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THE NEWSLETTER OF THE BRITISH HYDROLOGICAL SOCIETY

Circulation

Contents

Victor Appleby's 100th birthday

Call for nominations
Wanted: new Hon. Secretary, President Elect and two committee members

Hydrology in Scotland 2000
Report of the two-day conference at Dundee, 22-23 March 2000

Publications received

Easter floods: history?
Pennines Group meeting at Lancaster 9 February 2000

IH becomes CEH Wallingford

"Sustain flood hydrometry" – Government Minister urges
Press launch of the *Flood Estimation Handbook* at the ICE in London

News from members

Flood defence committee chairs

Obituary: Professor Eamon Nash

Second World Water Forum
The Hague, 17-22 March 2000

World Water Development Report

Postgraduate research in Scotland
Strathclyde University, 12 January 2000

Runoff changes in Scotland?

New members

BHS publications move north — while the web site moves south

ETNET and ETNET 21
European thematic network

Research needs for exploitation of weather radar in hydrology
Inter-Agency Report (abridged)

Recent meetings
Summary of some recent BHS meetings

Research grants awarded

BHS bursary to Exeter students

New committee member
Claire Keenan to represent ICE

Forthcoming meetings
Water environment 2000 — Dundee
Groundwater 2001 — Sheffield
Newcastle Symposium update

Diary of BHS and other events

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Victor Appleby at 100



Victor Appleby, the British Hydrological Society's oldest active member, celebrated his 100th birthday on 4th March. The occasion was marked by a lunch at Imperial College and, on behalf of the Society, President **Howard Wheater** presented Victor with a copy of "The Hydrology of the UK".

Victor obtained a first class degree in Civil Engineering from the University of Birmingham in 1923, and his MSc in 1924. His subsequent career included 17 years in local government, before he moved into contracting with W. and C. French, later becoming Executive Director.

Victor's first hydrological paper, "A general theory of storm water from urban areas" won an ICE Prize in 1934, and further publications followed in the 1930s, '50s, '60s, '70s and '80s. On reaching normal retirement age, he took the DIC in hydrology at Imperial College in 1964/65, and since that time he has pursued hydrological research as his primary interest. Most recently, he contributed to the discussion at the BHS meeting to launch the FEH in December 1999.

The respect in which Victor is held by the hydrological community was evident at his birthday lunch. Those attending included **Professor Jim Dooge, Professor Kieran O'Connor** and **Paul Johnston** from Ireland, **Dr Gabor Kienitz** from Hungary, **Professor Peter Wolf** (Victor's former mentor at IC), current and former IC staff, and a contemporary from his DIC class, **Terence Davies.**

Victor's enthusiasm for, and commitment to, hydrology has long been a source of inspiration to his friends and colleagues, and we wish him many more years of fruitful contribution to BHS events.

Howard Wheater
BHS President

Call for nominations to the BHS committee

Nominations are invited for the following BHS committee places:

Hon. Secretary (to serve for two years, starting from September 2000),

President Elect (taking over as BHS President in September 2001 for a two-year term),

Two **committee members** (to serve for three years from September 2000),

Plus one book review editor (***not*** a committee place, but desperately needed – please contact the editor).

Please consider whether you, or any member you know, could contribute to running your Society. The committee is friendly but businesslike and meets four times a year in London, with sub-committees now operating mainly by email/telephone.

If you want to know more about what the jobs entail, please ring the retiring Hon. Secretary (01228 710510), or talk to any of the committee.

Dr Peter D Walsh (BHS Hon Secretary)
Brackenbrae, Dalston, Carlisle, CA5 7AG,
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Hydrology in Scotland 2000:

Agenda for the 21st Century

Scottish Hydrological Group / BHS Conference
Dundee University, Scotland
22-23 March 2000

This successful Symposium, attended by approximately 150 delegates over the two days, provided a forum for lively discussion on the direction hydrological research and practice should be taking in the new 21st century.

I was able to attend *Hydrology in Scotland* with the aid of a BHS travel grant, and I presented a poster of my current PhD research into stochastic rainfall modelling.

Frank Law started the proceedings with a succinct set of questions that he thought the symposium should address. Together with the introduction to Scottish hydrology given by **Alan Gustard**, this provided a solid foundation for the remainder of the proceedings.

The most pertinent and interesting point to me, and one that was noted again and again by speakers, is that climate change can no longer be ignored. Alan Gustard mentioned it as an important issue even before the 'conference proper' started. This is in contrast to the last conference with the theme of Scottish Hydrology, held in Edinburgh in 1986, where 'climate change' was not referred to even once. Although some speakers acknowledged their own scepticism that 'climate change' is actually taking place, and not just an extended period of increased climatic variability, it was suggested by all that the need to plan for the eventuality of climate change has never been greater.

The main concern of Scottish hydrologists in terms of climate change appear to be the increasing rainfall totals in the west of Scotland, brought about by ever-increasing westerly weather types (especially in winter), which has contributed to the huge rise in flood events during the late 1980s and continuing today. Much research is currently being directed on this topic and was well presented by both **Terry Marsh** (CEH Wallingford) and **Andrew Black** (University of Dundee). The main consideration here seemed to be that longer records were needed. It was suggested that a common methodology for converting precipitation records into streamflow records at the catchment level was needed for a true comparison of historical data. The increased population living on flood-plains and increased public expectations of prompt flood warnings were also noted as contributory factors to the increased research on this matter. The political arena was further discussed by **P Wright** (The Scottish Executive) and **D C Crichton** (Association of British Insurers). An interesting point made by the insurance industry was that, as more data become available on the exact properties that will flood under extreme circumstances, insurance against flooding might become less widely available .

Lack of data was also cited as a problem in Scottish research. This related both to flooding, as most hydrometry is biased towards the measurement of low flows, and groundwater, where few data are available on quantity, drawdown or quality. Some interesting research being done by **Mike Cranston** (Dundee University) on linking radar-measured rainfall to gauged rainfall may provide a valid data source in this respect. The use of radar may become more prominent in the 21st century for the accurate forecasting of short-term high precipitation events that may lead to flooding.

The new EC Water Framework Directive, due to come into practice at the end of this year, was discussed in some detail. This has large implications for the water industry. It will provide tighter controls on pollution and it is hoped that it will improve standards of service, certainly in respect to abstraction control, water conservation measures, and the provision of actual 'duties' that must be undertaken. Present gaps in legislation mean, for example, that although SEPA is obliged to measure and record hydrometric information, it has no 'duty' to inform the public. **Professor Sue Walker** (Aberdeen University) suggested that we are gradually moving towards a local/regional/community approach to water management, one of 'local stewardship', and the Water

Framework Directive will enhance this change.

Generally, it was felt that a more proactive approach is needed in all areas of water management. Presently we employ a rather reactive stance. The Easter floods of 1998 in England, for example, providing the impetus needed for new hydrometric works and a review of methods of both flood forecasting and information dissemination among the public. This (unfortunately?) has not yet happened in Scotland. To enable a more proactive approach to be taken, it was felt that there was a need for an integration of methodologies, knowledge and different sciences. The phrase 'more holistic approach' was referred to many times, and maybe this should be the key element in the new agenda for the 21st century.

