THE NEWSLETTER OF THE BRITISH HYDROLOGICAL SOCIETY

Circulation

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From the President



The British Hydrological Society is now a little over two years old, and in that short period our membership has grown from about 350 to nearly 500. This increase is very encouraging and I am sure it goes a long way to vindicating what was described by our first President, *Mr. Michael Mansell-Moullin* as the initial 'act of faith' in forming the Society.

Mike Mansell-Moullin retired from the Presidency on 9 December 1985 and I take this opportunity of thanking him for nursing the Society through its formative years. His tasks have been many and at times difficult. His achievements have been considerable. It was a matter of much satisfaction to me when in 1983 members of the new Society elected Mike Mansell-Moullin to be the first President. It was I feel in total recognition of the part he played personally in promoting the idea for a corporate body of British Hydrologists, especially during the Exeter Symposium held at the first Scientific General Assembly of the International Association of Hydrological Sciences in 1982, and afterwards for his very active Chairmanship of the initial planning group.

On the 9 December when I became your President, I was presented with the President's files of business correspondence. There was a lot of them and they weighed a great deal more than a normally healthy Hydrologist should be expected to carry. Their transport to Newcastle was enterprising and only achieved by the help of several kind assistants. Having now browsed through these files I am able to confirm that the Society's success of Mike Mansell-Moullin's two-year Presidency is not accidental. It is in fact the result of a lot of hard work, a strong sense of good organisation, and considerable enthusiasm. I am very grateful that the base from which I start my work is well founded and very sound and on behalf of all Members I acknowledge and thank the Society's first President for a profoundly successful first two years.

I am sure that Mike Mansell-Moullin would wish me to take the opportunity to acknowledge the support he received from members of the main Committee and especially the work of our Honorary Secretary **Dr. Mike Hall** and our first Treasurer **Mrs. Anne Roberts.** In particular our thanks must go to the main Committee members who retired also in December, namely: **Professor Mike Hamlin** and **Professor Ken Gregory** as well as Mrs. Anne Roberts. We welcome to the main Committee **Dr. Howard Wheater** the new Treasurer, **Dr. Ian Cluckie**, and Mike Mansell-Moullin whose election is I am sure further recognition of his Presidential success.

On 6 January 1986 I attended my first main Committee meeting at which several important issues were discussed.

All members will be aware of the Directory of British Hydrology which is in preparation. First issue of this Directory is later than originally planned. Compiling the many items of interest and useful references from disparate sources is a complicated business and doing it on a part-time basis, as has to be, serves only to prolong the time required. At our Committee meeting final draft copies were given to three members, including myself, for editing before issue. First issue will I hope, be with the next edition of *Circulation*. We anticipate and hope that a period of use by members will promote critical comment for improvement and perhaps correction of subsequent issues, and we will be purposefully asking members for help in this way.

Finance was discussed following a first report from our new Treasurer Howard Wheater. The Committee feels that by making one or two adjustments to the way we administer financial arrangements of National Meetings, it is possible to avoid having to increase annual subscriptions for at least another year; and in doing so we also feel that an appropriate financial reserve will be developed.

The National Meetings Sub-Committee met on the same day as the main Committee. We currently have more ideas for topics on meetings than there will be dates available to hold them to the end of 1988. The 1987 programme is fairly well established. The main Committee hopes to issue a draft of the 1988 programme shortly.

Whilst mentioning meetings it is appropriate to congratulate the thriving Southern and Midland Sections, ably marshalled by Howard Wheater and **Richard Wood.** Their success raises the question whether in other areas members of the Society would wish to form similar Regional Sections. Please remember that promoting regional sections is statutorily part of the Society's aims. Members of the Committee feel that interest in forming regional sections should not be limited by numbers of members represented. Please therefore think about the possibility of forming Regional Sections in your own areas and let me, the Honorary Secretary, Dr. Mike Hall or indeed any member of the main Committee know of your interests.

In the Planning Group's Report, prior to formation of the Society, four important objectives for a Society were declared. These may be paraphrased as follows:

(a) developing a sound balance between the scientific and applied aspects of hydrology;
(b) being not unduly influenced by any one section of the inter-disciplinary interests involved;
(c) remaining self-governing;
(d) having the potential to achieve a high standing nationally and internationally.

The last of these, status, is important and on matters concerned with the science of Hydrology, I am sure the standing of the Society is already high and getting higher. However, I am interested also in the level of standing of the Society insofar as this relates to our

influence on Water Industry affairs. There are I believe, certain measures which may be taken to improve this aspect of our standing and it is a matter which I have already discussed with your Main Committee. We hope to make decisions in this area in the near future. If therefore, any member has a view to express on this rather important issue would you please write your comments and address them to the Secretariat.

