *(tel/fax 0191 222 6563, email cluwrr@ncl.ac.uk)*

12th September 2000
Welsh Hydrological Group AGM and site visit to Cardiff Bay Barrage
Contact: Claire Hammond *(tel 029 2023 5566, fax 029 2066 5413, email claire.hammond@srk.co.uk)*

5th October 2000
CIWEM/ICE Water Environment 2000: "Flood Warning & Management"
Venue: ICE, 1 Great George St, London
Contact: Erica Hammond, Terence Dalton Ltd, 47 Water St, Lavenham, Suffolk CO10 9RN *(tel: 01787 249290, fax: 01787 248267, email:erica@lavenhamgroup.co.uk).*

25th October 2000
BHS Southern Section meeting
"Floodplain management"
Venue: Imperial College, London
Time: 5.30 p.m. (tea at 5 p.m.)
Contact: Dr Adrian Butler, Dept of Civil Engineering, Imperial College, London SW7 2BU *(Tel 0207 594 6122, Fax 0207 594 6124, email a.butler@ic.ac.uk)*

27th October 2000
Scottish Hydrological Group
Half-day meeting on "Floods"
Venue: Dewar's Centre, Perth
Time: 1.00 - 5.00 p.m.
Contact: Dr Kate Heal *(tel 0131 650 5420, fax 0131 662 0478, email Kate.Heal@ed.ac.uk)*

1st November 2000
BHS Pennines Hydrological Group
"Estuarine barrages: environmental solution or problem?"
Venue: Dawson Building, University of Durham Science Site, Stockton Road
Time: 1.30 - 4.30 p.m.
Contact: Sue White *(tel 0191 374 3905, email sue.white@durham.ac.uk)*

15th November 2000
BHS National Meeting
"Modelling groundwater in an uncertain world"
Venue: Imperial College, London
Time: 13.30 - 17.00
Contact: Dr Adrian Butler *(see above)*

21st November 2000
Irish National Hydrology Seminar
"River basin management"
Tullamore, Co. Offaly, Ireland
Contact: Mark Adamson, OPW, 17-19 Lower Hatch Street, Dublin 2, Ireland *(tel: +353 1 647 6734, fax: +353 1 676 1714, email: mark.adamson@opw.ie)*

22nd November 2000
Scottish Hydrological Group meeting
"Applications of biogeochemical transport modelling in groundwater" – Andrew Barry (University of Edinburgh; Director of Contaminated Land Assessment and Remediation Research Centre)
Venue: Lecture Theatre A, James Clerk Maxwell Building, King's Buildings, University of Edinburgh
Time: 6.30 p.m.
Contact: Kate Heal *(see above)*

6th December 2000
BHS Southern Section meeting
"Bugs and beasties in water: the fate and transport of protozoic pathogens"
Venue: Imperial College, London
Time: 5.30 p.m. (tea at 5 p.m.)Contact: Dr Adrian Butler *(see above)*

13th December 2000
Royal Met Society meeting with BHS
"Extreme rainfall"
Time: 2 p.m.
Contact: Royal Met Soc *(tel 0118 956 8000, fax 0118 956 8571, web site www.royal-met-soc.org.uk)*

23rd January 2001
BHS National Meeting + CIWEM & ICE
"The EU Framework Directive"
Venue: ICE, 1 Great George St, London
Contact: Peter Midgley *(tel 01903 215835, fax 01903 215884, email peter.midgley@environment-agency.gov.uk)*

16th May 2001
BHS National Meeting
"Hydroecology of managed rivers"
Venue: University of Birmingham
Contact: Chris Bradley (0121 693 2888; email c.bradley@bham.ac.uk)

18th–21st June 2001
Groundwater quality 2001 (IAHS)
Venue: Sheffield University
Contact: Prof. David Lerner *(tel 0114 222 5743, fax 0114 222 5701, email gq2001@sheffield.ac.uk)*

The Meetings sub-committee is well advanced with planning a full programme in 2001 and plans to include meetings on LOIS, hydro-ecology of managed rivers and looking at the FEH one year on. Further details will be published in the November edition of Circulation.

Ralph Brown award

The RGS Ralph Brown award seeks to support a multidisciplinary research expedition associated with the study of inland or coastal wetlands, rivers or the shallow marine environment.

The value is up to £15 000, as part funding of an expedition, likely to involve extensive fieldwork, benefit the host country and involve its nationals.

Applications must be received by **30 November 2000**. For full information, contact the Ralph Brown Expedition Office, Royal Geographical Society, 1 Kensington Gore, London SW7 2AR *(email: grants@rgs.org, tel: 020 7591 3073, fax: 020 7591 3031, http://www.rgs.org/asptemp.asp?Page=9granral).*