THE NEWSLETTER OF THE BRITISH HYDROLOGICAL SOCIETY

Circulation

No. 35 August 1992

Fourth National Hydrology Symposium

CARDIFF

Call for Papers

13–16 September 1993

The Fourth National Hydrology Symposium provides an opportunity for members to come together to discuss current and future issues of national and international concern in hydrology.

The underlying theme is the imbalance between water resources, water supply methods and demand.

Within this theme, topics which may be addressed include effects of land use on resources, optimising resource use, hydrological implications of large-scale transfers, strategies for cost-effective distribution, climate change effects on resources and demand, and the water quality and environmental implications of all these topics.

Papers will also be considered on other themes in mainstream hydrology where significant advances have been made. Obvious examples are data management systems and software. There will also be a slot devoted to that perennial favourite, extreme events.

The involvement of the British hydrological community worldwide means that papers need not be restricted to UK experience, but excessive reference to Wales is unlikely to impress the organisers.

Preference will be given to papers on current or recent work, especially where the interpretation of results is likely to stimulate heated debate.

Abstracts of approximately 500 words should be submitted by **30 November 1992** to **Jim Blackie**, Institute of Hydrology, Crowmarsh Gifford, Wallingford, Oxon, OX10 8BB. Tel.: 0491 38800; Fax: 0491 32256.

Prospective authors will be notified about selection in January 1993 and completed papers will be required by **31 March 1993**.

Symposium programme

The venue is the School of Engineering at the University of Wales, Cardiff.

Registration and a reception on Monday 13 September will be followed by 2½ days of presentations, a dinner and hydrological games, culminating in an optional afternoon field trip to the Cardiff Bay scheme on Thursday 16 September.

Full details will be given in *Circulation 36*.

An exhibition will be mounted throughout the Symposium. Enquiries about exhibition space — and offers of sponsorship — should be addressed to **Rob Drayton**, Wallace Evans Ltd, Plymouth House, Cardiff CF6 2YF. Tel.: 0222 704321; Fax: 0222 709793.

BHS MEMBERSHIP SURVEY

Results of Analysis of the Questionnaire Responses

The results of the first survey of BHS membership has been analysed and scrutinised exhaustively. The questionnaires sent out in July last year have been subjected to the most rigorous analysis using well tried and tested statistical modelling techniques. After very many man-months input, the deterministic model developed specially for forecasting trends in membership behaviour has proved conclusively that the response to the survey was a VERY RARE EVENT INDEED! But, what does it all mean?

Some very interesting statistics are revealed in the analysis of the 22 questions carefully compiled by your current President to show exactly the 'who, what, why, wherefore and how many times' answers that should, we hope, enable the BHS Main Committee to improve planning of future activities, and indeed influence the very role of the Society in the future.

The completed questionnaires are being retained for the time being and will be further analysed as needs arise in the future.

MEMBERSHIP STATISTICS

The overall response from the Society's membership to the Questionnaire was encouraging with 358 forms returned out of a total of about 620 sent out: this is equivalent to 58% of the membership. Over 90% of the respondents were UK members, with a very welcome response from 32 overseas members; some UK members completed the forms whilst working overseas.

95% of the forms returned were from Full Members; the few replies from student members may reflect a reluctance by novice hydrologists to express opinions, give information or get involved in BHS activities.

The age profile of respondents shown in Figure 1 shows that 62% of the respondents fell within the two age groups 30-39 and 40-49 years, confirming the view that the Society's most active and opinionated members are experienced hydrologists, with younger members having much less involvement. A notable group was formed by the over 60s (the 'elder statesmen') who comprised 8% of the respondents, many of whom were retired.

PROFESSIONAL QUALIFICATIONS & AFFILIATIONS

Several questions were targeted at discovering more about the qualifications of hydrologists and of their affiliations to other Institutions and professional bodies.

Primary Qualification

The primary qualification for most Hydrologists 20 years ago was undoubtedly a Civil Engineering degree or equivalent. The analysis of qualifications presented as Figure 2 confirms the trend in recent years towards acceptance by employers of non-engineering qualifications. A Civil Engineering degree or equivalent remains the one qualification held by the largest number of members, but 61% of the respondents held a non-engineering primary qualification, such as (in order of group size) Geography, Environmental Sciences, Geology, Mathematics and Natural Sciences.

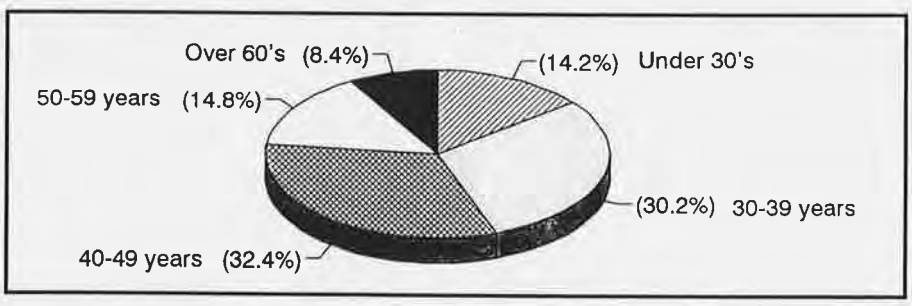


Figure 1 *Age group of respondents to BHS Membership Survey*

Postgraduate Qualification

A very high proportion of respondents, over 40%, claimed a relevant post-graduate qualification or to be currently attending a course. Engineering Hydrology or Water Resources Engineering/Management courses are by far the largest training ground for the professional hydrologist, with a proliferation of PhDs and research degrees on a multitude of subjects.

Professional Affiliations

The list of accredited professional affiliations held by respondents is impressively long and diverse. It is overwhelming dominated by two Institutions - IWEM with 144 members and ICE with 118 members. Other notable affiliations, each exceeding 20 members, are to the Geological Society, the Royal Geographical and Royal Meteorological Societies. One member actually belongs to the Institution of Explosive Engineers!

Most respondents are affiliated to more than one other professional body and many are members of 4 or more other Institutions or learned Societies.

EMPLOYMENT AND STATUS

One of the principal objectives of the questionnaire was to discover the nature of employment of members, such as the type of employer, the geographical area of their work experience and their status in terms of technical or managerial position.

Type of employment

The response was very surprising in terms of the distribution of hydrologists across a range of employment categories. Figure 3 shows a histogram of the numbers employed in each of the ten categories of employment offered in the questionnaire. With a basic level of understanding of the structure of the water industry, at least in the UK, one might expect that most hydrologists worked in either Consultancy, Water Company or NRA and Scottish RPB environments. The survey response did *not* confirm this, and the somewhat surprising statistic emerged that only 48% of the membership are employed in these three categories. Of more earth-shattering (or perhaps flash-flooding) significance is that the single largest group of employees are ***academics***!! Pause for reflection .... ! The results indicate that nearly 40% of all BHS members are either learning, teaching or researching hydrology.

A further surprise is the predominance of consultancy at the expense of the Water Company and NRA type of employment. Is it possible, one asks, that the NRA/PLC working environment is now so stressed because of a combination of reorganisation, tackling the effects of drought and floods, and management of consultancy projects, that hydrologists no longer have the time or energy to fill in questionnaires?

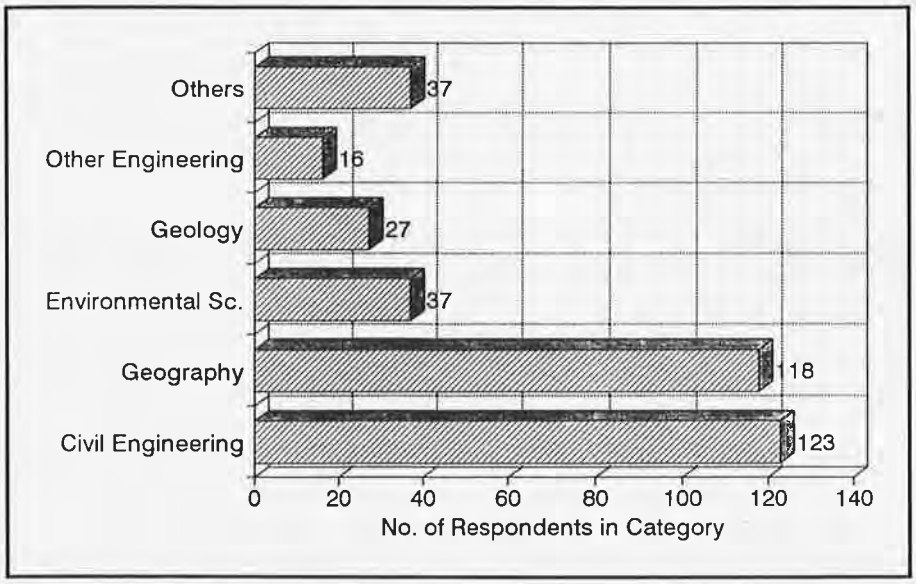


Figure 2 *Primary qualifications of BHS Members*

Or is this a stark illustration of the trend in recent years away from revenue expenditure on staff by PLCs and the NRA, in favour of capital investment on major projects undertaken by external Consultants?

Surprisingly, very few respondents were from the manufacturing/product side of the industry, and there was only one respondent who claimed to be a Contractor.

Can the response to this questionnaire be regarded as a representative sample of the BHS population as a whole? It is, of course, entirely possible that the responses are in some way biased towards one group of members. This might explain why there appear to be relatively so many academics and researchers, and so few working at the sharp end of hydrology? Undoubtedly, many members are working in academic environments on the fringe of the subject, but nevertheless have a strong interest in various learned aspects of hydrology. Further analysis will be required to show whether the response was representative of the membership as a whole.

Job Titles and Positions

The job titles and status of members are as varied as the countries they have worked in, but there was, not surprisingly, a clear bias toward professional and managerial status as opposed to trainee or technician status. In general, the younger graduate engineer or technical assistant either did not respond to the questionnaire or did not admit to such a status, preferring to offer the title Hydrologist, Engineer or Water Resources Officer.

Paid-up BHS membership is apparently not very attractive for groundwater professionals: surprisingly few respondents had job titles which included 'groundwater' or hydrogeologist' or something similar.

The society has within its membership, more than 20 Professors or Vice-Chancellors, nearly 30 Heads of Department, Partners, Directors or Associates plus the odd Managing Director. Again, the strength of interest by academics is illustrated by some 50 lecturers or readers responding.

About 40% of respondents classed themselves as Managers rather than Technical Specialists, which suggests that for every Manager in Hydrology there are only one and a half technical specialists. Perhaps there is, again, some bias in the response, with the typical Manager having more time, or a stronger inclination, to complete questionnaires than the subordinate technical specialist.

Employment base

Figure 4 shows the split between UK and overseas employment. As might be expected the vast majority of members either work entirely in the UK or with some work overseas. The response from those who work wholly overseas actually exceeded the number of overseas Members, indicating that some UK-based members, perhaps freelance Consultants, work entirely on overseas contracts.