The second of the objectives outlined was a matter on which Mike Mansell-Moullin wrote during his Presidential address in the first edition of *Circulation*. He expressed the wish that the Society should be an organisation which would be truly interdisciplinary in outlook and in activity. I fully support this aim and I hope during the next two years that we can in particular foster debate between the different disciplines represented by our Society and especially between different outlooks borne of our different occupations. Different perceptions caused by our various disciplines and occupations can and should lead to invigorating debate. I ask all members to approach our national meetings in this spirit for I am certain that if we do, our contribution to Hydrological understanding will be much enhanced.

A happy and prosperous Hydrological New Year to all members.

Hydrological consequences of the withdrawal from Unesco by the UK

There have been hydrological and water resources programmes in UNESCO for more than 25 years. Initially the effort was concentrated on the Arid Zone, but in 1965 UNESCO launched the International Hydrological Decade (IHD), 'a co-ordinated global programme of scientific observation and research in hydrology'. When the IHD finished in 1974 it was replaced by the International Hydrological Programme (IHP) which entered its Third Phase in 1984. IHP III aims to promote 'a rational policy for the development and management of the World's water resources' keyed to the targets of the UN Water Conference Action Plan (Mar del Plata 1977). It has two main thrusts: a scientific programme and an educational one. IHP III is based on 18 themes. Theme 1, for example, is 'Hydrological processes and parameters for water projects' while Theme 13 consists of 'Promotion of formal education and training in the field of water resources'. Field projects in hydrology and water resources are financed and administered separately from the IHP, usually by extra budgetary funds, but there is close co-operation between the two areas of endeavour.

As with other UNESCO based international initiatives, IHP III is promoted largely by organizing working groups on particular topics and publishing the reports from them, supporting university and technician level courses in appropriate centres and organizing symposia on important subjects usually with international non-governmental bodies, such as the International Association of Hydrological Sciences and publishing the papers presented. There are National Committees for the IHP in 130 member countries.

The UK's involvement in the IHP and in the earlier programmes has always been a critical one. British hydrologists have invariably argued that the programmes are too broad and not sharply focussed on the important hydrological problems. There has been criticism of the recent move away from science and engineering in some of the IHP III themes and into public information and awareness about water resources. There was criticism of the rather slap-dash and inefficient management of the IHD: now there is agreement that the present Water Sciences Division manages IHP III very effectively. There is concern that the publications resulting from the IHP do not reach a wide enough audience.

To provide a focus in one area of IHP III where there has been continuing effort since the IHD, early in 1984 the UK proposed a project on 'Assessing the human influence on the river regimes of Western Europe'. It was suggested that a 6-man team working for 3 years at the Institute of Hydrology should collect and analyse hydrological, land use and other records for Western Europe, but principally from the representative and experimental basin network. If the project proved to be successful for Western Europe, where the records are plentiful, then the techniques would be applied to other fairly hydrologically homogenous regions, for example East Africa. The proposal received considerable support from a large number of Members of UNESCO and was accepted by the governing body of the IHP as IHP III Project 6.1. The project was started late in 1984 with three members of the team being provided by the UK and the other three by Norway, Netherlands and the Federal Republic of Germany. For the first time an IHP project will actually be based on a team working with real data rather than talk in an office.

Consequences of a Withdrawal

Withdrawal will hurt hydrology in the UK in a number of ways. One obvious one is that the initiative that resulted in Project 6.1 may be in jeopardy and the status of the team in relation to the IHP could be unclear. UK hydrologists feel aghast that having made strenuous efforts to get their part of the UNESCO vessel more ship shape, the craft will be sunk by removal of the financial buoyancy.

The present 'advantage' of the UK hydrologists of being involved in the IHP by attending IHP working groups, attending symposia and conferences, acting as key speakers undertaking missions in developing countries and in writing and editing reports for publication may disappear.

The forum of UNESCO itself and the meetings the Organization arranges in Paris and elsewhere are extremely useful contact places where UK hydrologists meet their counterparts from other nations. The opportunity to soft-sell the UK expertise in hydrology and water resources in such places will vanish. Our competitors in the commercial world of consulting engineers will welcome our disappearance.

Following the departure of the USA, our withdrawal from UNESCO and the knock-on effect it may have on countries like Japan and Denmark will probably reduce funds for the Organization by up to 40%. Hence the IHP and the other programmes will suffer cutbacks but in addition to spending its income internally, UNESCO makes fairly generous grants annually to a large number of international non-governmental bodies. One of these is the International Council of Scientific Unions which then divides this money between its component Unions and the Associations in support of activities, such as the organization of symposia. In the case of the International Association of Hydrological Sciences (IAHS) which has its Secretariat in the UK, these grants have totalled $20,000 to $30,000 per year in recent years. Life without these grants will be that much more difficult for IAHS and similar international bodies. Hydrological activities will be degraded generally just at a time when the World's water is becoming more important and when Britain needs to maintain its ability to earn abroad.