Hayley Fowler
University of Newcastle upon Tyne

Publications received

The following publications have been received and are kept in the CEH Wallingford library *(tel 01491 692266).*

Perhaps the most innovative is the proceedings of an IAEA symposium held in Vienna last May on "Isotope techniques in water resources development and management". It is published in the form of a CD-ROM containing PDF files scanned from the papers. The papers are indexed and searchable, but the quality of the illustrations is varied.

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Former BHS Hon. Secretary **Professor Chris Collier** (Salford University) is the author of WMO Operational Hydrology Report **No. 46**, 2000, **Precipitation estimation and forecasting.**

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Three more UNESCO IHP-V Technical Documents in Hydrology:

Statistical and Bayesian methods in hydrological sciences, a large volume based on the 1995 conference in honour of Prof. Jacques Bernier, *edited by E. Parent et al.*, No. **20**, 1998.

Groundwater recharge in low coral islands *by Ian White, Tony Falkland et al.*, No. **25**, IHP-V Theme 6, 1999.

Droughts in small coral islands: case study, South Tarawa, Kiribati, *by Ian White, Tony Falkland & David Scott*, No. **26**, IHP-V Theme 6, 1999.

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Other publications received include *Stromingen* Vol. 6, No. 1 from the Dutch Hydrological Society (NHV).

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Selected publications will be exchanged with those of the US Geological Survey.

Easter floods: history?

BHS Pennines Group meeting
Lancaster University
9 February 2000

Around 80 people attended this meeting, chaired by *Jonathan Cooper* of W.S. Atkins. Three papers discussed various aspects of the Environment Agency's response to the Independent Review, and their internal review, following the floods of Easter 1998. Two more papers described methods of flood inundation mapping, which is essential to assess areas at risk of flooding.

Actions in the North West

Ian Crozier (Environment Agency North West Region) described the extent and effects of the Easter floods of 1998, and the actions resulting. He said that the floods had been due to prolonged rainfall and wet antecedent conditions, and that the areas affected covered 5000 km^2 in England and Wales.

The floods prompted an independent review into the Environment Agency's performance, and the final (Bye) report published on 30 September 1998 identified the main problems. The Agency then produced external and internal plans for improvements to the flood warning service.

Four key areas for improvement were identified by the internal report: a programme of improvements to telemetry and hydrometry is ongoing and will be completed in 2002; all flood defences are to be inspected twice yearly, and structural surveys are to be carried out.

Public awareness was identified as a major area for improvement. A week-long national campaign in October 1999 is to be repeated this year. An indicative flood plain map database has been compiled, and flood plains are being categorised into high, medium and low risk areas.

A new flood warning service strategy, updated from 1986, was published in September 1999, and a new clearer system of flood warning codes will be published this September. Address data is being collated for high risk properties to allow direct flood warning.

Geoff Noonan asked what proportion of those affected by the Easter floods had been warned. Ian said the national aim was to warn 87% of those affected, but in this case it had probably been less than that. Peter Walsh (Bullen Consultants) stated that none of the occupants of the 2500 homes affected in Northampton had been warned.

Kevin Tilford (Salford University) asked for a comment on the performance of flood forecasting models. Ian Crozier said that one of the actions dealt with this, and that consultants were writing a specification to use them in a consistent way nationally. Kevin suggested that national consistency might not be appropriate, as hydrology varied, and Ian replied that a core framework would be used.

North West hydrometric works arising from the Easter floods

Rod Furnell (Environment Agency North West Region) talked about the hydrometric works resulting from the Easter floods actions. The Bye report indicated that the inadequacies of the telemetry network made flood forecasting for the Northampton area difficult. This had been recognised previously but had not yet been implemented, so a three-year programme of works had now been established nationally.

It was recognised that adequate raingauge coverage was needed, as well as gauging stations capable of measuring extreme levels or discharges, particularly upstream of urban areas. Historically, flood warning had relied on radio, but now telemetry is used and therefore flood-warning sites must be on the telemetry network.

The raingauge network was found to be in good order, but may be expanded. There had been a review of existing gauging sites, and many are being modified to ensure that they can operate under extreme conditions. New sites are planned and should be built by March 2002, subject to MAFF approval.

Steve Coup then talked about the experiences of the Central area project team. He described the type of work that is being done at existing stations, such as raising equipment above extreme flood levels, replacing gauge-boards, and ensuring that sites can be accessed safely during flood conditions.

The problems of working to a tight schedule were highlighted in a case study – the Ribchester gauging station – where objections to the formal planning procedures had delayed progress.

Andrew Grimes (Wheatwood Services) asked why there was only one flood zone in Cheshire. It was explained that historically just 33 zones in the North West were considered to require a service, and most of these were urban, but the number might increase soon.

Geoff Noonan asked why radio was no longer the main flood warning tool: Steve Coup explained that the radio licences were up for renewal, were expensive and were not guaranteed.

1999 indicative floodplain maps

Jeremy Benn (Jeremy Benn Associates) described the development of the 1999 Indicative Floodplain maps. In November 1998 the MAFF Minister, Elliot Morley, promised that floodplain maps would be delivered to Local Authorities by September 1999. As a result, the current programme had been accelerated and Jeremy Benn and Associates and PB Kennedy and Donkin were contracted to produce the maps.

The maps were required to show the areas at risk from 1-in-100-year fluvial and 1-in-200-year tidal events. They are to be used in development control by Local Authorities and the Environment Agency, and for flood warning and flood defence. The different requirements of the local authorities, the Environment Agency and the public were outlined.

Initially historical data, modelled data, local knowledge and interpretation, and the IH130 dataset were collated in digital form using OS raster maps. Various lines delineating the areas based on different information were drawn, and then the Environment Agency staff chose the appropriate areas or drew their own based on their knowledge.

After further checking, the maps were disseminated on eight CDs, each corresponding to one of the Agency's regions, with stand-alone software entitled 'Flood Explorer '99'. The maps can only be printed at A1 size, with warnings to avoid misuse of information. New versions of the maps with additional information and updated software will be released later this year.

The feedback has been varied, and significant legal issues have been raised. The maps provide a base point of coverage, and can be added to in high-risk areas. It was concluded that the project was a success: it had been completed early thanks to the efforts of many people in the Environment Agency, as well as those at Jeremy Benn and PB Kennedy.

In discussion, **Jonathan Cooper** said that he had used his CD and that the project had indeed been successful.

Uncertainties in flood inundation mapping

Barry Hankin (Lancaster University) presented a methodology for incorporating uncertainty into risk assessment, applied to flood inundation mapping for a floodplain in Sicily.

He explained that uncertainties in flood inundation mapping can arise from topographic knowledge, digital mapping, distributed roughness and subjective decisions made by the modeller. GLUE (Generalised Likelihood Uncertainty Estimation) is a method of incorporating these uncertainties into risk assessments.

Calibration of flood models is often based on historical flood inundation data, which can be matched by multiple models and parameter sets (termed 'equifinality'). Within the GLUE approach, rather than selecting one optimum, all models that give an acceptable level of process representation are kept, and weighted according to how they fit the data using likelihood measures.