Those with overseas experience have worked in more than 100 different countries, in every continent except Antarctica. Has no BHS member yet experienced the thrill (or is it chill) of estimating snow-melt runoff from a glacier at the South Pole?

Interestingly, no member claimed to have worked in the former Soviet Union – are there any Russian-speaking hydrologists out there keeping a low profile?

Undoubtedly, there must be a multitude of tales-from-afar to be told by members working under trying circumstances or in remote locations, about which many of us are aching to here via the pages of *Circulation*. You know the sort of thing: boat gauging in Africa when a crocodile thought the current-meter looked rather tasty, or two years work on a flood-forecasting model ruined because a volcanic eruption caused half the contributing catchment of one basin to be transferred into another one overnight.

PROFESSIONAL INTERESTS

Technical Interests

The range of topics quoted by respondents as being of prime interest was impressively varied, although too large to outline here. Suffice it to say that the results will be scrutinised by the BHS Main Committee and will be extremely useful in planning future meetings.

Regional Groups

Figure 5 shows the analysed response to a two-part question relating to the attachment of Members to BHS Regional Sections or ICE Hydrological

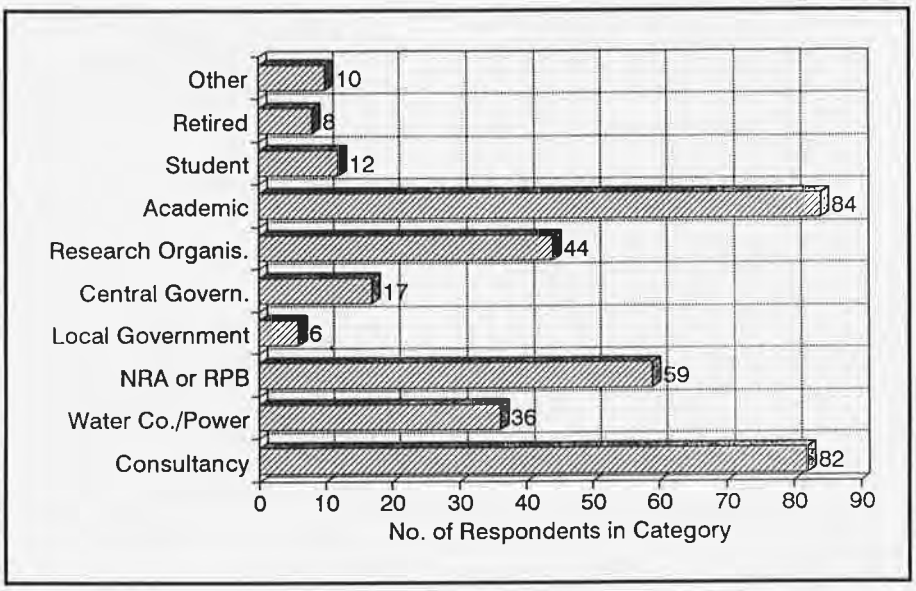


Figure 3 *Employment categories of BHS Members*

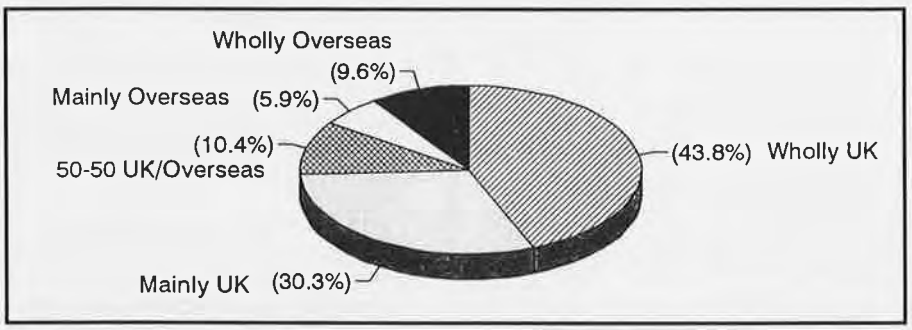


Figure 3 *Employment categories of BHS Members*

Groups. Information was requested about members' existing attachment to a Group or Section, and also asked whether they were interested in joining or in receiving further details about the activities of a particular regional organisation. The Southern Section is clearly very successful, but it also has the largest captive market. Most of the other groups and sections are less successful in reaching their respective potential local market of hydrologists. In four of the groups or sections – Pennines, Midlands, Welsh and South West – about as many want further information about activities, or are interested in joining, as those who are already attached to the particular organisation.

Attendance at Meetings

The analysis of the frequency with which members attend meetings showed that in general about half of the membership do not have either the inclination, the opportunity, the time or possibly the money to attend meetings regularly, whether organised nationally or regionally.

With national meetings, of the 358 questionnaires returned, 49% had either not attended meetings or not bothered to answer the question about frequency of attendance: it is therefore reasonable to assume that there was a reluctance to admit that they did not attend meetings. Only 6% attended meetings on more than two occasions during the 18-month period concerned.

Regional meetings are less regularly attended than national meetings, with 55% not attending one or more meeting since January 1990. This must be a major disappointment, though not a surprise, for regional organisers, since these are the meetings which should be easiest for most members to get to. However the more committed members of the Groups, 9%, have attended more than twice since January 1990.

Many members are attached to, or are interested in joining, more than one regional organisation.

MEMBERSHIP DIRECTORY

From the options suggested for including additional information in the Directory, there was wide support for 'Areas of interest' and 'Job Titles' being added, each attracting more than 50% of respondents. The addition of information about qualifications was less popular with only 35% of respondents ticking that box. Only 19% felt that 'Date of Joining' should be included.

Other suggestions included Employer, Research Topics, availability for consultancy and consultancy details, areas of interest and experience and countries worked in.

REGISTER OF CONSULTANTS

The question which asked whether self-employed Consultants would like to be included in a Register or receive further information produced an enormous response. It is not known how many members of BHS are truly self-employed, or indeed what the definition of a freelance or independent Consultant is, but 91 respondents decided to tick the box. In view of the fact that only 82 respondents worked in 'Consultancy', there appear to be a lot of 'moonlighters' in hydrology – available for midnight flood gauging exercises perhaps! The assumption must be that many, or perhaps most, academics and perhaps many retired members are available for freelance work. Clearly, if freelancers are happy for the Register to be published, then it could be attached to the Membership Directory and updated with the same frequency.

***Circulation* Newsletter**

The Society's quarterly newsletter emerged from the survey with flying colours. An overwhelming 89% felt that the content was 'fine'. Only 3 members (less than 1% of respondents) felt it came through their letter boxes too often and the balance thought it was published 'too seldom' or did not tick any box.

A massive 74% of those who answered the question thought the balance between technical content, accounts of meetings, humour and gossip was already good, with 19% wanting a "more technical articles, more professional, more 'learned' society" approach. The remainder preferred "more light-hearted accounts of meetings, more humorous, more gossip" content.

Many members expressed an interest in submitting items of news or articles for publication in *Circulation*. About 40 respondents offered to contribute something on 'Research Projects'. Nearly 70 indicated that they could make a contribution either occasionally, once a year or once every two years.

OTHER COMMENTS

Several members had strong views on the success or otherwise of various aspects of BHS. Most were of a complimentary nature, with many comments such as "Very Good", "Well Done", "Very Impressive", etc., and others congratulating the Society on its achievements to date. Very few comments were derogatory in any way and much of the criticism was constructively phrased.

A handful thought meetings were too expensive or that the cost should be kept low: conversely one member actually thought fees should be raised to increase the Societies resources. A few members commented that *Circulation* was "poor", but the statistics proved that the consensus opinion was just the opposite!

Many comments indicated that greater attention needs to be devoted to organising and publicising regional section/group meetings. Several members thought that there should be more advance notice of meetings. The frequency of meetings attracted some comment, although this was evenly balanced between those who thought there were too many meetings and those who wanted more. Several comments were on the lines that more meetings should provide a forum for exchange of information and practical experiences, with fewer devoted to describing research work.

Some members felt that BHS could do more to enhance the professional standing of hydrologists to the extent of providing a professional qualification, a Chartered Status for it's members which could become widely accepted by employers.

Many other useful comments were gratefully received but are far too numerous and diverse to include here. All have been carefully scrutinised and many will be considered further in the future.

CONCLUSIONS

The first survey of members carried out 10 years after the formation of the Society, has produced an excellent response with a 58% return of questionnaires. This is considered to be generally representative of the views of the membership as a whole, although there may be some bias towards the older, more experienced, more active members who regard BHS as a learned Society.

The results indicate that a typical member is most likely to be aged between 30 and 50, work in Consultancy or as an Academic (or both) and

be attached to the Southern Section. The older members of the Society probably have a background in Civil Engineering and are affiliated to ICE or IWEM, whereas the younger members have a qualification in one of the Environmental or Earth Sciences including Geography and have more difficulty in attaining Chartered status as non-engineers.

In general, the Society was seen to be doing a very good job for its members, and gave excellent value for money in doing so. In particular, *Circulation* received an overwhelming vote of confidence: take a bow, Editors!

However, it is clear that more could be done to broaden the Society's appeal to its younger, less experienced, less well qualified members. Further efforts may need to be made to promote activities at grassroots level perhaps by encouraging greater participation by members in the regional organisations outside the South East of England.

The survey has been extremely important in providing detailed information for planning activities and it will undoubtedly influence how the Society develops in the future to serve its members even better.

Rod Hawnt

The President's Piece

Rather late in the day, I would like to take this opportunity of thanking those of you who voted me into this job and commiserating with those of you who did not. Having just spent two or three days helping my daughter carry boxes of member's Handbooks up and down stairs, in and out of various vehicles, and finally dodging the traffic in Watlington High Street to get the ones we had to post into the garden shed at the back of the village post office, let me tell you that the President's life is more fatigue than prestige! But I am honoured by your choice and I will do my best to continue the steady development of the Society along the lines so well followed by my predecessors.

Talking of the Handbook, you should have all received it. Having foolishly agreed to sort out the final stages of packing and despatching direct from the printers, I was concerned to find that some of the address labels seemed to be out of date (we corrected them where possible). Presumably delivery of this copy of *Circulation* has been delayed to some of you for the same reason. Please let *Peter Bacos* (address on the back page) know if your mailing address has changed.

As you can see, the Handbook is designed for growth, but the Statutes and membership list are only our first offerings. The latter will be updated annually and we hope to have eliminated problems with incorrect addresses and lapsed membership before the next issue. In particular, we have to decide exactly when members will disappear from the mailing list after failure to pay their annual subscription. To prevent this happening to you, and to save us a great deal of administrative effort, please, please will you consider paying your subs by direct debit.