John C. Rodda

LETTERS

Dear Editor,

Does anyone know fuller details of an outstanding flood in the first half of the sixth century AD through the city of Tarsus in Cilicia, Southern Turkey (facing Cyprus)? P.N. Ure in his book 'Justinian and his Age' writes on page 238 that –

'At St. Paul's city of Tarsus the mountain-fed river Cydnus had recently caused so disastrous a flood that it had carried away the bridges and flooded the houses to the upper stories'.

The source book is Procopius' 'Buildings' Vol. 5 Chapter 5 written it seems between AD 540 and AD 550 by which time remedial works were complete. Emperor Justinian's response to this flood disaster had been to have 'a new channel constructed for the river, so that henceforth only half its waters flowed through the city in the old channel, and built a new bridge over far broader and stronger than the old, "so that life in the city has been freed of fear and peril for all time".' Clearly a consummate politician but at least one who got the job done.

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Weather Radar and Flood Warning Symposium



Organised by North West Radar Consortium and the Institute of Hydrology

Lancaster University,
16-18 September 1986

Over 150 delegates were presented with the findings of the successful North West Weather Radar Project and were brought up to date on the meteorological developments and uses of weather radar and on the progress of flood forecasting methods and systems. In his concluding remarks *Leslie Crowther* of North West Water said that the Symposium had been held at a very opportune time in the development of UK weather radars. It had demonstrated how co-operation of the Meteorological Office and Water Authorities in the field of advanced technology had led to improved forecasting services in an efficient and effective way.

To set the scene **Vin Collinge** of Lancaster University reviewed the development of weather radar for precipitation measurement and forecasting. Key projects were seen to be the Dee radar project in North Wales, started in 1967, and the North West Radar project started in 1977, the latter now in NWW's flood warning system. Such projects are only possible through collaboration between private industry, Government research and the water industry. Current developments were outlined, including the Meteorological Office work on short period weather forecasting, the FRONTIERS project and the case for a UK weather radar network and its benefits in improving flood forecasts.

George Hill (Met. Office) and **Rob Robertson** (NWWA) then went into more detail about the North West Weather Radar Project which involved the establishment and operation of an unmanned radar station, a major step forward in weather radar system technology. Archiving an integrated, operational system of communications, display and reporting links with North West Water's existing real-time telemetry system for flow forecasting presented many problems, technical and otherwise, which were successfully overcome by the close co-operation of the Meteorological Office and NWW. Indeed, the system has proved to be more reliable than originally expected, and the anticipated frequency of maintenance visits has been reduced.

After coffee **Chris Collier** (Met. Office) entertained, and informed, the audience with some wonderful meteorological expressions in pursuit of improving the accuracy of rainfall figures from radar. A new procedure to calibrate the radar data in real time was described, which used telemetered raingauge data. This initially determines the weather 'type' (frontal system, showers, etc.) and then applies adjustment factors to the appropriate domain. A lively discussion included comments on the costs of operating telemetry linked raingauge networks for determination of areal rainfall to the optimum number of raingauges required for radar calibration, and the possible use of other meteorological parameters in the calibration of radar.

Users' experiences of weather radar was the main thrust of the second session. **Frank Dalton** (Met. Office at Manchester Airport) looked at the role of the regional weather forecaster, especially in an area such as the North West with the Pennine Hills, Welsh Mountains and the Irish Sea influence to contend with. The weather radar display, available since 1980, has proved to be an invaluable source of information on rainfall patterns in the area and has been particularly effective in the short term forecasts. Examples were given of advanced warnings associated with thunderstorms. Improved aviation forecasting was also described where radar helped to give better indications of visibility and cloud bases at airfields in the region.

Once a rainfall warning has been issued by the forecasters then the Water Authority's flood warning officers have the job of monitoring, forecasting and issuing effective warnings if necessary. **Geoff Noonan** (NWWA) showed how North West Water's flood warning system worked and in particular how useful the operational experience of radar in that system had been. Quantitative values of rainfall from the radar were used in automatically running rainfall/run-off models to give early indications of possible flooding whilst the radar display has highlighted the areas of rainfall and their movements. Discussions indicated that extensions to further flood prone areas could now be contemplated with radar data that was now available, but it was acknowledged that the next significant step in improving forecast lead times and bringing in new areas would be the introduction of FRONTIERS.

Appropriately following on from the last paper, **Geoff Sargent** (Met. Office) let everyone into the secret of what the acronym FRONTIERS meant (see footnote for the right answer!). This Meterological Office project uses a sophisticated computer system operated by experienced forecasters to improve short period forecasts of rainfall — up to six hours ahead — using combined radar and satellite data to give, for the first time, some quantitative estimates of precipitation. The system has essentially three parts: (1) correcting the radar picture, (2) integrating the satellite with radar to produce extended coverage of rainfall area, and (3) the forecasting stage. Only the 'cleaned-up' radar picture is disseminated to users — on a trial basis at present — but intentions are to implement FRONTIERS operationally some time during 1986. Perhaps the weatherman will improve his image yet!

(FRONTIERS — **F**orecasting **R**ain **O**ptimised using **N**ew **T**echniques of **I**nteractively **E**nhanced **R**adar and **S**atellite data.)