The model used is based on the St Venant equations with mass and momentum conservation. 1000 Monte Carlo simulations were run, varying the roughness in the channel and the floodplain. Fuzzy methods were used to combine multiple constraints to give likelihoods for each simulation at each of the 17 water elevation measurement sites. At each water level site the acceptable predictions were arranged in ascending order and cumulative likelihoods were plotted, from which the 90 and 10 percentiles were cut off to provide prediction limits.

Renata Romanowicz (Lancaster University) showed how the method could be used to provide probabilistic maps of inundated areas, which could be updated as more data became available. She showed how she had applied the GLUE approach to a slightly different model using maximum inundation maps, gauged data, digital elevation data and aerial photos for three events on the River Colne in South Wales. Probability weights derived from previous events could be used to give inundation probabilities for the floodplain in a new event.

Public awareness and flood warning dissemination

Mark Tinnion (Environment Agency North East Region) spoke about the need to disseminate flood warnings to the public, a responsibility of the Agency since 1996. He said that warnings had to be received, believed, understood and acted upon.

He outlined various warning methods available. An automatic voice messaging system was used, but it was difficult to keep track of changes. He suggested that in the future a national warning system could be developed based on GIS and used for several types of emergency. Loudhailers and sirens were used in London and the North East, and in some areas flood wardens were responsible for knocking on their neighbour's doors to warn them. Blanket broadcasts could be used on radio and television, and the public could also phone 'Floodline' to hear recorded flood information.

He emphasised that there were many public awareness issues to be dealt with. Of the 1.6 million properties at risk, only 5% were aware. In the public awareness campaign information packs were sent to those at risk, and the blanket media coverage was good. However he suggested that future public awareness strategies should target those at risk more.

It was highlighted in the Bye report that the current colour-coded warnings are not understood. The new, easy-to-understand flood warning codes to be introduced in September were termed *flood watch*, *flood warning*, and *severe flood warning*.

The Environment Agency is also involved in the response to flood events. They would work closely with Local Authorities and the emergency services to produce Major Flood Incident Plans and test them.

Mark concluded that dissemination and emergency response were the biggest challenges, and that public awareness was vital.

Kathy Bashford
Lancaster University

For IH read CEH

The Institute of Hydrology name will not be seen much from now on. Since 1st April 2000, IH has become the specialist hydrology site of the Centre for Ecology and Hydrology, and is now known as CEH Wallingford.

The same high-quality research programmes in hydrology will continue to be carried out there, still under the wing of the Natural Environment Research Council. This is essentially a management change, and IH has been one of the four CEH institutes since 1994. The IH Director, Professor Jim Wallace, is now Director of Hydrology within CEH (as well as deputy to Professor Mike Roberts, CEH Director) and strong support for the Society will be maintained. In fact, BHS President Howard Wheater chairs one of the new research advisory committees.

Many members might mourn the passing of the name, but the quality and importance of the research go on.

"Sustain flood hydrometry" Minister urges

Published in the dying embers of the 20th century (December 1999), the *Flood Estimation Handbook*'s arrival was marked by a press launch on 23rd February 2000, hosted by the Institution of Civil Engineers.

ICE President and hydrological and hydraulic engineer extraordinaire, **Professor George Fleming**, welcomed the guests. He highlighted the extent to which engineers and planners look to the hydrologist for effective flood risk estimation in support of sustainable development – or sustainable change as Professor Fleming said it really was.

In declaring the *FEH* well and truly published, the MAFF Parliamentary Secretary, **Elliot Morley MP**, spoke of the advances in statistical analysis, computer science and digital terrain modelling that had made the new methods possible. He won warm applause from the guests (including the President of the British Dam Society, **Rod Bridle**, and BHS Officers **Howard Wheater** and **Peter Walsh**) for his closing remarks:

"Before I finish, I would like to make a particular point about data collection. This is one of those day-in-day-out activities that so frequently goes unrewarded. It is only when we realise what we can achieve with projects like this, based on the analysis of vast amounts of data collected over the years by many different authorities, that all that effort is appreciated. A key aspect of the new approaches is the reliance on ongoing collection of high quality river flow data throughout the UK. Because the best estimates will rely on reference to data for similar catchments, which may be anywhere in the country, all authorities will have a mutual benefit in maintaining and extending their river flow records. I would urge that this is not lost sight of in the face of other, short-term pressures."



On behalf of the Institute of Hydrology (now the Centre for Ecology and Hydrology Wallingford), **Professor Jim Wallace** thanked MAFF for their strong support for the research programme, and presented Professor Fleming and Mr Morley with numbered copies of the Flood Estimation Handbook.

Pictured at the launch are Prof. Jim Wallace, Elliot Morley MP, Prof. George Fleming and Dr Duncan Reed.

Peter D Walsh

News from members

Congratulations to BHS member **Thorsten Wagener**, who has won an outstanding student paper award for 'A generic rainfall-runoff modelling toolbox', which he presented at the American Geophysical Union Fall meeting in San Francisco last year.



This is quite an accomplishment, given that only 15 awards were made from the 307 student papers presented. Thorsten is employed at Imperial College working on a NERC-funded project, which is supervised by **Dr Matthew Lees** and **Professor Howard Wheater**. The aim is to develop a new approach to rainfall-runoff modelling for application to gauged and ungauged catchments.

Flood defence appointments

Congratulations to BHS member **Professor Roy Ward** (formerly of Hull University and now a hydrological consultant with particular interest in flooding and drainage problems) on his appointment as Chairman of the Yorkshire Regional Flood Defence Committee (RFDC).

Nick Brown, Minister of Agriculture, Fisheries and Food, has appointed people to chair the nine English RFDCs of the Environment Agency. Among the others are **Peter Bye** (Anglian), who chaired the Independent Review of the Easter 1998 Floods; **Peter Watts** (Severn Trent), a chartered engineering consultant, formerly with Yorkshire Water as Water Resources and Treatment Manager and then Regional Engineering Manager; **William Cutting** (Southern), former Managing Director of Southern Water Services, member of NRA Southern Regional Rivers Advisory Committee and past Chairman of the Water Industry Environment and Quality Committee, and **Mrs Jean Venables MBE** (Thames), a chartered civil engineer and consultant.

The appointments take effect from 1 July 2000 for three years.

Professor Eamon Nash

News has been received of the death of **Emeritus Professor Eamon Nash** of the National University of Ireland, Galway. He was a founding father of the original Hydrological Research Unit in Wallingford (later to become IH) and a great original thinker among hydrologists internationally.

His work on unit hydrograph theory will be cited for a long time yet. A formal obituary will follow in the next issue, but it seemed proper to share the sad news of his passing here.

Frank Law

Second World Water Forum

The Hague, The Netherlands 17-22 March 2000

The Second World Water Forum started with streakers on the stage during the Opening Ceremony and a number of other demonstrators in the hall, one suspended from the balcony by a rope. They disrupted the proceedings (graced by Prince William of Orange) and made them much more memorable than the usual staid affair. It turned out later that they were protesting against a dam in Spain and water privatisation. The Forum was the latest gathering on water in the series of largely United Nations conferences, which began with the UN Water Conference at Mar del Plata in 1977. The series continued with the International Conference on Water & the Environment in Dublin and UNCED in Rio de Janeiro in 1992, progressing to the First World Water Forum in Marakesh and to the Session on Water of the UN Commission on Sustainable Development, both in 1997. In 2002 there is likely to be a "Dublin plus 10" in Germany in advance of the "Rio plus 10" event.