One of the aims of *'The President's Piece'* is to pass on to members some of the exciting happenings at the previous main committee meeting. There are four *Circulations* a year and four such meetings, so it should fit in rather well. We met on 15 July, in London as usual, and there was a lot to discuss. I hope that 58% of you can remember completing the questionnaire which we sent out a year ago. ICE staff entered your responses into a database and then sent the statistics and the original replies on to **Rod Hawnt** who has produced the entertaining report and revealing diagrams published in this issue. Rod has spent a lot of time on this, especially in bringing out the many extra comments which you added to the form and which therefore evaded computer coding. Many of the points you raised were brought before the committee and much discussion ensued. This will doubtless continue in future (the returns are to be retained and scrutinised for various planning purposes) and I hope members will be inclined to repeat the exercise in a few years time. The committee is very definitely in the business of responding to the views and suggestions of Society members and, although the questionnaire has been the most significant vehicle for these, please remember that there are other routes too. There are six regional representatives - three covering the Society's own regional sections (Southern, South West, and Midlands) and three representatives of the ICE hydrological groups: Pennines, Scottish and Welsh. They are all individual BHS members and are equally willing to act as conduits for the views of BHS members residing in their regions. All contact names and telephone numbers are given on page (i) of the Handbook.

The other main route for expressing your views is through *Circulation*. We have often appealed for contributions and the editors will probably always have to bully and cajole in order to get promised or half-promised items, but why cannot we have a 'letters' column? Go on, somebody, write a letter: tell us how we could do things better, or about some interesting hydrological happening, or warn of impending problems: anything really.

Perhaps some of the committee deliberations may prompt you to write. No fewer than 70 questionnaire respondents said they could make the occasional contribution, so come on, let's be having you!

Are we doing enough for younger members? Again arising from some of the questionnaire responses, we talked through some of the issues. We were also forced to admit that nobody there could seriously claim to represent that 14.2% - see Rod's Figure 1. (Rod said he thought of himself as young, but then our committee meetings are always good for a laugh.) We agreed to explore the possibility of specific representation (see the separate notice in this issue) but if you, younger reader, have a different suggestion then please write in, or speak to any committee member.

The whole question of Education and Training is kept under constant review. Changing rules and practices at ICE and IWEM mean that the best route to Chartered status for non-engineering graduates may change from time to time. We are also aware that 'Chartered Engineer' status is not necessarily relevant to many practising hydrologists and we are looking at 'accreditation' schemes to see if we can take any steps towards the establishment of a recognised system whereby 'rounded' hydrologists can prove themselves as such. I must emphasise that there are many practical difficulties and that such ideas have been debated many times before, only to perish under close scrutiny, but we will continue our efforts and we will report our findings to you.

Much time is taken in committee in considering the Society's 'rolling programme' of regional and national meetings. Along with *Circulation* and, now, the Handbook, it is the programme of meetings which provides tangible evidence of the Society's existence. Presumably if we held no meetings many members would question the value of the Society. Why then do we attend so few of them? (see Rod's report again). Are they too rarefied? Never on topics which interest you? Too far away? Too expensive? Too time-consuming? We try to hold a number of meetings jointly with other groups (e.g. IWEM, Royal Met. Soc.) but inevitably the total number of meetings being organised by all the different Societies and Institutions may seem rather excessive. **Chris**

Collier tries very hard to include all such meetings in the published programme (see *Diary*) but he admits that some slip through the net. We are planning to do more to publicise our meetings by way of posters in case lack of awareness is a contributory factor.

There are many other discussion topics to be explored in committee. Planning for the Cardiff Symposium in 1993; subscription levels; development of regional structures and liaison with the ICE regional groups; liaison with other national hydrological societies and international bodies; contributions to national debates on research directions and administrative policies; publications of our own newsletter and occasional papers: prizes and grants to be funded from Society reserves: all these came up at our July meeting but I have run out of space and time to tell you about them. Next time perhaps.

In the meantime, please note that nomination forms for committee positions have been sent out now. The Hon Secretary, the President-Elect, and two 'ordinary' members must all be elected this autumn. If you would like to help run the Society then please let yourself be nominated. Those considering the second position would be well advised to do some weight training!

Mike Lowing
BHS President

Rainfall and Flood Forecasting Using Radar Measurements of Rainfall

Met. Office-NRA meeting sponsored by the BHS — Discussion Session

London, 4th March 1992

The Chairman, *Chris Collier*, introduced the discussion session by posing a number of questions which he suggested the meeting might like to address:

System Development

* Do we need heavy rainfall warnings?
* Do the perceived benefits justify the current level of activity?
* Can meteorological forecasts be incorporated into hydrological forecasting systems successfully?
* Should we devote valuable resources to integrating met. forecasting systems with operational flood warning procedures?
* Can flood duty officers use new rainfall forecasts within existing procedures?
* Is reliability more important than forecast accuracy?

Scientific Studies

* Further assessments of FRONTIERS forecasts are needed/not needed.
* Techniques for forecasting convective development are essential before rainfall forecasts can be used operationally by hydrologists.
* Flood forecasting models are inadequate at present for incorporating rainfall forecasts with unpredictable error characteristics.
* Resources should be concentrated on improving models rather than on data assimilation procedures.

Product Distribution

* Where should new forecast products be produced: at the user's site or centrally?
* Do forecast products need real*time quality control?
* How timely do rainfall forecasts need to be?

Operational Service

* Should the aim be to develop one?
* Should payment be linked to performance?
* Should any service be negotiated locally or nationally?
* Should any service be product led or customer driven?

The following is an edited version of the discussion. Some interesting issues are raised generally regarding the development of rainfall forecasting and hydrological flow forecasting models.

Linda Aucott (Wessex NRA) began by saying that FRONTIERS products have been found to be not very accurate on some occasions, but would be more useful if some form of 'confidence indicator' could be included.

The Chairman replied that there had been consideration of this facility, as mentioned by **Rod Brown** (Met. Office), but there would need to be consultation with the users to define precisely what was required and the meaning of any such indicators.

Prof D Newsome (CNS Scientific Eng. Services) referred to the lead time for warnings of events – it seems that for domestic property the optimum lead time is one hour. Within that period there is time to do all that may reasonably be done to safeguard property and/or minimise damage. This suggests working toward forecasts with 90-95% probability at T+1, 80% at T+3 and 60% at T+6.

M Nicholls (Met. Office) said that confidence levels are increasingly being used with meteorological forecast products and are most important. It is hoped that this feature would be extended to FRONTIERS products.

Dr Peter Ryder (Met. Office) added that it was intended to make FRONTIERS products widely available during the next six months to Met. Office users: Weather Centres, Forecast Offices, etc. This expressed the Office's confidence in the products and it was hoped that this confidence would lead to further improvements in the products.

Peter Borrows (Thames NRA) said that both the NRA and the Met. Office had learned a lot during the trial about each other's needs and experiences. It was important that the Met. Office should not attempt to 'go it alone' but liaise closely with the users.

Mr B Smith (Scottish Hydro-electric Board) was concerned that all the talk and the trial evaluations had been concerned with England, and never a mention of Scotland!

The Chairman explained that although the trial was conducted with two English regions of the NRA this was because until very recently there had been no radar data over Scotland. However, last November the FRONTIERS area was shifted

northwards to accommodate the introduction of the Scottish radars. The problems in Scotland, especially because of the terrain, mean that different emphases will feature in R & D with these radar data.

Mr R Chaplain (Weather Watchers Service) felt that Scotland wanted to be involved in the research but that there was disquiet at the allocation of costs – some "£40K for radar data".

The Chairman agreed that Scottish involvement was welcome but discussion about costs was outside the scope of the present meeting and he could not comment.

John Cole (WRC) added that work on the measurement and forecasting of snowfall should not be forgotten.

Cliff Dobson (Severn Trent NRA) felt that the need for work on snow was often overrated, although clearly there were occasions when it was important.

Chris Haggett (Thames NRA) raised the point that it is essential that more work is done on handling convective storms. These often lead to damaging events not just caused by rivers flooding. A high proportion of the flood damage is also due to flooding from surface water sewer systems in urban areas. As things stand no warnings are issued by the Water PLCs and local authorities, and this is an area where the potential benefits are very high. Better forecasting of these storm types will enable these benefits to be realised in urban areas.

Dr Keith Browning (Met. Office & University of Reading) thought that FRONTIERS alone would not be able to handle these problems. The Mesoscale model is the key to predicting where convective development is likely to occur. The way forward was the introduction of second-generation METEOSAT high resolution satellite data in conjunction with FRONTIERS quality-controlled radar actuals fed into the Mesoscale model.

The Chairman was sure that artificial intelligence techniques would have a role in enabling these data to be blended together effectively.

According to **Dr M Cullen** (Met. Office) the main way forward lay in the automation of analysis leading to greater consistency of products. Assessment of recent performance could lead to confidence indicators. Amalgamation of analysis and modelling systems was planned which should lead to the improvement of data assimilation into the models.

Regarding consistency, Cliff Dobson (Severn Trent NRA) said that FRONTIERS forecasts are most useful for small catchments, and this requires frequent forecasts. If FRONTIERS forecasts vary from cycle to cycle this has a disastrous effect on runoff models.

Dr Cullen replied that as forecasts improve they will become more consistent.

Prof E Vilar (Portsmouth Poly) suggested that the use of Artificial Intelligence techniques might be used to assist in the production of forecasts. The customer had to understand that the forecast would never be perfect but the use of probabilities might be helpful.

The Chairman asked whether the Flood Room Duty Forecaster could make use of probabilities, to which **Mr M Edwards** (Met. Office) replied that probabilities could be used to produce a span of forecast river flows.

Cliff Dobson said that in a particular river basin a 2% error in the discharge forecast would lead to 100 mm difference in river level. Thus a span of flows would be of little use, and the hydrologist was up against an accuracy problem.

Dr Peter Walsh (North West NRA), described the flood warning philosophy in the North West region. If the answer to the question: 'are we going through the warning threshold?' is 'Yes', a warning is issued. Judgement is required to predict when the threshold will be crossed – it is less important by how much it is crossed. Better a false alarm than no warning of an actual flood. Do we need heavy rain warnings? – Yes. Can the predicted cost benefits of the FRONTIERS forecasts be realized? He felt that there was still a long way to go, but we are getting nearer. As to what happens next, the last twelve months have been disappointing because of the lack of rain to fully evaluate the system but the need for further cooperation is obvious: the problems must be taken seriously. A four-hour lead time is probably more realistic than a one hour one.

John Mosedale (Welsh NRA) stated that no heavy rainfall warnings of the type currently available were required! However, six-hour FRONTIERS forecasts *are*. Six hours are needed for all the necessary steps from issue of a flood warning to action being taken. Rainfall forecasts are needed to improve the warning system. Radar images have helped by giving indications of the back edge of rain bands: they had probably reduced false alarms by 50%. Are hydrological models satisfactory? Maybe, but there is little point in improving them if rainfall forecasting is not improved. Cooperation is essential to effect improvements. It is clear that current FRONTIERS forecasts would be very useful in the Welsh NRA area.