To complete the day's session **David Newsome** (CNS Science and Engineering Services) brought us up-to-date on what was happening in the rest of Europe about weather radar. Over the last five years a COST (CO-operation in Science and Technology) project has been going on to develop an integrated network of weather radars over Western Europe and devise protocols, etc. to allow useful exchange of data. The Meterological Office have been very active in this project and have developed a noteable software system for merging cloud cover and cloud top temperature information from satellites with radar data to give a composite picture.

During the evening an excellent exhibition of equipment with an international flavour was on view, mainly related to weather radar, communications and telemetry. Anyone who felt like leaving the campus however, could check on the local weather situation using NWW Water's live radar display transmitted from Hameldon Hill.

Tuesday's session began with **Duncan Reed** from the Institute of Hydrology whose paper summarised his investigations into the practice of flood warning in the UK. He gave a qualitative appraisal of several flood routing and rainfall/run-off methods, emphasising the constraints involved in real time applications. A lucid and unprejudiced comparison of various methods of updating or correcting forecasts was made. These included state updating, parameter updating, error prediction, and blending, where a hydrology assessment is usually made graphically.

The following paper by **Richard Douglas** and **Cliff Dobson** described the flow routing procedures used by Severn Trent Water Authority for flood forecasting. Lead times of 12 to 36 hours permit telemetered data to be transferred to a forecasting computer. Channel routing is simulated using separate storage/outflow relationships for the within-bank and out-of-bank flows. Tributary inflows, measured or predicted from rainfall/run-off models, are added to the inflow or outflow as appropriate.

The paper by **Dr Ian Cluckie** and **Meg Owens** from Birmingham University exhibited a penetrating analysis of the problems in determining an ARMA model for online use in North West Water catchments, using calibrated radar data. Model order optimisation is achieved interactively through examination of the Unit Response, a process analogous to varying the shape of the Unit Hydrograph. Changes to percentage run-off are achieved through the delta factor, which is their (strongly) preferred mode of updating forecasts. A most interesting point was that using lower resolution radar data (i.e. 'picture' quality), gave updated forecasts only marginally worse than for high resolution data.

Professor Gert Schultz from Ruhr University illustrated his HYREUN model, using

calibrated radar data from Bavaria. Exponential parameters for the rainfall excess are calculated interactively on the rising levels. Rainfall is treated very differently from the FRONTIERS work. The depth and duration of future rainfall is predicted as a function of rain depth already fallen using conditional probabilities. Forecasts are related to the risk at a particular site by probability of exceedance.

After lunch, **Professor Nemec** of the WMO, Geneva, argued the case for appropriate technology in developing countries, where the technical facilities and skilled manpower resources may not be sufficient to maintain a Weather Radar and its associated telemetry for raingauge calibration data. As on the Welsh Dee, the most cost-effective flood-prediction could be telemetering raingauges or upstream stations and a simple flexible ISO type model. Illustrations of several radar systems in developing countries were presented.

The next paper by **Peter Walsh** and **Tony Lewis** illustrated the place of radar data in the data development policy of North West Water. A system has been developed to incorporate real-time radar, raingauge, river-level, and water quality data into the archive of data gathered by more conventional means. This integrated set of data and programs allows more efficient management of resources and greater thoroughness in hydrological investigations.

In his paper **Bob Moore** from the Institute of Hydrology considered that catchment-wide rainfall estimates were inaccurate, and what might be needed is a separate little model for each part of the catchment, and a method for combining their outputs. The complex calibration is simplified slightly if the parameters are assumed to have a probability distribution over the catchment. Updating is conceivable using the multiple conceptual storages of the model. This approach may be of most value when the rainfall profiles across a catchment differ.

Peter Ryder of the Met. Office gave a thorough run-down on the growth and future of the UK network of weather radars. New radars are to be established in the South West, Lincolnshire, Northern Ireland, and possibly, Scotland. Methods for removal of ground clutter by hardware and bright band by software are being studied, as is interactive control of each Radar Site's calibration parameters using the expertise of FRONTIERS staff. He confirmed that the dissemination of FRONTIERS forecasts is confidently predicted.

Finally **Keith Browning** of the Met. Office showed, with many examples, how useful the images of radar and satellites are to the weather forecasters. The identification of large scale systems and features, impossible with any feasible network of point measurements, enables the Meteorological assessment of growth, decay, and movement of rainfall, fronts, etc. It has already lead to the recognition of new phenomena. When the Meteorological Office achieves the input of these images to their atmospheric models, reliable forecasting for days ahead will be one step nearer.