Over 4500 people participated in the Forum, which was excellently organised by the Netherlands Government for the World Water Council. They represented the UN and its agencies, governments and their institutions, professional and scientific NGOs, development NGOs, water services bodies, conservation groups, manufacturers and a host of other interests from over 130 countries. The programme over the six days was divided between the Forum itself, a large exhibition (The World Water Fair) and a ministerial conference held on the last two days. The closing ceremony on 22 March also marked World Water Day.

Every day participants were able to select from some 20 parallel sessions, one or more featuring a different region of the globe. There were sessions on water use, sessions devoted to the interests of NGOs, gender, youth, local government and science, and sessions on special topics, such as water and space, water and globalisation and water and ethics. The largest hydrological presence was in the session on Scientists on Water and Knowledge, organised by Gordon Young (Secretary General of IAHS) in his capacity as Chair of the International Water Liaison Committee. Scientists and professionals were also involved in the sessions on water and history, groundwater, water in rivers and others. One of the most challenging topics was dams, addressed in several sessions, some resulting in heated arguments between the proponents and the opponents. The report of the International Commission on Dams, expected late this year, was eagerly awaited by both sides.

The Forum was also the platform for unveiling the results of the World Water Vision – an exercise that had been piloted by a Vision Unit, housed in the IHP Secretariat in UNESCO. Several parallel sectoral visions (e.g. the IUCN Vision for Water and Nature, and the Water Supply and Sanitation Collaborative Council's Water for People) were also presented. The Forum also saw the publication of the report of the World Commission on Water in the 21st Century and the launch of the Global Water Partnership's Framework for Action – how to achieve the vision for water. The Framework included development targets, such as at least a halving by 2015 of the number of people living in extreme poverty in the developing world. It included similar water targets; such as halving the number of people without hygienic sanitation by 2015, and estimates of the costs of achieving these targets. Over the period from 2000 to 2025 some $17 billion a year needs to be invested in sanitation in the developing countries, out of a total of $180 billion for water services as a whole. This is substantially more than the estimates made at the time of UNCED. As well as investment, the Framework also looked at effective governance, raising awareness, the role of women, managing floods and a number of other areas identified in the Vision.

Several of the sessions prepared statements, which were put to the ministerial session for consideration. Some of the concepts and arguments from these statements were later incorporated in the ministerial statement. This contained a number of sentiments somewhat similar to those in earlier ministerial meetings on water, but it also pledged more government attention to water, greater investment in services and increased awareness raising.

Questions may be asked about the value of the Forum, whether it contributed to progress in reducing poverty and in protecting lives. As with all such conferences, there are no simple ways of measuring whether it did any of these things. However, although there were few reports in the British press, it seemed to raise awareness of water as an issue, and it succeeded in securing the attention of some high profile people to do this, notably Prince William of Orange, the Crown Prince of the Netherlands, and Mikhail Gorbachov. Questions can also be asked about the involvement of hydrologists, particularly through IAHS and IAH, in the Forum, the Vision and the Framework for Action. Most would agree that the Water and Knowledge Session was very successful and attracted quite a lot of attention. Quite a number of hydrologists attended the Forum, but their impact appeared to be rather small on the Vision and Framework for Action, although the Vision depended heavily on the water resources assessment work of Igor Shiklomanov and the State Hydrological Institute at St Petersburg.

With this heavy dependence, it is a puzzle that there are so few references to the need to improve the reliability of hydrological and water-use data and scant mention of investment in hydrology. There is probably a need for hydrologists to be better organised in advance of the Third World Water Forum (to be held in Japan in three years time) in order to make a bigger input into world water affairs.

John C Rodda
President, IAHS

World Water Development Report

A six-page brochure was presented at the Second World Water Forum in The Hague to launch the *World Water Development Report*. This report will be produced by a UN world water assessment programme based at UNESCO's Division of Water Sciences in Paris.

An electronic copy of the brochure was circulated to the BHS mailbase in PDF format. If you would like a copy, please contact the IHP Secretariat, Division of Water Sciences, UNESCO, 1 rue Miollis, 75732 Paris Cedex 15, France *(tel +33 1 4568 4004, fax +33 1 4568 5811, email ihp@unesco.org).*

Postgraduate research in hydraulics and hydrology in Scotland

Scottish Hydrological Group and Scottish Hydraulics Study Group joint meeting Strathclyde University 12 January 2000

This half-day meeting was in two parts. The first session gave eight first- and second-year research students the opportunity to present their topics and the findings to date (see table below).

In the second session, introduced by **Robin Wardlaw** (Scottish Hydrological Group chairman), three students approaching the completion of their studies gave more detailed summaries of their research.

Donald McKay (Dept of Energy and Env Tech, Glasgow Caledonian University) presented his research entitled 'Detailed LDA studies of erosion control geomats'. Turf reinforcement geomats, used for environmentally aesthetic flexible embankment reinforcement and channel lining, have become fairly commonplace within the construction industry. The polymeric filaments of the mat are designed to protect the grass by providing an erosion resistant structure for the root systems. However the mechanisms involved at the fluid-mat interface have been poorly understood. Donald described his studies on a number of different mats using laser Doppler anemometry. He has developed a modified log-law profile with zero-plane displacement that predicted the water velocity- depth relationship. Donald suggested that this 'canopy' equation corresponded surprisingly well to those used by micro-meteorologists for the description of airflow over forest canopies. He hoped that his findings would enable an optimum size and structure for mats to be identified in the future.

Alistair Cargill (Dept of Geography, University of Dundee), presented 'Risk assessment for extreme floods in the UK: a heterogeneous approach'. His research has developed a new method of risk assessment based upon the heterogeneous nature of flood processes. Flood generating processes chosen by Alistair for detailed study were: snowmelt, seasonality, synoptic weather types, and floodplain controls which all operate to varying levels in terms of magnitude and frequency within the different UK regions and catchments. 162 station records from England, Wales, Scotland and Northern Ireland were used in POT analysis. Available POT series were updated to 1998. Alistair disaggregated the flood series according to flood generating characteristic. To identify snowmelt events he used a simple degree-day snowmelt model coupled with Met Office recorded snow depth data - the results of which were correlated to the POT series. Synoptic types were based upon the Lamb classification; and seasonality upon the four seasons. His regional analysis of snowmelt events suggested interestingly that the NE and Midlands of England had a greater proportion of snow related floods than anywhere else in the UK. When floods in general were related to synoptic patterns consistent regional pattern were apparent, however Alistair showed that this was not the case for the station maximum floods. Similarly the general trend in seasonality from the entire POT series suggested a clear tendency towards winter events, however the station maximum floods were less seasonally homogeneous. These findings, he suggested, confirmed the importance of accounting properly for heterogeneity within the analysis of the more extreme flood events. The use of a 3-parameter Generalised Pareto Distribution gave results from the component series that improved the return period estimates for the maximum recorded floods. Out of the 162 catchments studied the analysis suggested that, 123 sites could be improved in terms of extreme modelling, and that the maximum recorded flood return period should be decreased in 55% of these cases.