Mr I H Pearse (Northwest NRA) said that heavy rainfall warnings are required as well as FRONTIERS products. FRONTIERS can be right or wrong! Duty officers often have little experience of using FRONTIERS forecasts although the situation is improving. The FRONTIERS forecast sometimes looks 'silly' and this biases the user against using the product. Waving cold fronts are not handled well, either by FRONTIERS or by forecasters. Inconsistencies in the FRONTIERS forecasts are too prevalent and reliance on using them in an automatic flood warning scheme could be disastrous.

Peter Walsh pointed out the difference between forecast lead times and warning lead times. The public expectation was growing and therefore the task becomes more difficult and challenging. Expectation is likely to outstrip capability, thus it is imperative to keep on trying to improve the products.

Bob Moore (Institute of Hydrology) referred to integration of rain forecasts into hydrological models: a project in Yorkshire takes in all types of rainfall data on a prioritised scheme. It might use FRONTIERS forecasts or local rainfall forecasts: say, local forecasts up to two hors and then FRONTIERS forecasts thereafter. There would be an option to deactivate the radar input if it was deemed to be inaccurate. As to whether it is more important to improve the models rather than the data input, it was thought that models were as good as the data, but now it seems that more work is required to improve the models.

Dr Andrew Eccleston (The Computer Department) said that the reason for his leaving the Met. Office was the lack of pace in making progress, which was perceived to be due to inadequate funding. The fact that NRA Northwest had been receiving the FRONTIERS accumulation forecasts but not using them was probably because there was no software expertise available to make use of them. It was felt that funding should be commensurate with the needs of the users.

Peter Ryder replied that the Met. Office had sought to develop the hydrological use of radar data in partnership with the Water Industry. There had in fact been considerable investment over the last few years. Although there had been a lack of rain during the trial period, Cliff Dobson referred to one event just before Christmas 1991 that was ripe for investigation and he hoped that it would be taken apart in some detail. It was agreed that further work needed to be undertaken.

Peter Borrows said that the NRA had put a lot of resources into the project and a lot had been learned: the priorities for any future work would need to be looked at carefully.

Summing up, the Chairman said that a lot of good things had come out of the project and there was a clear need for the work to continue. He expressed the hope that the trial would be carried on for a further period, and that there would be sufficient rainfall to produce further worthwhile results.

Chris Collier

Hydrology, urban development and water quality management

BHS National Meeting
Institution of Civil Engineers
25 March 1992

During the course of this day-long BHS meeting in London, seven papers were presented, covering a wide spectrum of topics.

The morning session was dominated by issues of source control of the quantity and quality of stormwater runoff. The afternoon session chiefly covered issues downstream of the source — real-time control of sewer systems, impacts of stormwater on river quality, planning of waste water and stormwater disposal for a new development — and the day finished with a review of integrated catchment planning.

The first speaker was **Prof Mike Hall** (International Institute for Hydraulic and Environmental Engineering, Delft). His paper, entitled *'Scope of Control of Urban Runoff'*, started with a review of the traditional approach to urban storm water management, and its adverse impacts, going on to examine techniques which may be used in future planning to reduce adverse impacts. Prof Hall emphasised that urban runoff should be regarded as a resource for potential re-use, rather than as an inconvenience: in particular, he recommended that more consideration be given to on-site retention and infiltration techniques in future planning. He pointed out that CIRIA Report 404, which will provide a tool for engineers to use in a more integrated approach to urban stormwater planning, will soon be published.

'Water Quality Improvements from Source Control Procedures' was the title of the presentation by **Prof J B Ellis** (Middlesex Polytechnic). This commenced with an illustration of the decline in quality of UK rivers in recent years. Prof Ellis pointed out that this was due partly to physical restructuring of river systems, and partly to degradation in water quality. In the UK, as elsewhere, it will be difficult to attain standards set out in certain EC directives (such as those associated with bacteria levels for water contact sports) for waters receiving untreated urban runoff. Prof Ellis explained how the quality of storm water drainage could be improved by using grassed swales, flood storage ponds and artificial wetlands. His presentation included guidance on the design of such systems. For water quality objectives, controls should be designed for smaller events, and with shorter return periods, than were required for flood control.

The final paper of the morning, *'On-site Retention and Re-use of Stormwater'* was by **Prof C J Pratt** (Coventry Polytechnic). Despite having to contend with a fire-scare and evacuation of the building in the middle of his presentation, Prof Pratt effectively argued for increased use of source controls for stormwater. There were several advantages associated with this approach: smaller peak stormwater flows (and hence reduced costs of stormwater control systems); enhanced vegetative growth, and preservation of low stream flows, resulting from increases in groundwater recharge, and increased potential for stormwater re-use, reducing costs of water supply. He presented examples of systems such as porous pavements and 'soakaway trenches' which may be used to encourage infiltration. Design guidance for these systems was also presented. Prof Pratt pointed out that subgrades of porous paving systems, and the aggregate of soakaways, tend to filter out undesirable solids in the runoff: hence some properties of the stormwater, such as pH, could be 'tuned', by appropriate choice of aggregate.

Questions on the morning's proceedings began by focusing on design lives and maintenance costs associated with source control systems. The authors emphasised that although no such thing as a 'maintenance free' system exists, renewal of many of the proposed systems can be accomplished with relatively low cost and little inconvenience. Concern was voiced about the ultimate disposal of contaminated sediments which collect in source-control systems. Prof Ellis pointed out that sediments recovered from these systems are not so badly contaminated that they require special disposal. The session closed with a discussion of the question of restructuring legislation, so that planning for urban drainage could be managed proactively.

The afternoon session began with a presentation by **Prof Ian Cluckie** (University of Salford) on the futuristic topic of *'Real-time Control of Urban Sewer Systems'*. Prof Cluckie believed that the use of real-time control, to optimise storage within sewer systems of large cities, could effectively prevent combined sewer overflows. He asserted that advanced warning of rainfall intensity and distribution was essential, in order to gain enough lead time for control purposes. He considered the use of point-measurements from rain-gauging inadequate for this purpose. The presentation therefore focused chiefly on the use of radar systems for monitoring the passage of storm cells. Radar systems could, if associated problems were solved, give a lead time of the order of half an hour. Among the problems associated with the use of radar for control purposes are questions of cost-effectiveness, and the 'bright band' problem (this concerns identification of liquid-coated ice particles in the atmosphere by radar techniques). Prof Cluckie discussed research carried out towards the solution of these problems and highlighted the need to devise a reliable 'water quality index' so that the impact of real-time storm water control could be reliably assessed.

The session continued with a paper entitled *'Impacts of Stormwater on River Water Quality'* presented by **Dr M B Beck** and co-authored by **A Reda** (both of Imperial College). It dealt with the effects of a surge of stormwater on a waste water treatment plant and on the receiving river. A case-study of the River Cam demonstrated how different design and operational strategies could be used to minimise adverse impacts on the waste water treatment plant, as well as on the downstream water quality. A model has been developed using a series of 'continuously stirred tank reactors' (CSTR) to simulate the river water quality. The model was calibrated against hourly observations of stream water ammonia content and

good correlation between predictions and observations was achieved. The model was also calibrated against daily observations of dissolved oxygen, biological oxygen demand, ammonia, nitrate, and chlorophyll-A. A puzzling deficiency in the daily modelling of river ammonia was revealed. Further development in the modelling of organic nitrogen is now being pursued and it is hoped that the results of the model might be used to optimise the size, location, and spill options of stormwater temporary storage tanks.

In the discussion following the talk the question was raised of why a CSTR system was chosen for the model. The authors replied that for this particular system, the CSTR simulations performed better than 'Aggregated Dead Zone' simulations, and numerical solutions of the advection-dispersion equations. They pointed out that river morphology and the availability of data influenced the choice of the 'best' model. The point was raised that implementation of the type of integrated control for which this study clearly illustrated the need has unfortunately been compromised by privatisation of the UK water supply system.

Dr Howard Wheater presented *'Water Management of a Proposed New-Town Development'*, co-authored by **J A Spearman** and **Dr M B Beck** (all from Imperial College). The paper examined the impact of urbanisation on an area underlain by chalk, where the groundwater regime dominates hydrology. The impacts of disposing of stormwater runoff, and waste water from the town, alternatively to groundwater and to the river (after appropriate treatment) were examined. The storm water flow from the town would be very much larger than the natural river flow, so that disposing of stormwater to the river is not an attractive option.

The disposal of waste water to the river was shown to raise the local stream level slightly, and is therefore considered a viable option. In order to assess the options of disposal to ground, the groundwater regime was modelled using the MODFLOW model, with a surface hydrology pre-processor. The model was calibrated against observations of stream and groundwater table levels over the past few years. Attention was drawn to the difficulty encountered in estimating an appropriate root constant for the model, in order to predict groundwater recharge reliably. The options of disposal of stormwater and waste water to groundwater are calculated to cause a slight rise in the local level of the groundwater table. It is expected that this rise may in fact have a beneficial effect on the hydrological regime, since it will compensate for water abstractions from the catchment by users in other areas, during times of drought.

During discussion, attention was drawn to the fact that this development provided the ideal opportunity to implement the source control measures for stormwater which were presented during the first session.

The day's proceedings concluded with the presentation of *'Urban Development and Catchment Planning - An NRA Perspective'* by **Dr John Gardiner** (NRA Thames Region). Dr Gardiner reviewed many examples where the water environment had been given little attention during development planning. He demonstrated that these situations arose because of the existence of separate organisational responsibilities for urban and infrastructural development on the one hand, and for the water environment on the other. His examples illustrated the need for integrated catchment planning, as well as the potential cost-effectiveness of the process.

Dr Gardiner pointed out that the NRA is now working towards this aim within the framework of Section 16 of the Water Resources Act of 1991. The emphasis in the NRA's approach is on cultivating a partnership with local planning authorities to plan for development which will be ecologically and economically sustainable. The NRA has produced draft model policies for development planning and is currently producing catchment plans which will aid an integrated approach to catchment development. Dr Gardiner briefly reviewed the difficulties associated with, and the benefits that may be derived from, such integrated catchment planning. He pointed out a number of techniques which may be used in catchment planning, and concluded that integrated planning has emphasised the importance of source control of stormwater runoff.

Dr Gardiner's presentation acted as an appropriate summation of, and conclusion to, the day's proceedings, highlighting the increasing interest in methods of stormwater management which exhibit sensitivity to the water environment, and are characterised by source controls and integrated catchment planning.

Jenny Blight
Imperial College, London

News from Members

Hon. Hungarian Hydrologist

Dr John Rodda has been made an Honorary Member of the Hungarian Hydrological Society, an organisation founded 75 years ago and now with a membership of over 3000. John says that this impressive membership is due more to the Hungarian society's wider interpretation of the word 'hydrology' than to any particular concentration of hydrologists in that part of Europe.