J.M. Knowles and I.H. Pearse

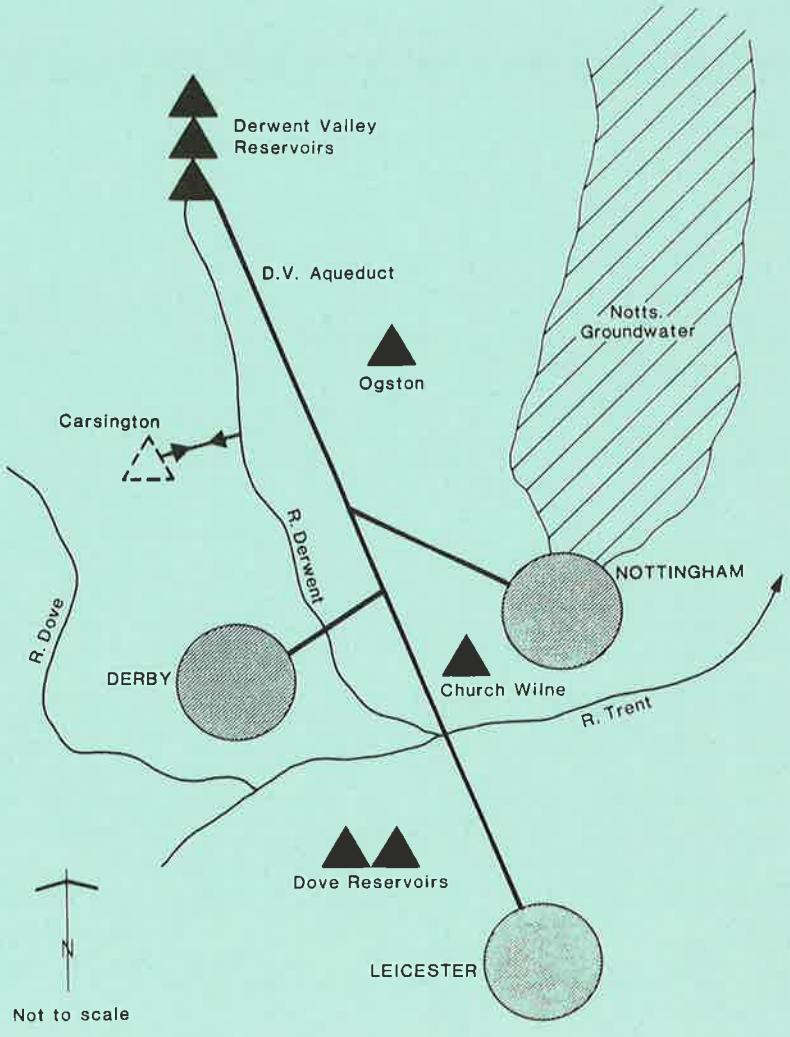
Water Resources in the East Midlands

BHS Midlands Meeting
13 November 1985

What goes up very occasionally and dishearteningly comes down. With demands and resources closely matched in the East Midlands, the well-publicised slip of the virtually completed dam at Carsington in June 1984 has placed an unexpected and frustrating question mark against the way in which Severn-Trent provides sufficient water resources into the 21st Century. An informative and honest appraisal about the current situation and future prospects was given by Graham Sharp (STWA) in a presentation to 50 members and guests at Birmingham University under the Chairmanship of Professor Mike Hamlin (Birmingham University).

The East Midlands Command or Supply area of Severn-Trent covers the three operating Divisions of Derwent, Lower Trent and Soar. The principal urban centres at Derby, Nottingham and Leicester make up a large proportion of the 2.8m population, supplied in total with just under 800 Ml/d. The co-ordinated resource system in the East Midlands is one of three supplying STWA, the other two being based on the River Severn, covering the West Midlands, and a relatively small system in the Upper Trent area for the Potteries.

The main elements of the East Midlands resources system are the rivers Derwent and Dove, the Derwent Valley reservoirs and aqueduct, Ogston reservoir and the Nottinghamshire Groundwater. These elements are extensively interlinked providing considerable system flexibility. Integrated source operation makes it difficult to summarise the yield of the system adequately in a single figure.



Schematic of the major demand centres, reservoirs and rivers in the East Midlands.

However, an ascribed yield in dry weather of 785 Ml/d means there are no surplus resources left to distribute, and no margin during a drought for source, works or strategic link failure. In the short term, this yield figure will be reduced by the need to close down some existing sources, particularly in Nottinghamshire groundwater. Some boreholes are experiencing rising nitrate levels, and there are some over-licensed aquifers.

By 2011, summer season demands in the East Midlands were forecast in 1984 to be 140 Ml/d higher than at present. This is in spite of the industrial recession and reduced leakage levels. Severn-Trent's regional demand forecasts assume growth rates which are near the bottom of the RWA's league of forecasts. Growth rates of per-capita consumption rising from 125 to 160 litres per day are well in line with most other Authorities. Forecasts of savings through leakage control have increased, but recent UK experience has shown that some forecasts have in practice been over optimistic. Demand growth is still expected to rise in the East Midlands, and there is now in 1985 no margin in the provision of resources over demands, exactly as was forecast at the time the contracts for Carsington were let in 1981.