During the questions **David Price** (Babtie Group) queried the prevalence of snowmelt related floods in the Midlands and North-East of England. Alistair agreed that it was surprising and suggested that it could be a combination of both snow abundance and the likely occurrence of climatic conditions that lead to high melt rates. **Tim Jolley** (SEPA) questioned the suitability of using seasonality as a flood generating mechanism. He also asked if the reduced number of events available to the individual analyses compromised the confidence one could place in the distribution fits, and also whether Alistair had obtained comparable results using suitable multi-model distributions. From his experience Alistair felt that, although there was a balance between number of data points and the associated uncertainty in the analysis, the disaggregation method remained useful. He had not compared the results of any multi-model distributions to his results. Robin Wardlaw (University of Edinburgh) asked if an approach such as described in the new Flood Estimation Handbook could benefit from including heterogeneous analysis. Alistair thought that it could benefit FEH pooling group selection.

The third presentation was by **Kampanad Bhaktikul** (University of Edinburgh) and was entitled 'Application of a genetic algorithm to water allocation in an irrigation canal system'. He described an optimisation approach based on genetic algorithms for the real time allocation of irrigation water supplies. Kampanad explained that previous objective functions solved by quadratic equations could be computationally bound for large systems. However the genetic algorithm approach used and developed during the course of his research had proved to be very flexible and relatively easy to set up for a large range of both linear and non-linear objective functions. He finished by describing how he had successfully applied the system to an irrigation system in Bali.

Yusuf Kaya (Scottish Hydraulic Study Group chairman) summed up at the end, and thanked **Steve Wallis** (Heriot-Watt University) in particular for his hard work in setting up and organising what had proved to be a very successful event.

David Price
Babtie Group, Glasgow

Student	University	Presentation title
Telemachus Koliopoulos	Strathclyde	Landfill gas management – modelling and risk analysis
Nick Burke	Heriot-Watt	Travel times in semi-urban streams
Eliane Guiny	Glasgow	Fish pass at weir and barrage
David Mayne	Edinburgh	Finite element modelling for cohesive sediment transport
Simon Neill	Strathclyde	Tidal fronts in the Tay Estuary
Nik Nadia Hussin	Heriot-Watt	Offshore hydrodynamics using nonlinear strip theory
Herve Morvan	Glasgow	Modelling of flood channel facility series B in 3 dimensions
Alasdair Hardie	Edinburgh	Modelling soil water regimes and Mn/Fe movement in Scottish upland soils

Runoff changes in Scotland (?)

In common with many hydrologists, I often prepare mass plots or other analyses to investigate the possibility of trend in data. These usually produce either a "no trend" conclusion or are inconclusive, and are accompanied by the hydrologist's perennial wish for more data.

However, in the course of recent work for East of Scotland Water I came upon a single mass plot that might form a textbook example (Figure 1): the slope changes abruptly by more than 40%. A change in rating curve was the immediate suspect, but analysis for other stations on the same river, and one in a nearby catchment, showed remarkably similar results. In each case, the change of slope of the mass plot occurred at about the beginning of 1977 (Table 1). Two of the stations have records from before 1968: these suggest that runoff before that date was at a similar rate to that from 1977 onwards, although the length of record before 1968 is too short to allow this to be stated with great confidence. It is also important to remember that the identification of changes/trends is often sensitive to the exact period of data used, and the periods of record available are relatively short.

Table 1 Changes in average recorded runoff

Gauging station		Mean annual runoff (mm)		Increase	
Number	Name	1968-76	1977-98	mm	%
021030	Megget Water at Henderland	1090[a]	1389[b]	299	27
021034	Yarrow Water at Craig Douglas	885[a]	1259[b]	374	42
021020	Yarrow Water at Gordon Arms	924	1203[b]	279	30
021011	Yarrow Water at Philiphaugh	781	1032[b]	251	32
021017	Ettrick Water at Brockhoperig	1267	1705	438	35

[a] 1969-76 [b] Naturalised for the effect of Megget Reservoir from April 1982 onwards

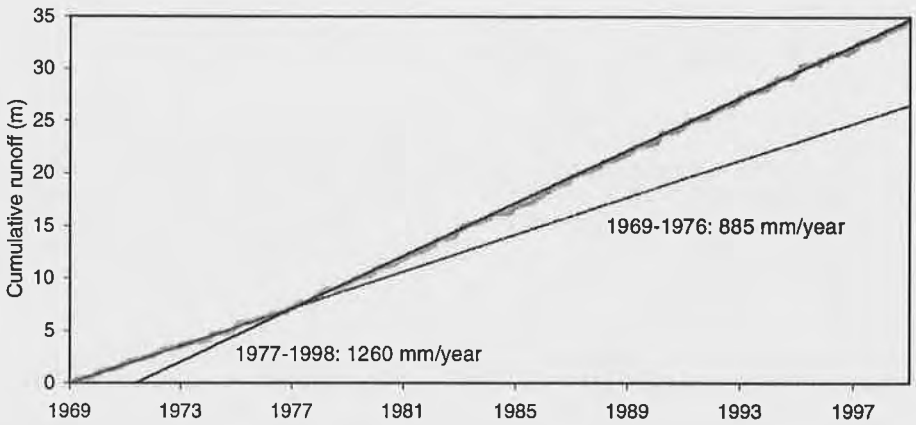


***Figure 1** Single mass plot for the Yarrow Water at Craig Douglas*

The early 1970s are known to have been a generally dry period in southern Scotland (indeed exceptionally so in the long Edinburgh rainfall series), but lower rainfall does not appear to provide a sufficient explanation. In the Henderland catchment, for example, average rainfall increased by about 110 mm, only just over a third of the increase in runoff. Has anyone seen this sort of change in other data? Does anyone have a hydrological explanation? As well as the interest in understanding catchment response, the data are important because the 1970s generally provide the critical drought for reservoir yield assessment in Scotland. If some error in the data were to be identified, there could be significant implications for reservoir yields and consequently the need for further resource development.

I am aware that various researchers, including Alan Werrity (*Circulation 57*), have reported increasing runoff in Scotland. However, the abruptness of change illustrated here is perhaps an additional angle on the subject. I am grateful to staff at the National Water Archive, SEPA and ESW for providing data and supporting information.

Peter Ede
Mott MacDonald

New members

We welcome Professor George Fleming (ICE President) as an Honorary Member of BHS. We also welcome these sixteen new members to the Society:

Paul D. Bates ..... School of Geographical Sciences, University of Bristol
Dr Chris Fawcett ..... Hydro-Logic Ltd, Bromyard, Herefordshire
Andrew B. Frost ..... Lancaster University
David P. Harvey ..... University of Bristol
Dr Richard Kelly ..... Birkbeck College, University of London
John A. Langley ..... Godalming, Surrey
Kelvin J. Limbrick ..... Centre for Ecology and Hydrology, Wallingford
David A. Luckhurst ..... School of Applied Sciences, University of Wolverhampton
Graham P. McLelland ..... Environment Agency, Brighton, East Sussex
Sue Moore ..... Swanage, Dorset
Alastair M. Morrison ..... Redhill, Surrey
Edward J. O'Brien ..... School of Geography, University of Leeds
Linda M. Pope ..... National Centre for Risk Assessment and Options Appraisal
Christopher R. Print ..... London
Gavin L. Robbins ..... University of Salford
Michael J. Thorn ..... Baldock, Hertfordshire

Publications move north

The Society's publications will now be administered and sold from Dundee University, under the supervision of Committee Member **Dr Andrew Black**. Please tell Andrew in good time if you want a selection of BHS publications for a meeting.