Members on the move

After more than eighteen years at the Institute of Hydrology, **Ben Piper** has left to join GU Projects as their Senior Water Resources Engineer. GU Projects is the technical arm of General Utilities, the UK holding company of the Compagnie Générale des Eaux.

Training subcommittee

Because of the amount of interest in training and chartered staus, and the considerable workload involved in furthering BHS members' interests, the Training and Qualifications Subcommittee is being expanded: **Peter Sims, Rod Hawnt** and **Chris Collier** will join Sue Walker on this subcommittee.

Members' Handbook

We hope that the new *Handbook* has now reached every member safely. If your copy arrived with nothing inside it — yes, it has happened (to past-President **Allan Lambert**, would you believe!) — please let us know at the Editorial Office at Wallingford and we will send you some innards forthwith.

Back copies of *Circulation*

If any member has an unwanted copy of *Circulation No. 11*, would they be willing to send it to the Editor? This will help the President to complete his set.

River Severn field visit

BHS Midlands Section
Wednesday 17 June 1992

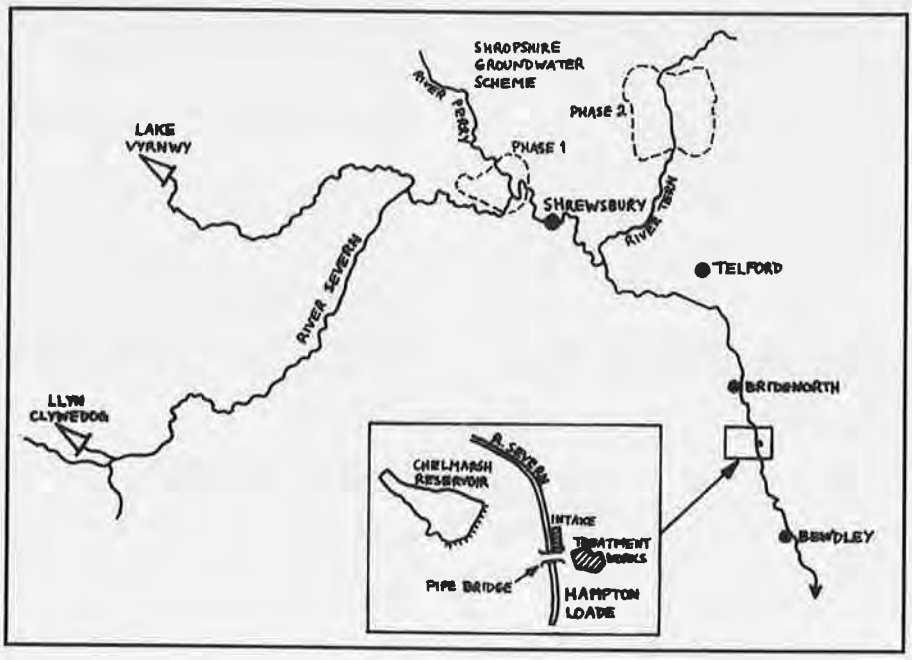
For their summer field trip, the BHS Midlands Section had chosen the River Severn as the theme. With a programme including visits to Hampton Loade, the Shropshire Groundwater Scheme and an evening IWEM meeting, the day promised to be most worthwhile. The importance of the Severn as a national resource was reflected by the participation of many people from outside the Severn basin.

A convoy of minibuses and cars arrived at Hampton Loade, on the east bank of the River Severn about four miles south of Bridgnorth (see map below), and disgorged 28 BHS members and guests. They had come to see the river intake, bankside storage reservoir and treatment works which together make up the Hampton Loade works of South Staffordshire Water plc.

Waiting to meet them were **Keith Marshall**, the Works Manager, and **Mike Mooney**, the Plant Chemist. Provided with the first of the day's several cups of coffee, the party listened as Keith outlined the main features of the works and their operation. Water from the Severn passes through coarse screens and rotating band screens at the river intake, before being pumped over to the east bank into the Chelmarsh reservoir. With all six pumps operating, a maximum of 320 Ml d^{-1} can be abstracted, although the station is licensed for an average abstraction of 182 Ml d^{-1}.

Chelmarsh reservoir forms an essential part of the treatment process: the 3 or 4 days retention time significantly reduces turbidity. The time lag gives the Plant chemist time to make up his mind how to treat the water, depending on variations in river quality. It also gives him the option of stopping abstraction, for example if both colour and turbidity are high in the river, or if there should be a pollution incident upstream. Up to 155 Ml d^{-1} can then flow under gravity back to the treatment works, but in-line boosting by low-lift pumps can increase this to the plant's maximum treatment capacity of 225 Ml d^{-1}.

The raw water first enters four clarifiers run in parallel, two of which are the conventional circular accentrifloc clarifiers; aluminium sulphate is the most common coagulant used. Then it goes on to rapid gravity sand filters, which are slowly being replaced by Granular Activated Carbon filters. Chlorine contact tanks and sulphur dioxide dechlorination follow. Fluoride is added, at the rate of 1 mgl^{-1}, at the request of the local health authority; the only other chemical used is lime, for occasional pH correction. The treated water is then pumped into supply by high-lift pumps, heading initially for Sedgley service reservoir. Meanwhile, washwater recovery tanks recycle up to 5 Ml d^{-1} of filter washings, and sludge thickening tanks and presses produce on average about 9000 m^3 $year^{-1}$ of sludge with 25% solids. The sludge presses are scheduled for replacement with centrifuges.



At this point the party split into two groups: one concentrated on the treatment process with Mike Mooney, but the real hydrologists went with Keith Marshall for a closer look at the river intake and Chelmarsh reservoir.

Impounded behind an earth embankment dam, Chelmarsh has a total volume of 3000 Ml, with a maximum depth of about 25 m. It has no natural catchment. The designers took great care to position the inlets to ensure mixing, and to avoid short-circuiting between the inlets and outlet. The mixing and the reservoir's high throughput means that Chelmarsh has never had problems of algal growth and stratification.

The most interesting aspect of the reservoir is the way it is used to improve the effectiveness of river regulation. With a delay of 4 or 5 days between Clywedog reservoir and the Bewdley control point, making regulating releases from Clywedog can often be a gamble with the weather. To improve the odds, Chelmarsh reservoir can be drawn down by up to 500 Ml for regulation purposes, in an admirable example of close cooperation between the NRA and South Staffs Water.

If the flow in the Severn is dropping close to the 5-day moving average of 850 Ml d^{-1} at Bewdley, South Staffs Water can cease abstraction at Hampton Loade, and use Chelmarsh storage to maintain their supplies. Conversely, if it rains soon after a release has been made from Clywedog, Hampton Loade can abstract at maximum capacity so that water is not 'wasted' flowing past the door and out to sea.

Built in the late 1960s, jointly by South Staffs Water and Wolverhampton Corporation (whose interest has now been taken over by Severn Trent Water), Hampton Loade works is a key component in the South Staffs Water network, supplying about 40% of its daily requirements. Severn Trent Water is entitled to take just over 60 Ml d^{-1} treated water to supply Wolverhampton, but have no operational control over the plant.

A noteworthy feature of the works is the bridge, with the two raw water mains crossing the Severn in graceful arches, supporting the roadway between them (Figure 1). As currently operated, one main fills and one



Figure 1 *The pipe-bridge across the Severn*

empties Chelmarsh reservoir, but there is a scheme afoot to allow both mains to transfer water from Chelmarsh to the treatment works. This would result in considerable savings in pumping costs, by avoiding the use of the in-line booster pumps.

Under the watchful eye of the trip organiser, BHS Midland Representative **Paul Webster**, the intrepid party re-embarked for the drive to Shrewsbury. The destination was the NRA Upper Severn Area Office, and the purpose was to find out at first hand the exact nature of the well-known but often misrepresented Shropshire Groundwater Scheme.

Over the second of the day's cups of coffee, **Steve Morley**, Principal Catchment Manager for the Upper Severn Area, gave a brief overview of the characteristics of the Severn basin, and the role of the Shropshire Groundwater Scheme in managing its resources.

Most of the major abstractors from the River Severn have declared an intention to increase their abstractions and, with colleagues from the Thames catchment turning their eyes westwards to the Severn, there is clearly a need for provision to support the additional abstractions. Drawing on the huge reserves of groundwater held in the Triassic sandstones, the Shropshire Groundwater Scheme was designed as a 'long-stop' to supplement the yields of Clywedog and Vyrnwy reservoirs, should the need arise.

The complete scheme consists of 8 phases, with a total yield of well over 200 Ml d^{-1}. To date, the first two phases are operational, with a combined capacity of about 80 Ml d^{-1}. The first phase, the South Perry, was commissioned in 1985 but not used until 1989. It consists of 10 separate boreholes, 8 of which feed into a spine main which discharges directly to the Severn. The other 2 discharge into the River Perry.

The aquifer in this area is semi-confined, and pumping causes only a small reduction in the flows in the River Perry. The net yield of the Scheme is thought to be 85% of the gross output of the boreholes and it is hoped that good wet winters will replenish the residual drawdowns. To ensure recovery of the groundwater levels, the phases would be used alternately, and the abstraction licences are formulated to avoid overpumping in one area.

The Tern phase, whose completion was brought forward to cope with predicted dry spells, discharges into the River Tern, enabling abstractors on that river to benefit from the releases. The boreholes are strung out over about 10 km. Yields have not always been as good as expected, the output per borehole being typically in the range 3.5 to 7 Ml d^{-1}. In certain cases aeration is needed to avoid quality problems in the receiving river.

The third phase (Leaton) is due for completion in 1995, and will take the total capacity of the Scheme up to about 120 Ml d^{-1}. It is not anticipated that the fourth and fifth phases will be ready before the turn of the century. For operational reasons a phase is only switched on if it is thought that pumping will be required for a reasonable period.

The decision to use the Scheme is taken with the aid of a computer model of the Severn system and in conjunction with the Clywedog control curves. With pumping costs of about £3500 per week (for the South Perry phase) the decision is not taken lightly. 1989 was the last year it was operated, and its contribution to river regulation in that year is well illustrated by the graph in Figure 2. There is only a 50% chance it will be needed this year.

The abstraction licences include annual and 5-year limits, and the NRA went to great lengths at the public enquiry to allay fears of overpumping, accepting the onus of proof for derogation claims. Soil moisture levels are monitored throughout the Scheme by neutron probe, and close contact is maintained with the National Farmers Union in case of claims for loss of crop yield through lowering of the water table.