Turning to the history of the promotion of Carsington, the Trent River Authority realised in the late 1960's that a major new source was needed. At that time, demands in the Potteries were included in the calculations, and a pump filled reservoir to regulate the Rivers Dove and Derwent at Carsington was selected for promotion to provide 235 Ml/d in 1978 from several mainly surface water alternatives. After the first Inquiry in 1973, there was a change in the Command area to include Lower Trent rather than the Potteries, with a consequential change in the scheme to concentrate only on regulating the River Derwent. Several other scheme alternatives were added to the list. Among these were notably the raising of Derwent Dam, the introduction of Rutland Water, further development of Nottinghamshire Groundwater, the additional abstraction from Lower Dove and Lower Derwent, and abstraction from the River Trent. Following further Inquiries in 1976 and 1977, the decision letter confirming the promotion was received in 1978, and the powers to proceed were obtained in 1979. The main contracts for the dam and aqueduct were let in 1981. They were scheduled to be substantially complete by Autumn 1985.

In June 1984, with the embankment of the dam nearing crest level, a serious slip occurred over a 500 m length on the upstream shoulder. There was a maximum throw of 13 m, and the movement took place over 48 hours. The mechanism of the failure was conventional rotational slip. It was caused primarily by the presence of yellow clay which had only half of its assumed strength at the dam base, a 'boot' shaped clay core, and progressive failure of the fill material. The core itself was of low strength, but this was to be expected as its role was in making the dam impervious.

The slip has caused a major set back to the completion of the scheme. The need for reapprraisal, fresh planning permission, redesign and reconstruction has put back scheme completion at least to the early 1990s. In the meantime, a package of largely non-capital short-term measures is being implemented. These measures stretch the existing resources and will involve higher revenue costs. They rely largely on increased river abstraction, and the introduction of water into Leicester via a new link from Coventry. These short-term measures are likely to produce about 45–50 Ml/d. However more than half of this increase could be lost after the Notts groundwater problems are taken into account.

A review of the longer-term options was made in Autumn 1984. It clearly included the reconstruction of Carsington, but also the transfers of water into the East Midlands from the Severn resource system, imports from Rutland, and the development of potable supplies from the River Trent.

The present state of play is that Severn-Trent and DoE are awaiting the final report from the DoE's Expert Assessor appointed to consider the Carsington Slip, Roy Coxon. He is expected to report early in the New Year. Reconstruction could start at best in 1987.

Some interesting points emerged in the discussion. In answer to a question raised by Ian Cluckie (Birmingham University), Graham Sharp firmly rejected the suggestion that a national water resources broker might have found a way of making the Rutland option attractive to Severn-Trent. The negotiations between Anglian and Severn-Trent had been business-like. The old chestnut of a National Water Grid came up, which was also decisively rejected now that population and demand growths are so much lower than forecast in the 60s and 70s.

The River Trent could still one day be a potable supply. Richard Wood (STWA) reminded the meeting that the Trent River Authority had considered it to be a long-term objective at the time demands were rising fast. However, Graham Sharp reminded us, until a new source was available it would be inevitable that the risk of appeals to conserve water in dry weather would increase. Professor Hamlin developed the point by asking about the justification for the regional imposition of hosepipe bans in Severn-Trent in 1984. The explanation lay in the need to play safe in such a situation, especially as seen by Central Government, who were clearly most anxious to avoid a national emergency arising from a water shortage at the time.

A final comment from Graham Sharp was that in general, the local view in the Carsington area was that the dam should be completed. Next time it goes up, we must be sure that it's going to stay up!

W.T. Bradford

DIGITAL MAPPING
— Scientific and operational applications

BHS Southern Section/IPHE (Metropolitan District) Meeting 18 November 1985

Two papers were presented at this well attended evening meeting chaired by Peter Herbertson (SWA). The speakers showed that whilst the potential benefits to both hydrology and water resources management of holding mappable information on computer were great, the development work necessary to fully exploit this new approach was considerable.

Roger Moore's (IH) presentation concentrated mainly on the digitisation of the UK river network, a project which had its origins in the now disbanded Water Data Unit (WDU) of the DOE. WDU produced a variety of UK river maps depicting such things as mean flow, pollution levels and fish types. As all these maps were just variations (in colour and line thickness) of the same basic river map, it was clear that the whole procedure could be speeded up if that basic map were held on computer, and the specific cartographic instructions could be input via a graphics terminal.

On designing a database to hold the digital river network, provision was made to allow, within a computer program, 'navigation' upsteam and downstream from any point on the network. Abstraction locations and effluent discharge locations were also recorded, enabling automatic assessment of causes and effects of pollution incidents. The first area to be digitised, NWWA, produced promising results.

In 1982 the project was transferred to IH where it was eventually merged with existing IH interests in spatial data to form the 'hydrogeographical database' project. A major additional objective was to provide a facility so that a user at a computer terminal could request a river map of the UK, zoom in to a particular region, select any point on a river and then ask the system to estimate a range of flow statistics for that point — a procedure which currently takes hours of error-prone map analysis and calculations.