Thanks go to **Jenny Reddaway** at Salford for doing this job previously.

Web site moves south

The Society's web site has moved from Salford (where it was first set up by Kevin Tilford) to London, where it is now administered by **Matthew Lees** at Imperial College. Matthew has set up this new web address (though links from Salford's site will be maintained):

www.hydrology.org.uk

ETNET and ETNET 21:

The European thematic network of education and training for environment-water

Rise and decline of networks

Networks have been a fashion for many years. The European Commission introduced the concept in 1987 into several of its education, training and research programmes (ERASMUS and its successor SOCRATES, COMETT and its successor LEONARDO, TEMPUS, MEDCAMPUS and ALFA in the field of education and training; the 4th and 5th Framework Programmes in the field of research and development).

The general aim of a network is easy to understand, but less easy to implement and very difficult to sustain. Bringing together interested people around a given theme for developing specific activities is straightforward if benefits for the network-participants are available and visible. Societies (such as BHS) or associations (such as IAHS) have a long tradition in networking and building upon a strategy of facilitating, promoting and dissemination. Everyone recognises how much is needed to run these activities. Once financial support is needed for implementing the activities, one runs the risk that the network will operate only as long as the (generous) funding is available, and then fail to be sustained if the finance decreases.

An example is TECHnology for WAter REsources (TECHWARE), a European not-for-profit association of universities and enterprises for organising training and professional development with a European dimension through EC funding. It has successfully organised some 500 student training placements throughout Europe. The funding was generous between 1990 and 1995, but gradually decreased under the subsequent LEONARDO programme. Membership support will not sustain its development, even though universities and enterprises are interested in continuing its activities at a European scale.

The SOCRATES Programme for higher education introduced the "institutional contract" scheme for student and staff mobility amongst European universities in 1996. It thereby lost the strong networking advantages of the former ERASMUS ICPs (Inter University Cooperation Programmes), based on disciplinary fields and using decentralised management through a coordinator — e.g. the ICP "Hydrology and Water Management" from 1989 to 1997 was one of the largest ERASMUS networks, responsible for 372 student movements and 78 staff movements among 47 university departments in 14 countries.

SOCRATES thematic networks

The EC was conscious of the danger of losing the networking spirit, which had flourished through the ICPs, and initiated its SOCRATES Thematic Network Projects (TNPs) or "university co-operation projects on subjects of common interest". They aim to create fora to study the status of development of the disciplinary fields concerned, to promote the European dimension and innovation and to improve the quality of education and training in a domain.

It must be stressed that TNPs are *not* meant to operate for mobility, curriculum development, etc: they are "think-tanks" for future developments and projects to be funded through other EC programmes.

ETNET 1996-1999

While there had been 2700 ICPs, only 34 TNPs in broad fields of interest were funded in the period 1996-1999.

It was an interesting negotiation to have a TNP for water accepted in 1996: a compromise was reached and the network was finally called ETNET. ENVIRONMENT-WATER.

It had five Specific Projects (SPs), each with its own "Team Leader" gathering a total of 177 academic partners from 108 departments/ universities and 22 non-academic partners in 22 countries. ETNET's objectives, its activities and outcomes have been published in two General Reports and some specific publications, all available from the co-ordinator (avdbeken@vub.ac.be) and on the web http://etnet.vub.ac.be (with updated list of all partners, e-mails, web sites).

ETNET's summit was the Paris International Symposium, "The Learning Society and the Water-Environment" in June 1999. The Proceedings of this Symposium have been published by the EC-DG Research in March 2000 (*A primer with respect to collaboration between DG Education and DG Research*, 512pp, ISBN 92-828-8308-6).

Other outcomes of ETNET include the consolidation of the European Engineering Graduate School Environment Water (EGW), offering high-level short courses, mainly aimed at PhD training.

ETNET 21

Following discussion at the International Symposium in 1999, an application for a renewal (called ETNET 21 for ENVIRONMENT-WATER) was submitted in March, subtitled "The relationship between education and research within a perspective of life-long learning".

ETNET 21 focuses on the relationship between the learning processes, methods and tools, and research and technological development (RTD) in the broad domain of environment-water, to enhance the transfer of new knowledge and skills into higher education, including professional development, in a perspective of life-long learning.

Analysis of obstacles to effective transfer activities and study of new technological tools, are being developed during three years through five interlinked Specific Projects (SPs).

The outcomes of ETNET 21 are specific study reports and general reports with recommendations/best practice guides, also disseminated through the KeyWATER/ETNET website at http://etnet.vub.ac.be .

ETNET 21 builds upon existing networks and creates new synergies between the educational, scientific and professional communities in the environment-water domain.

The core partners include the Vrije Universiteit Brussels, IHE in the Netherlands, the University of Bristol, the European Regional Division of the International Association of Hydraulic Engineering and Research (IAHR) and the UNESCO IHP.

The whole ETNET 21 network is represented in 26 countries by 71 institutions or organisations, including 108 departments or laboratories with 121 contact-persons.

Interested in joining?

ETNET 21 is an inclusive network for all institutions of higher education, continuing education, associations, companies (service or manufacturing), public authorities and research institutes.
To join, a "Letter of Intent", signed by the head of the organisation and naming the contact person(s), should be sent to the co-ordinator of ETNET 21: Prof. A. Van der Beken, Chair of Hydrology and Hydraulic Engineering, Vrije Universiteit Brussel (VUB), Pleinlaan 2, B-1050 Brussels, Belgium, Fax: 0032 2 629 3022, Email: avdbeken@vub.ac.be

Since the SOCRATES Programme supports only a percentage of the total budget of the project (ETNET 21 will run from 1 September 2000 to 31 August 2003), a contribution is expected of all partners, as a token of their active interest in the project, by subscribing to the ETNET/KeyWATER website and its weekly LATEST NEWS. Subscription fees depend on the GNP per capita of the country. Full details are under SUBSCRIBER in the homepage http://keywater.euro.net.

Welcome to ETNET 21!

Research needs for the operational exploitation of weather radar in hydrology

Inter-Agency Research Committee for Hydrological Uses of Radar Data* (edited by Prof. C. G. Collier)

Both the Met. Office and the Environment Agency require precipitation data, and have sought to quantify their needs in terms of resolution and accuracy. The demanding needs of urban hydrology (river and sewer operations) have also been considered. Weather radar offers the only way of obtaining precipitation data over wide areas from a single location in near real-time.