There was time to visit one of the borehole sites close to the NRA offices, but the architecture of pumping stations is not what it used to be. With most of the borehole headworks below ground level, the only visible structures were the access hatches and a small brick building for the control equipment (Figure 3). The BHS party took the opportunity to question Steve Morley closely about various aspects of the Scheme. Then it was back into the convoy vehicles for the dash to Telford, as there were fears that the refresh-

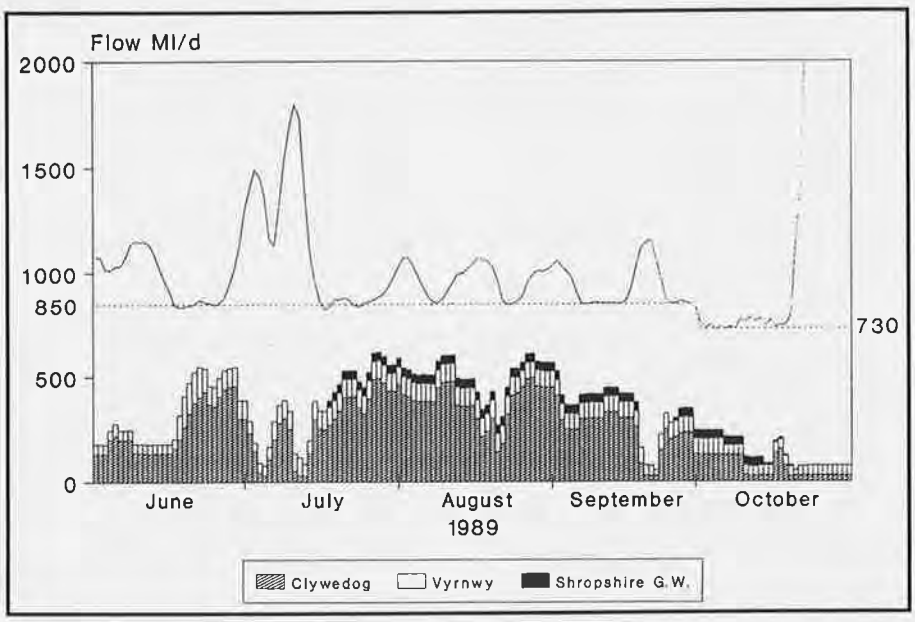


Figure 2 *Regulation releases at Bewdley, 1989, showing 5-day mean and maintained flows*

ments (a prelude to the evening meeting) would be finished.

The fears proved groundless, and the sandwiches (and much else besides), kindly laid on by the NRA, were consumed gratefully. The BHS party had been invited to attend an evening meeting of the West Midlands Branch of IWEM. With **Roger Key**, Acting Branch Chairman, in the chair, the subject was 'Reassessing the Control Rules for Regulating the River Severn': the speaker was **Roger Goodhew**, Principal, Water Resources, NRA Severn Trent Region.

A very thorough presentation of the history and development of River Severn navigation, regulation and abstraction was followed by a detailed look at the factors being taken into consideration by the NRA team charged with reassessing the control rules. This was a subject very much on the minds of the BHS party after the day's visits.

Questions followed, fielded by the speaker and his team, with subjects including water quality, fisheries, and regional water transfers, not to mention the start of Roger Goodhew's career. A vote of thanks was proposed by **David Walker**, to which all those present responded enthusiastically.



Figure 3 *BHS members examining a Severn Groundwater Scheme borehole*

The day had indeed fulfilled its promise. Paul Webster, on behalf of all the participants, thanked the personnel from South Staffs Water and the NRA Severn Trent Region who had helped to make it enjoyable and worthwhile.

Richard Boak
Birmingham

The Australians go from strength to strength

Those of you who were at our first National Hydrology Symposium in Hull may remember that the structure and style of the event was based, to some extent, on the long-established series of hydrological symposia run by the Australian Institution of Engineers. I was encouraged to go to Australia originally by **Professor Crawford Munro** (who was visiting Imperial College at the time I was there) and came back much impressed with their way of doing things. He has passed on, but his memory (he is regarded as the 'father' of Australian hydrology) is perpetuated by the 'Munro oration' which is given by an eminent speaker at each symposium. The other feature of the event is the 'Hydrological Games' which, as many of you know, we have tried to emulate in the UK.

I was able to attend the most recent symposium in Perth, Western Australia last October and it was clear they had come a long way since they began in 1962. For one thing, the pre-published Proceedings run to three A4 volumes, each 1" thick. There were four parallel sessions over three full days, with three keynote speakers - all excellent - who began each day's proceedings in plenary session. The symposium was held - in the Hyatt Regency Hotel - on the theme of 'Challenges for Sustainable Development' although, such is the art of writing papers to suit any such vaguely worded title, this did nothing to constrain the range of topics. There was something there for everybody in hydrology, and everybody in hydrology seemed to be there.

As if the delights of holding the symposium on the banks of the Swan River were not enough, the organisers laid on a full programme of tours and visits for delegates and companions. Perhaps the best of these was an evening cruise on the river down to Fremantle (Cardiff organisers please note!).

When word got out that a BHS member was attending, I was persuaded to judge the hydrological games. I thought at first that this would be better than in 1982 when I found myself singing as part of the "Tasmania and other offshore islands" team, but I was wrong. Their games had grown in complexity and production skills every bit as much as the symposium itself. On each side of the dining hall (where the 300+ delegates were consuming the best Australian beef) was a stage. There was a third stage in the centre.

Your president was marooned in the centre with a microphone, given a totally inadequate briefing and told to help the Mistress of Ceremonies as well as to judge the contest. This (between teams from each state and the "Rest of the World") began with explosions and red smoke from the side stages. Teams competed in pairs, one each side. Each team was given a bag of ping-pong balls and a bunch of drain pipe and fittings together with a plan for constructing a 'pipeline'. Points were awarded for accuracy and speed of construction and according to the number of balls blown through the system thereafter.

At the same time, delegates from each team held a mini-debate on the pros and cons of constructing this pipeline (actually a thinly disguised reference to the contoversial proposals to bring water from Northern Australia to Perth and Adelaide) and I was obliged to assess that too. Everybody cheated of course and confusion reigned supreme. After the four debates I chose a controversial winner and ran for cover.

All in all it was a most enjoyable occasion. The organisation of the proceedings was impressive and there were many excellent papers: more, indeed, than one could hope to attend, however cunning the hopping in and out of the four lecture theatres.

Whether we shall ever see ourselves being quite so ambitious in terms of venue or scope remains to be seen, but this was their twentieth symposium, and their first to go International: we are just planning our fourth.

Mike Lowing

Register of independent freelance consultants

One of the questionnaire items concerned a register of independent consultants (see report this issue). 91 people expressed an interest in this! The next step for those, and anyone else who feels they would like to be included, is to send, by **1st October** directly to the President at his home address (see *Member's Handbook*), the following information, in the sequence requested.

Title
Full name
Letters
Address
Telephone number
Fax number
Age
Employment history: 1 line per employer, with dates
Area of expertise (150 words max.)
Three recent assignments (topics, duration, clients)
Countries worked in
Languages spoken
Availability and status (e.g. vacations only; ties with an employer)

Additional information (including full CV) can be sent in if you like but the above is probably all that will be held in the register. Please also answer the following:

Would you like to see the register
a) Held centrally by BHS and used only to advise would-be clients.
b) Included in the Members' Handbook.
c) Sold (proceeds to BHS) to enquirers?

Finally, would you be prepared to pay a small fee (say £5 annually) for inclusion? (It would not seem right to spread the charge over the whole membership.)

All further correspondence on this issue will be only with those responding now. There will be full consultation, and a chance to check your entry, before publication.

The primary purpose of the register is to enable a prospective client to make contact with one or more possible consultants. There is no present intention to enter the dangerous waters of fee structures, liability insurance and the like.

Please note that it may be necessary to refine the definition of 'self-employed consultant'. At present we envisage the register as containing only the names of those who are (a) BHS members, (b) available to take on work for others without reference to anyone else and (c) working as a sole proprietor or in partnership with one or two others in a similar situation. The nature of your trading arrangements is not the issue - it is simply a matter of deciding who is genuinely freelance. If, in the light of experience, this definition needs tightening then we shall do so.

Mike Lowing

To the young

Are you under 30? Are you interested in promoting the interests of the younger members of BHS (including students) by representing them on the main committee? Can you attend four day-long meetings, in London, each year? [i.e.: have you a sympathetic and generous employer?!]

If you can answer 'Yes' to all these questions, then please write to **Rod Hawnt**, Hydro-Logic Ltd, The Annexe, West Lodge, Rainbow St, Leominster, Herefordshire, HR6 8DQ (*Tel* 0568 616847, *Fax* 0568 616947), or the Editor.

IUCN — The World Conservation Union

Requires a

Freshwater Management Advisor

Principal responsibilities:

1. Support regional office and project staff in the design and implementation of field projects which address the problems of freshwater management including assistance in the design of hydrological studies.

2. Drawing upon the work of these field projects and other relevant studies, further develop IUCN policy in the field of freshwater and river basin management.

3. Work with regional office and project staff in designing a series of training courses in the field of freshwater management. These should pay special attention to the critical role played by freshwater in the functioning of a wide range of riverine and lacustrine ecosystems, and the importance of addressing these issues in river basin planning.

4. Work with the Vice Chairman (Wetlands) of the Commission on Ecology in developing the network of specialists in the field of freshwater that can work with IUCN in developing its role in this field.

The successful applicant will have a higher degree in hydrology or a related discipline and possess five or more years experience in the study and management of natural hydrological systems. Experience in modelling of hydrological systems will be of particular importance. Fluency in English is essential, while a strong command of a second major language, notably French and/or Spanish, will be an advantage.

Preference will also be given to candidates from developing countries. The position is based in Gland, Switzerland.

Applications should be sent to the Head of Personnel, IUCN - the World Conservation Union, Avenue Mont-Blanc, CH-1996, Gland, Switzerland, Fax no: 010 41 22 999 00 02 before 30 September 1992.

BOOKS

Statistical techniques still relevant

Sneyers, R. *On the statistical analysis of series of observations*, World Meteorological Organization, Geneva, Technical Note no. 143, 1990, 192pp.

This Technical Note is an English translation of that originally published in French by WMO in 1975. According to a note *To the Reader* immediately before the contents page, the only additions to the text have been the correction of errata and a few amendments "... which seemed useful". A cursory look at the Bibliography therefore reveals that out of over 70 items only four references and four sets of conference proceedings are dated 1976 or later. Why then should the WMO Commission for Climatology wish to produce an English translation of a 15-year-old Technical Note? The answer, of course, lies in the scope and content.

The Note sets out to summarise those techniques of statistical analysis that are applicable to modelling time series of observed climatological data. The text is divided into three parts: the first discusses the testing of a time series for a simple random model; the second develops the topic of statistical estimation, both parametric and non-parametric, for both continuous and discrete variables, and the third part elaborates on estimation for recurrent, periodic and persistent series. The approach throughout is methodical, with expositions of theory followed by worked examples and occasional summaries of Reference Works Consulted. Despite this agreeable format, the text falls short of being a working manual. The writing style makes few concessions to the non-specialist in statistics and some knowledge of stochastic processes would not come amiss.