The work required falls into three categories: (a) data acquisition, (b) database design and (c) algorithm development and programming. Of the first of these, digitisation of the UK river network, from the OS 1:50000 series, is proceeding well (see Figure). With the exception of SWA, all the English WAs are involved. The WAs pay for digitising and IH for research and development. Digitising is put out to contract by competitive tender, and costs typically £1,400 per 40 km x 40 km map sheet. Experience has proved the necessity of fixed price contracts with tight specifications. The situation with regard to copyright of data derived from OS maps is still unclear. Other data types required are gridded data, particularly of ground ele-



UK River Network Digitisation — Progress October 1985

vation (termed a digital terrain model). The MOD hopes to complete such a model, based on a 50 m square grid within five years, although at considerable cost. IH have gridded the five type soil map from the Flood Studies Report, and other maps should follow.

The gridded data are being stored on a simple hierarchical database. Such a structure is not suitable for the river data where the choice lies between a network database or a relational database. A network database uses pointers (i.e. numbers held with one item of data which relate to the storage location of other items) making it ideal for upstream/downstream navigation, and quickly finding rivers of a particular name or in a particular grid square. Relational databases are best suited for data that can be naturally expressed in tabular form. Water authorities with digital river networks have opted for network databases, but recent developments may mean that IH have to adapt a relational database for their data.

Recently, IH have developed programs to define catchment boundaries automatically from digital terrain models. These may need to be refined to operate in areas of gentle relief. Mr. Moore's concluding slide showed a very good agreement between a boundary obtained in this way from ground elevation data gridded at 200 m interval and one drawn in the traditional manner.

Neil Cullen (WRC, Swindon) described a pilot project which is being undertaken to assess the feasibility of computerising the maps held by water authorities. This principally involves sewers and water mains with their associated plant, but a large proportion of the digitising work goes into recording other features such as streets and buildings. The project has been split into three studies: water supply and distribution (in SWWA Dart area), sewerage and sewage disposal (YWA Kirklees) and river catchment management (SWA Medway). The project is financed by the water authorities and involves nine WRC staff and seven seconded from the WAs. Two important aspects are comparison with traditional methods and trial operation; the latter in the STWA where there has been an involvement in digital mapping since the late 1970s.

The digitised maps are stored on a database which holds a wide range of additional information such as meter readings, pipe material, date on which a pipe was laid, burst records, pipe depth and road surface material. A flexible query language allows a user at a computer terminal to construct his own questions, for example:(after selecting a particular locality) 'show every concrete road with more than six bursts since 1975'. The database is normally interrogated from a colour graphics terminal which allows the user to zoom in from a map of the UK, through progressively larger scales right down to an individual street. At the highest resolution, an individual main may be pointed to, and all its technical details will be displayed on a separate screen. The different mapped features (mains, sewers, roads, railways, other utilities etc.) may be considered to belong to separate layers, thereby permitting a map composed of any selection of layers and colours to be composed on the screen.

The system should give many benefits because it is a complete information source which is easily maintained, gives centralised information control and is a flexible and powerful tool. So, for example, if a road layout changed or a new main was laid, there would no longer be a requirement to update numerous maps and then distribute copies to all offices; instead there would just be a single edit of the database.

Aware of the possible pitfalls of such a massive exercise ('if you automate a mess, you get an automated mess') the team are making very detailed analyses of the procedures to be computerised. Firstly, rather complex business models are being constructed in which activities are depicted as boxes and information flows as arrows, all with identifying numbers. Secondly, equally complex data models are constructed containing all possible data types, linked by arrows where a relationship exists; for example, type 'water main' is linked to type 'water main failure' in a 'one to many' relationship. The data model for one of the study areas extends over 30 sheets of paper.

In conclusion, Mr. Cullen said he thought that the effect of digital mapping on the water industry would be greater than anywhere else. It could lead to a major change in working practices and had great potential for more effective operation of the industry. To be successful it must have full management backing, and the secondment of WA staff to the project was an encouraging sign.

Dave Morris

BRITISH HYDROLOGICAL SOCIETY
Committee

Membership of the Main Committee, December 1985

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EVAPORATION — Theory and Practice

BHS National Meeting
9 December 1985

The meeting was opened by the retiring BHS president, *M. Mansell-Moullin*. He reminded those present that it was being held as a tribute to Howard Penman who died last year. No single name in the field of evaporation is better known than that of Penman, and his equation is used in countries world-wide. He spent many years at Rothamsted, was an FRS, a member of the Sub-Committee on Hydrology and one of the small number who initiated the founding of the Institute of Hydrology. He was a keen follower of hydrological activities and was supportive of the birth of this Society.