Over the last 30 years substantial progress has been made in developing real-time quality control techniques, accuracy improvement and assessment and providing very short period rainfall forecasts (a few hours ahead). But there remains a lack of confidence in radar measurements on any single occasion, and further work has been identified in order to improve data quality and user confidence.

Both science-based and near-market research is needed: one specific topic is the development of a mobile research radar. Synergy between university and Agency research is important and a costed research programme is proposed.

What data do hydrologists need?

The Met. Office uses precipitation data (which includes rainfall, hail, graupel and snowfall) in association with other meteorological data to provide weather forecasts and a wide variety of other services. This requirement is embodied in the recent Met. Office/Environment Agency agreement, and the Agency's need for precipitation data is integrated into the same agreement. These data are needed for flood warning and water resources management, specified in terms of spatial, temporal and accuracy needs for both rural and urban areas. Also included are research and commercial requirements, including the need for real-time control of combined sewer systems. The hydrological need is to know the location/area of precipitation for actual and forecast events over a range of timescales.

Most of these requirements are only likely to be met by weather radar data, because accurate, reliable measurements and forecasts are needed over a range of space and time. Urban hydrology (river and sewer operations) is particularly demanding, calling for accurate measurements and forecasts over a few minutes and areas of a few kilometres.

What can radar offer?

Weather radar can supply measurements of the four-dimensional backscattered electromagnetic radiation from hydrometeors (raindrops, hailstones, etc.) from a single location, over a wide area, in nearly real-time. Doppler radars also measure hydrometeor motion away from or towards the radar. These measurements can be converted to rainfall or snowfall amount using climatological formulae to relate radar reflectivity (Z) to rainfall/snowfall (R), and/or a range of adjustment algorithms based upon vertical profiles of reflectivity measurements and/or independent measurements provided by raingauge networks.

There is, as yet, no commonly accepted procedure for carrying out this adjustment, although use of the vertical reflectivity profile in some way is now more or less accepted as being necessary. Nevertheless, the range of error characteristics exhibited by these algorithms is substantial, and is discussed in the detailed paper.

Weather radar data can very easily generate estimates of precipitation over areas from a few hundred m^2 up to hundreds of km^2, and duration from seconds to days and even months. Indeed, all commercial radars offer digital output data, and extensive product generation software packages, and radar output is shown routinely in television weather forecasts.

Developmental pathways to reach where we are now

Radar was developed during the Second World War to detect aircraft. It was soon realised that the "clutter" on radar displays was usually due to weather (rain and snow). After the war there was considerable research effort to improve theoretical understanding of radar, and to use radar data as a tool for cloud physics research. However, it was only in the early 1960s, with the availability of digital communications and relatively cheap computers, that radar networks were considered practical. At the same time, people began to explore radar's ability to measure precipitation quantitatively.

The Dee Weather Radar Project in the late 1960s led in 1975-76 to the North West Radar Project and the first operational unmanned weather radar in the world. This C-band radar was funded jointly by the Water Industry, MAFF and the Met. Office. Its success led to the installation of a network of similar unmanned radars covering a large part of the United Kingdom.

Data from this network satisfy many of the needs of the Met. Office and the Environment Agency, but flood warning needs to be extended to rivers in urban areas where flood forecasting is difficult to achieve.

It was soon recognised that network radars needed to be complemented by radars of limited performance providing detailed information over specific areas. North West Water, the University of Salford and McGill University, Canada, embarked upon a research programme to install a C-band radar on the western edge of the Pennines at Harrop Edge, later relocated near Warrington, and further investigation of the utility of the data was undertaken by United Utilities and the University of Salford.

In parallel with these networks, the Met. Office developed a network processing system centred on Bracknell, providing radar composite products and very-short-range forecasts of precipitation. The FRONTIERS forecaster-computer interactive system became operational in 1986. This led on to the development of the new Nimrod system and later GANDOLF, which has now been combined with Nimrod.

The Met. Office and the Agency are developing a strategy to secure and enhance the operational weather radar network in England and Wales. Research continues into performance levels of radar for measuring precipitation, focused on the world class S-band Chilbolton research radar operated by the Rutherford Appleton Laboratory.

The Doppler facility, first investigated in 1953, is now standard on weather radar systems (e.g. Cobbacombe and Clee Hill). Whilst the Met. Office have undertaken some investigation of the utility of wind measurements from Doppler radar, more work is needed to confirm its operational contribution.

Current performance of weather radar for measuring precipitation

[This section describes sources of error]

In spite of the problems, **radar remains the only technique for providing detailed precipitation information over wide areas in real time.** The importance of particular errors depends upon the type of measurements and the type of rainfall.

Many problems related to bright-band and range dependency are in fact

* This is a shortened version of the report. For the full version contact Prof. Chris Collier (tel 0161 295 5465, fax 0161 295 5465, email c.g.collier@salford.ac.uk)

problems of measuring the vertical profile of radar reflectivity. This realisation has enabled progress towards better quality real-time radar data without the need for raingauge data.

Why has radar not been comprehensively used for operational flood forecasting?

Although radar can provide detailed measurements of precipitation from a single location in real-time over a river sub-catchment, there has been a reluctance by many hydrologists to use such data quantitatively, mainly because of the uncertainty in rainfall estimates from radar generated by the unusual and varying error characteristics. Hydrologists are uncertain of its reliability, particularly at critical times, when river levels are reaching bankfull and warnings have to be issued.

Part of the uncertainty comes from a lack of understanding of the quantitative range of a weather radar. In general measurements are much less reliable beyond 75-100km., and a substantial area of the UK lies beyond this range from any of the radars.

It is sometimes not of appreciated that a sparse raingauge network can provide measurements with significant errors too. Raingauges often do not represent the rainfall beyond a small area around the gauge site.

Over the last few years there has been increasing emphasis on forecasting for catchments with rapid response times. These may be both rural "flashy" catchments, sometimes ungauged, or urban combined sewer systems. This has shown the need for radar measurements over small areas at high resolution in time and space. Such measurements need to be of the highest accuracy possible if hydrologists are to rely upon them for the real-time control of urban drainage systems and for urban flood forecasting.

Gaps in our knowledge

The NERC-funded HYREX Project, focused on the River Brue catchment, established an important dataset, but there remain gaps in our knowledge, which Professor David Newsome listed in his report to the Inter-Agency Committee outlining the need for further work.

Where do we go now?

The Met. Office and the Environment Agency together have generated a strategy for the future development of the operational C-band radar network. This recognises the requirements of the Water PLCs, but does not cover their specific requirements. It does note the research needed to improve precipitation data: many of these requirements can only be met using weather radar.

Both *science-driven* and *applications-driven* research are needed.

Professor Newsome recommends a mobile research radar system usable in a range of hydrological environments. with the Water Industry significantly involved in its use.

Synergy between Agency and university research

This research programme needs the expertise of government agencies (Met. Office, EA, SEPA, Water PLCs) and university research groups. The synergy from bringing together both approaches can be very productive and further development of weather radar in the UK needs to provide the right conditions to spark this synergy with stable funding over 3-4 years.

The final sections outline the budget (£3M) and how money should be targeted, the overall objective being "To use weather radar information better for water management in and around urban areas".