Nevertheless, closer study reveals how concisely the author has summarised those tests and procedures that are usually only accessed by hunting through several textbooks. The erudite style is tempered by the occasional piece of practical advice. For example on parametric estimation (p 43): "Choosing functions containing the largest possible number of parameters with a view to obtaining the best fit to the observed values is usually counter-productive", and on distribution fitting (p 82): "It will often be ease of calculation which determines the final choice of the fitted distribution".

A personal disappointment was the lack of full tabulations of some of the original time series employed for the examples. Many of the latter begin with partly-processed results and therefore prevent a total re-working of the data. Nevertheless, this Technical Note will repay study by those who have any interest in time series analysis and statistical estimation in hydrology and climatology. The standard of presentation is as high as readers have come to expect from WMO publications, and only the occasional "et", "ou" and "en", particularly in the third section, betray the origins of the text. The WMO Commission for Climatology were right: a good presentation of basics does not date.

Professor Mike Hall
IHE, Delft, The Netherlands

More flood guidance

Reservoir flood estimation: another look Duncan W Reed and Elizabeth K Field, IH Report 114, Institute of Hydrology, May 1992, 87 pp, ISBN 0 948540 41 9, Price £15.

This IH Report marks another important contribution in the series of publications - begun with the Flood Studies Report (FSR) in 1975 - produced by the Institute on the topic of sizing reservoir outflow arrangements. By citing more than 150 references (most of them post-dating the FSR), the report is essential reading for all who need to be aware of current thinking on the topic.

Chapter 2 of the report contains a particularly useful review of exactly what published guidance is already available in the UK, the relationship between the several guides, and recommendations on which should be used for what purpose. Many users will find the report worth buying for the sake of this chapter (and the associated Appendix B) alone. There is one table of values (specifying seasonal PMP as a percentage of all-year PMP for 1,2,4 and 8-day durations) which is recommended to supersede the existing guidance but otherwise the report is mainly discursive and therefore educational rather than prescriptive.

Perhaps the most surprising finding in the report is that the basic methodology of the FSR has stood the test of time rather well - in most respects at least. It would be easy to attribute this to the fact that the same organisation is involved but this would be unfair. The authors were not part of the original Floods team and would have pulled no punches in exposing major flaws. They have certainly found some minor flaws and these are nicely dissected.

This reviewer (who *was* one of the original team!) admits to finding the chapter on snowmelt rates for PMF design purposes confusing and inconclusive. The original (FSR) recommendations were an awful compromise between accepting that PMP rainfall could occur simultaneously with probable maximum snowmelt (impossible) and ignoring snowmelt altogether (stupid). There was no physical justification for what was done; it was a pragmatic decision, a token allowance. The authors are rightly critical of this but offer no real improvement.

At the recent conference in Stirling a Panel Engineer remarked that the FSR was too prescriptive, that there was too little scope for the exercise of 'judgment'. He would be encouraged, therefore, to read in this report that 'reservoir flood estimation is rarely straightforward, even with strict adherence to the flood standards given in (the FSR)'. This certainly accords with the experience of this reviewer who finds something new in every case even when using the systematic methodology built in to the Micro-FSR program. For example, on the question of catchwaters, the authors make the point that the catchwater hydrograph should be truncated. In a cascade of reservoirs, however, the flows in excess of the capacity of catchwaters in the higher catchment have to be added to the inflow hydrograph for the lower catchment. This raises the question of whether the same catchwater capacity should be assumed for each case or whether conservative assumptions should be made (a high value for the upper catchment design; a low value for the lower): there are plenty of subjective decisions like this to be made.

There is a useful chapter on rainfall-runoff modelling which outlines research in progress and points to expected improvements in the robustness of regression equations used to estimate the expected volume of runoff. There is a chapter (and an appendix) on routing through a reservoir which will be of benefit to those who wish to understand the details of the numeric computation. It exposes the whole sequence of steps and, although the authors do not make the claim, it is understood to be more accurate (particularly when dealing with compound overflow weirs) than existing methods. A full listing of the (FORTRAN) program is included. I liked also the excursions into side issues, one of which deals with the search for an approximate formula to predict reservoir lag. Along the way, we learn that a hydrograph with a nicely rounded peak can be described as 'platykurtic'; I can't wait for an opportunity to use that!

There is a very useful chapter on flood estimation procedures in use in other countries. The authors admit that it is incomplete but it certainly gives us a flavour of what is available elsewhere and may prevent us from imagining that FSR-type techniques are the only ones available. On the whole, however, it would seem that the UK has been

well served by the FSR, not only for its comprehensive use of national data and its recommended application of tried and tested methodologies but also on account of the many research papers and reports which it has been spawning ever since. This latest report continues the tradition of gradual refinement and improvement to the original document: as already said, it must be read by all who use flood estimation methods or profess to understand them.

Mike Lowing
Brightwell Baldwin

British Dam Society Conference

Water resources and reservoir engineering. M.N. Parr, J.A. Charles and S. Walker (eds). Thomas Telford, London, 1992, 424pp, hardback. ISBN 0-7277-1692-1.

This book comprises the 43 papers presented at the 7th conference of the British Dam Society held at the University of Stirling, 24-27 June 1992. The meeting was cosponsored by the British Hydrological Society, the Scottish Hydrological Group and the Institution of Water and Environmental Management, which probably explains the good mix of topics covered, including an unexpectedly high proportion of papers on hydrology, as well as civil engineering and consideration of environmental and botanical issues. The use of computers surfaces in most of the papers.

The volume is divided into three sections entitled: Reservoir Planning, Operation and Environmental Aspects; Reservoir Design and Construction, and Reservoir Monitoring and Maintenance. It explores current issues and recent international developments under these headings.

Section 1 reports a number of uses of hydrological models to predict reservoir yields and reliability. Operating rules for existing and planned reservoir systems are explored using computer simulation techniques. Case studies of water supply for human and hydroelectric station consumption are discussed. The papers reflect the worries raised by past droughts, the fears of the effects of possible climate change, increasing awareness of the environmental impact of reservoir schemes and the recreational possibilities offered by reservoirs.

Section 2 contains papers on engineering practice and hydrological modelling. The prediction of sedimentation effects and the engineering implications of geological setting are presented. Use of reinforced grass and stepped block spillways are described. European standards for spillway flood design, and statistical methods of predicting floods for UK catchments are explained. The plea for appropriate technology and control for small (agricultural) reservoirs is made. Facets, relevant to dams, of a recent report by CIRIA/CUR on using rock in coastal engineering are given.

Section 3 describes instrumentation installed and procedures adopted (often supported by computer aided data acquisition, databases and graphical presentation) in reservoirs and dams in response to legal requirements (e.g. the 1975 Reservoirs Act) or for site and safety investigations. There is much advice to be found on the use of piezometers for monitoring and investigative work. Other papers detail routine and remedial engineering work carried out on dams causing concern. Recent research on protecting dams from wave damage and the effects of ageing are presented. Those interested in the effects of vegetation (including tree roots) on embankment dams will find much of interest in the paper of Hoskins and Price. The final paper outlines the work carried out by the (UK) Department of the Environment since 1983 under its reservoir safety research programme.

Minor disappointments are the

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SIMON Environmental

number of spelling errors remaining in a few papers, and the lack of an introduction from the editors or organizing committee. An overview of the conference themes to give structure to the book would have been very helpful to the reader (even if it just repeated the conference announcement). Some trumpet-blowing on behalf of the organizing bodies would not have gone amiss either. However, the editors are to be congratulated on the prompt production of the book and its collection of case studies of recent computer and engineering applications should prove useful reference material to consultants, engineers and hydrologists involved with reservoir operation, design and supervision. Although the book concentrates on work in the UK, there are many good examples from elsewhere to interest the reader and doubtless to provoke debate about best practices.

Roger Templeman
Garsdale, Cumbria.

Environment Agency

The announcement by Environment Secretary **Michael Howard** that the creation of the new unified Environment Agency is to take place "as soon as possible" must be welcome news to many members after all the speculation. This new body is to bring together all the functions of the National Rivers Authority, Her Majesty's Inspectorate of Pollution and the waste regulation work of the local authorities; the Drinking Water Inspectorate will remain an independent body.

[It would nice to think that BHS views – see Circulation 34 – contributed to the Minister's decision to go for a single, integrated agency.]

Research grants in hydrology

These are titles of some research projects grant-aided by the Natural Environment Research Council – *more next time*:

Experimental modelling of fluvial aggradational sediment sequences (Dr JK Maizels, Aberdeen)

The fate of pollutants in an urban aquifer - or why is Birmingham's groundwater not more polluted? (David Lerner & others, Birmingham)

Snow-melt hydrology (Prof LW Morland, East Anglia)

FRESHWATER QUALITY - recommendations on objectives and actions on eutrophication.

Royal Commission on Environmental Pollution Report No. 16 "Freshwater Quality". Cm 1966, ISBN 0-10-119662-8. HMSO.

This report, published in June 1992, concerns pollution of rivers, lakes and groundwater*. It looks at surface and groundwater use, quality monitoring, eutrophication and acidification, and at a wide range of pollution sources: industrial and domestic waste water and sewage treatment, contaminated land (including landfill sites), transport, farming (in particular nitrates and pesticides), waterborne pathogens.

Possible economic instruments are discussed and comprehensive recommendations are made regarding water quality objectives and management.

The report emphasises that there are elevated levels of phosphates in rivers, lakes and reservoirs in most of central, eastern and southern England and that this contributes to eutrophication. The recommendations made underline the need to set up a comprehensive nationwide system of monitoring of surface water quality, including assessments of eutrophication levels based on:

* biological species diversity assessments
* nutrient level analysis
* definition of quality objectives based on 'natural' nutrient levels

To achieve these objectives, "widespread removal of phosphate from sewage works' effluents may be needed. Substitutes for phosphates in detergents should not, however, be adopted on a widespread basis until their environmental impact has been fully assessed".

The report recommends that the Government investigate steps to facilitate reductions in detergent consumption in areas with soft water, where less phosphate builder would be required to neutralise mineral ions present in the wash water and in textile soils.

The report points out that the use of zeolite, the detergent builder most widely used as a partial substitute for phosphates, implies an increase in sewage sludge volumes and a reduction in its calorific value. The report notes that zeolites act more slowly than phosphates in binding calcium ions and are less active for magnesium ions, thus necessitating the use of co-builders, typically polycarboxylates (PCA) whose "effects on health and the environment have still to be investigated fully".