Recent meetings

About 80 people attended the National Meeting on *Flood forecasting*, held on 28th March in Bristol. It was very successful, with good presentations and a positive and lively debate, to be published in a BHS Occasional Paper.

The Southern Section's meeting at the Institute of Hydrology on 15th March (organised jointly with CIWEM) was also well attended: over 70 people took part in a wide discussion on water resources. **Matthew McCartney** (IH) presented work on freshwater ecosystems management, which had arisen from the first World Water Forum in 1997. **Chris Hines** (Surfers against sewage) described ten years of research, lobbying and media campaigns to raise awareness of untreated sewage discharges. This led to a stimulating debate on the roles of environmental pressure groups and methods of cost-benefit analyses for decision making in wastewater treatment.

About 60 people attended the Scottish Hydrological Group's meeting on 17th February in Edinburgh, focussing on the changing organisational framework in Scotland. Peter Ede described the North of Scotland Water Resources Study; Jim O'Connor and Nigel Goody spoke on surface water yield assessment and operational reliability in Scotland and Northern Ireland.

World Water Day (22 March) was marked in the Netherlands *(see p. 6)*, but the ICE also organised an event in London, attracting 160 schoolchildren: this included a boat trip on the River Thames, speakers from Thames Water and Ove Arup and presentations at the Institution.

Research grants

Research grants on topics of interest to hydrologists have been awarded as follows (from the BGRG Newsletter):

Glasgow University: Dr Drummond *et al. "Integrated water resource management for important European lakes and their catchment areas"* 270000 euros from the EU.

Leeds University: Dr P. Chapman, *"Application of catchment scale data to the quantification of soluble organic and inorganic nitrogen fluxes within and from UK upland soils."* £177099 from NERC.

Leeds University: Prof Mike Kirby, *"Pan-European soil erosion risk assessment"* 232835 euros from the EU.

Leicester University: Prof T. Parsons *"A new conceptual model for understanding and predicting erosion by water from hillslopes and catchments."* £200546 from NERC.

Kings College, London: Prof S. Lane *"Application of large eddy simulation for understanding natural river flows."* £151230 from NERC.

Southampton University: Prof Paul Carling* *"Modelling sediment level in spawning gravels"* £199329 from MAFF.

End-1999 awards under NERC's Global Nitrogen Enrichment (GANE) Thematic Programme can be found at http://www.nerc.ac.uk/awards/gane.htm Awards from NERC for lowland permeable catchment research (LOCAR) are eagerly awaited.

Frank M Law

***Prof Paul Carling** has moved from Lancaster University to the Geography Dept at the University of Southampton.

BHS bursary

The Exeter University bursary scheme was set up following the successful BHS international conference there in 1998. This year two awards from the scheme (£250 each) are going to PhD students in the Geography Department: **Julie Carton** and **Aly Walsh**.

Julie will present a paper (based on her PhD research) at an International Symposium in Canada on the role of erosion and sediment transport on nutrient and contaminant transfer.

Aly is looking into the impact of

global climate change on stream water temperatures, and will be attending the Inter-Celtic Colloquium in Aberystwyth to learn more about environmental change impacts on hydrology and water resources in general.

New committee member

Welcome to **Claire Keenan** (University of Strathclyde), recently appointed to represent the Institution of Civil Engineers on the BHS Committee.

FORTHCOMING EVENTS

Meetings

CIWEM/ICE Water Environment 2000: FLOOD WARNING & MANAGEMENT
5 October 2000
ICE, London

This conference aims to bring together the best methods and practice so that professionals in flood warning and management can address the questions that will be asked during the coming millennium.

CIWEM and ICE, in conjunction with co-sponsors British Water, have put together a range of papers on climate change, catchment and shoreline management strategy plans, flood alleviation, flood forecasting, flood warning and case histories of strategy plans, flood alleviation schemes and flood events.

For details contact Erica Hammond, Terence Dalton Ltd, 47 Water Street, Lavenham, Suffolk CO10 9RN *(tel: 01787 249290, fax: 01787 248267, email:erica@lavenhamgroup.co.uk).*

GROUNDWATER QUALITY 2001
3rd International Conference
18–21 June 2001
Sheffield

This research-based conference, sponsored by IAHS and IAH and run by the Groundwater Protection and Restoration Group at Sheffield University, will discuss the newest understanding of natural and enhanced restoration of pollutants in groundwater and soils. It will address the physical, chemical and biological sciences in the subsurface context.

Papers are welcome on any research-based topic within the overall theme. The scientific committee will all give invited talks on recent research and topic overviews, and further oral presentations will be selected from the abstracts submitted. There will be no parallel sessions. The oral presentations will finish early each day (before we are all too tired) to leave time for well-run poster sessions with refreshments, intended to offer serendipitous opportunities for discussions with others on the topics that interest you most.

Abstracts are invited (200 words) by **10 September 2000**, indicating your preference for oral or poster presentation. Acceptance will be notified by 30 November; a short camera-ready paper and registration by one or more authors is requested by 31 March 2001. A refereed IAHS Red Book will be published after the conference.

For details please contact Prof. David Lerner *(tel 0114 222 5743, fax 0114 222 5701, email gq2001@sheffield.ac.uk)* or see the website at www.shef.ac.uk/~gq2001/

Newcastle symposium

Professor George Fleming (President of the ICE), who has accepted honorary membership of the Society, will be the guest speaker at the President's Dinner on *7th September* during the Newcastle Symposium.

Professor H V Gupta from the University of Arizona has been invited to give the Penman Lecture.

Diary

14th June 2000
BHS Southern Section meeting
"Rehabilitation of the Rivers Darent and Kennet"
Venue: Imperial College, London
Time: 17.30 (tea at 17.00)
Contact: Dr Adrian Butler, Dept of Civil Engineering, Imperial College, London *(Tel 0171 594 6122, Fax 0171 594 6124, e-mail a.butler@ic.ac.uk)*

14th June 2000
CIWEM North Western & North Wales
"Water resources planning in NW England / catchment management in Tallin, Estonia"
Venue: Isleworth
Contact: J Wotherspoon *(tel 01256 461161)*

21st June 2000
BHS Southern Section
Field visit to the River Darent
Contact: Dr Adrian Butler *(see above)*

27th June 2000
BHS National Meeting (full day)
"Water resources plans"
Venue: ICE, London, 10.30 for 11.00
Contact: Prof. Sue Walker *(tel/fax 013397 41619, email susan.walker@abdn.ac.uk)*

3rd–7th July 2000
IAHS/BHS 2nd Inter-Celtic Colloquium
"Water in the Celtic world: managing resources for the 21st Century"
Venue: University of Wales, Aberystwyth
Contact: Dr J.A.A. Jones *(tel 01970 622595, fax 01970 622659, email jaj@aber.ac.uk)*

5th–7th July 2000
MAFF Conference of River Engineers
Venue: Keele, Staffordshire
Contact: Monica Henry *(tel 0207 238 6742, fax 0207 238 6665)*

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)*

5th October 2000
CIWEM/ICE Water Environment 2000:
"Flood Warning & Management"
Venue: ICE, 1 Great George St, London
Contact: Erica Hammond *(see Meetings)*

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

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