**Estuaries and coastal waters are excluded, as is drinking water: the first two topics are covered in the Commission's Reports Nos. 3 (1972) and 10 (1984).*

New Members

We welcome the following members to the Society:

Adamson, Dr P. T. ..... Sir William Halcrow & Partners, Swindon
Boak, R.A. ..... Birmingham
Chan, N. W. ..... Flood Hazard Research Centre, Middlesex Polytechnic
Ewen, C.A. ..... Allen Gordon & Co., Perth, Scotland
Ganjigatti, S. B. ..... Bangalore, India
Grey, S. T. ..... Edinburgh Hydro Systems
Hammer, J.A. ..... Nunningen, Switzerland
Jones, C. ..... Mott Macdonald, Cambridge
Jones, H. ..... Caernarfon, Gwynedd
Keegan, L. ..... Reading, Berkshire
McDonnell, R.A. ..... School of Geography, Oxford University
MacKay, R. ..... Civil Engineering Dept, Newcastle University
MacMillan, L.C. ..... South West Water, Exeter
Marshall, C.T. ..... Wigton, Cumbria
Mason, P.J. ..... Reading, Berkshire
Mathews, S.H. ..... Swindon, Wiltshire
Mukherjee, D. ..... Stirling, Scotland
Murchie, R. ..... Eastleigh, Hampshire
Owen, Dr J.M. ..... NRA North West Region, Warrington
Pollard, O.G. ..... Mott Macdonald, Cambridge
Price, M. ..... Twyford, Berkshire
Schofield, T. ..... Leamington Spa, Warwickshire
Slattery, M.C. ..... School of Geography, Oxford University
Tarrant, F.R. ..... Binnie & Partners, Redhill, Surrey
Thompson, I. ..... Birmingham
Vaughan, M.D. .....

FORTHCOMING EVENTS

BHS 'Rolling programme' of future meetings

Date	Venue	Theme	Associated Organisation	Organiser
1992				
7-11 Sept	Hannover	2nd Int. Conf. on Hydrological Applications of Weather Radar	University of Hannover	Prof. Ian Cluckie, University of Salford
7-11 Sept	Hamburg	2nd Int. Conf. on Modelling Global Climate Change & Variability	Max Planck Institut	Dr L Dumenil, Max Planck Institut für Meteorologie, Bundesstr. 55, D-2000 Hamburg 13, Germany
15-16 Sept	Loughborough Univ.	Drought Workshop		Prof. Geoff Petts, Geography Dept, Loughborough University
17 Sept	UWCC, Cardiff	Modelling the River Severn floods	Welsh Hydrological Group, ICE	Linda Aucott, NRA Wessex, Rivers House, East Quay, Bridgwater, TA6 4YS
+ 21 Sept	Leeds	Preferential transport of sediments and solutes from uplands to estuaries	ICE Pennines Group	Prof M J Kirkby, Dept of Geography, Univ. of Leeds, LS2 9JT. Dr J Bathurst, Dept. Civ. Eng., Univ. of Newcastle upon Tyne
22-23 Sept	Montpellier	Régionalisation en hydrologie: application au développement (in French)	ORSTOM	Luc Le Barbe, Centre ORSTOM, BP 5045, F-34032 Montpellier Cedex 1, France
5-7 Oct	Enschede, Netherlands	Workshop: Use of remote sensing in hydrology: runoff prediction models	EARSel / ITC	EARSel Secretariat, BP 209, F-2108 Boulogne-Billancourt, France
13 Oct	Edinburgh (8 pm)	The importance of hydrology in landfill Prof G Fleming, Strathclyde Univ.	ICE Scottish Group	Dr David Gilvear, Dept Environ. Sci., Stirling University, Stirling KK9 4LA
13-14 Oct	Brighton	Symposium: The management of scarce water resources	IWEM/BHS	Conf. Manager, IWEM, 15 John Street, London WC1N 2EB
14 Oct	Chepstow	Catchment drainage strategies for urban development control and flood defence	Welsh Hydrological Group/IWEM	Linda Aucott (address above)
28 Oct	London	Symposium: Engineering implications of climate change	ICE	M Beran (IH) or Chris Collier (Met Office)
1-5 Nov	Nevada, USA	Managing water resources during global change. Am. Wat. Res. Ass: 28th Annual Conf. & Symp.		Raymond Herrman, WR-CPSU, Fort Collins, Co 80523, USA Fax: + 1 303 491 2255
4 Nov	Univ Birmingham	A Eadon, Severn-Trent Water: Practical aspects of stormwater modelling in small urban catchments	BHS Midlands Section	Paul Webster, Dept. Civ. Eng., Univ. of Birmingham, Birmingham B15 2TT
10-12 Nov	Brussels	Conf: Protecting the North Sea: practical steps in controlling waste water	ICE	Conference Office, ICE
18 Nov	Imperial College	Applying meteorology to practical problems	Roy. Met. Soc.	Chris Collier, Met Office
*+ 14 Dec	Sheffield	BHS AGM Land use change impacts		Dr R Ferguson, Univ. of Sheffield / Dr James Bathurst (see above)

* National Meeting
\+ Meetings for which the programme is not yet confirmed; contributions are invited.

Meetings

BHS National Meeting
PREFERENTIAL TRANSPORT OF SEDIMENTS AND SOLUTES FROM UPLANDS TO ESTUARIES
Leeds
21 September 1992

Through nine invited papers, this one-day meeting will examine transport behaviour of different sediment sizes throughout the river basin, from the hillslope via the river system to lakes and estuaries.

Particular emphasis will be placed on preferential movement of fine sediments (clay, silt and sand) and the implications for transport of contaminants, especially agricultural pollutants and heavy metals.

One important outcome of this meeting will be an integrated review of sediment and contaminant transport at the catchment scale, including their export to the sea.

Further information is available from Dr James Bathurst, Dept of Civil Engineering, University of Newcastle upon Tyne, Cassie Building, NE1 7RU. (*Tel:* 091 222 6333, *Fax:* 091 222 6669)

Hydrogeological Group Meeting
CURRENT RESEARCH IN GROUNDWATER
London
2 February 1993

This is an informal half-day session of presentations and posters on current research. It is for PhD students and more senior research workers in the field of groundwater.

Please send an abstract by **1 December** to Dr David Lerner, School of Earth Sciences, University of Birmingham, Birmingham, B15 2TT. (*Tel:* 021 414 6156, *Fax:* 021 414 3971)

BHS & Hydrogeological Group Joint Meeting
HYDROGEOLOGY OF WETLANDS
Birmingham
13 July 1993

Please contact the convenor by **31 December** if you are interested in presenting a paper or a poster at this full-day meeting.

The convenor is Dr David Lerner, School of Earth Sciences, University of Birmingham, Birmingham, B15 2TT. (*Tel:* 021 414 6156, *Fax:* 021 414 3971)

Courses

GEOCHEMICAL MODELLING TECHNIQUES FOR HYDROGEOLOGISTS
Wallingford
28 September – 2 October 1992

This five-day course on hydrogeochemical modelling will be held at HR Wallingford, featuring

- Overview of hydrogeochemistry
- Step by step presentation of theory and application of hydrogeochemical models
- Hands-on experience with transport models PHREEQE and PHREEQM

Presentations will be given by speakers from the Free University of Amsterdam and the Technical University of Denmark.

This course is supported by IGWMC (Delft), IHE (Delft) and TECHWARE Europe.

For further details and application forms, contact Mrs Hazel Dandridge, HR Wallingford, Howbery Park, Wallingford, Oxon OX10 8BA. Tel: 0491 35381 Fax: 0491 26703.

Diary

3rd-5th September 1992
Assn Brit. Climatologists Summer Meeting: "Precipitation: causes, characteristics & consequences"
Venue: St David's College, Lampeter
Contact: Sue Postle (Tel: 071-276 8297)

7th-11th September 1992
2nd International Conference: Modelling Global Climate Change & Variability
Venue: Hamburg, Germany
Contact: Dr L Dumenil, Max Planck Institut für Meteorologie, Bundesstr. 55, D-2000 Hamburg 13, Germany

7th-11th September 1992
2nd International Conference on Hydrological Applications of Weather Radar
Venue: Hannover, Germany
Contact: Prof Ian Cluckie, University of Salford M5 4WT (*Tel:* 061-745 5036)

15th-16th September 1992
Drought Workshop
Venue: Loughborough University
Contacts: Prof Geoff Petts, Department of Geography, Loughborough University (*Tel:* 0509 222791) & Dr John Mawdsley, NRA Northumbrian Region, Eldon House, Regent Square, Gosforth, NE1 7RU (*Tel:* 091-213 0266)

17th September 1992 – note change of date
Welsh Hydrological Group – AGM
"Modelling the River Severn floods"
Venue: UWCC, Cardiff
Contact: Linda Aucott, NRA Wessex Region, Rivers House, East Quay, Bridgwater, TA6 4YS (*Tel:* 0278 457333)

21st September 1992
BHS National Meeting *with Pennines Hydrological Group*
"Preferential Transport of Sediments and Solutes from Uplands to Estuaries"
Venue: University of Leeds
Contact: Dr James Bathurst, Department of Civil Engineering, University of Newcastle upon Tyne (*Tel:* 091-222 6333, *Fax:* 091-222 6669).

21st September 1992
ORSTOM
"Régionalisation en hydrologie: application au développement"
Venue: Montpellier, France (in French)
Contact: Luc Le Barbe, Centre ORSTOM, B.P. 5045, F-34032 Montpellier-Cédex 1

22nd-24th September 1992
2nd International Conference on Hydraulic and Environmental Modelling of Coastal, Estuarine & River Waters
Venue: Bradford University
Contact: Prof. R Falconer, Dept of Civil Engineering, University of Bradford, Bradford, West Yorkshire, BD7 1DP *(Tel: 0274 383871; Fax 0274 383888)*

13th October 1992
Scottish Hydrological Group
"The importance of hydrology in landfill" – Prof G Fleming
Venue: Strathclyde University
Contact: Dr DJ Gilvear, Dept of Environ. Science, Stirling University, FK9 4LA *(Tel: 0786 731711; Fax 0786 67843)*

13th-14th October 1992
IWEM/BHS 2-day Symposium
Management of Scarce Water Resources
Venue: Old Ship Hotel, Brighton
Contact: IWEM Conference Manager, 15 John Street, London WC1N 2EB *(Tel: 071 831 3110; Fax 071 405 4967)*

14th October 1992
Welsh Hydrological Group/IWEM
"Catchment drainage strategies for urban development control and flood defence"
Venue: Chepstow, Gwent
Contact: Linda Aucott *(address above)*

4th November 1992
BHS Midlands Section
"Practical aspects of stormwater modelling in small urban catchments"
Andy Eaton, Severn Trent Water
Venue: Birmingham University
Contact: Paul Webster, Dept of Civil Engineering, University of Birmingham, Birmingham, B15 2TT. (*Tel:* 021 414 5055, *Fax:* 021 414 3675)

14th December 1992
BHS **AGM** and National Meeting
"Land-use change impacts"
Venue: University of Sheffield
Contact: Dr James Bathurst, University of Newcastle upon Tyne (Tel: 091 222 6333, Fax: 091 222 6669)

Copy Deadline for Issue No. 36
8th October 1992

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