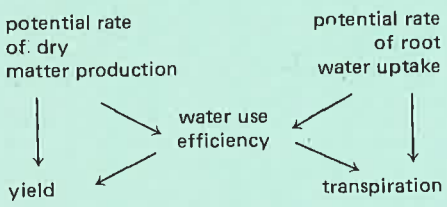


Dr H.L. Penman, OBE, FRS

The opening paper, 'From Penman to present', was presented by **Professor J. Monteith** from Nottingham University who for 13 years had worked in Howard Penman's group at Rothamsted. He outlined the development of the Penman equation in 1948 and showed a picture of the old Rothamsted lysimeter site. The formal theoretical approach of Penman was contrasted with the empirical approach of Thornthwaite. The now classical definition of 'potential evaporation' as being the loss of water from short green cover plentifully supplied with water was explained by Professor Monteith, who also reiterated his aversion to the term 'evapotranspiration'.

There had been two developments from the original equation. The first was the concept of 'equilibrium evaporation' such as that used by Priestley and Taylor. It was shown that the 'α factor' of 1.26 — which has to be applied to obtain potential evaporation from the 'equilibrium' rate — does have some validity for short vegetation, but can give totally erroneous results for taller crops and wet conditions. The work of Morton and Boucher was also described. The second development allows knowledge of vegetation control evaporation to be included by incorporating a 'surface resistance' for the crop into a Monteith-Penman type equation. Examples of how this resistance has been shown to vary with various plant, soil and meteorological factors were given, and importance of rainfall interception, especially for tall crops, was stressed.

Penman had derived irrigation requirements from calculations of actual evaporation which took into account the soil moisture deficit levels at which growth was limited. Professor Monteith suggested that we should now go back and make use of the conservative nature of water use efficiency in crops, with more accent on determination of the potential rate of root water uptake. The 'flow diagram' for future work was illustrated by the following:—



In his talk and subsequent discussion he emphasized the need for much more work on plant physiological carbon exchange (water use dry matter production). Under non water-limited conditions he suggested that carbon exchange was the dominating mechanism, with water use following as a consequence. However, under water-limited conditions how much water the plant 'could get hold of' — and hence the root water uptake — was the critical factor. He stressed the leading world role that the Institute of Hydrology has played and continues to play in all aspects of evaporation studies. Other discussions centred on the agreed lack of root physiology data for tropical forests and the fact that for some areas for practical field applications there was still no alternative to the Doorenbos and Pruitt equation.

After lunch the second paper entitled 'The influence of land use change on water yield in upland areas of the UK' was presented by **Dr. I. Calder** of the Institute of Hydrology. By the late 1970s it had been established that the high interception by trees in comparison with grass could, for wet areas, result in twice the total annual evaporation and a 20% reduction in runoff. A considerable amount of work was going on to extend the knowledge to include, among other factors, the effect of heather removal and of snow interception.

Recent IH process studies were illustrated with descriptions of projects investigating transpiration from heather and forest at Crinan in Scotland; a wet surface lysimeter experiment for rain and snow interception; a mass-energy transport over snow project carried out in Norway; γ-ray attenuation, tree weighing and plastic sheet equipment for rain and snow interception for forests. Typical results for the contrasting evaporation rates from forest, heather and grass [under wet conditions] (.25, .15 and < .1 mm hr^{-1}) were presented. For snow cover the losses were considerably smaller.

Dr. Calder then went on to describe a simple seasonal model for total evaporation and its application to the effect of the afforestation programme at the Crinan reservoir, which showed that in the future the forest could have a severe detrimental effect on the reservoir supplies. Future work would include the development of a comprehensive forest/snow interception model, investigations of the effects of afforestation on low flows in rivers, and larger scale evaporation/atmospheric interaction studies.

In discussion Dr. Calder explained that heather had stronger stomatal control than grass and that the ratio of the annual total evaporation losses for these surfaces will depend on rainfall, 1500 mm being the level at which the ratio is unity. Small amounts of evaporation from snow had been observed under freezing conditions, but the highest rates were when the surface was at 0°C. He also further explained the γ-ray technique and stressed the need for more work on low flows.

The third paper entitled 'Surface hydrology in models of global climate: where are the data' was presented in lively style by **Dr. A. Henderson-Sellers.** She explained that the representation of runoff in a water budget model for a general circulation model (GCM) is very different from a basin modeller's concept. Most GCMs see the land surface merely as a 'bucket' to be filled to a fixed capacity which then overflows. The global modeller has to simplify many processes, uses a very coarse grid (e.g. 5° × 5°), needs 'minimal but accurate' data and has significant problems with forcing agents such as diurnal variations, precipitation and the planetary boundary layer. A good data set is needed for land use/vegetation. At present only four are available and these are far from perfect. It is also very difficult to validate a GCM due to a lack of comparative data. She illustrated the complexity of the processes with an example of the feedback effects demonstrated by a GCM study of large-scale deforestation in the Amazon.

There is an urgent need for more data. Dr. Henderson-Sellers expressed her worry that the proposed 'HAPEX' study in France, which will use a 100 × 100 km grid, might be too small to be of significant use for GCMs. The ISLSCP project in the USA will go up to 400 × 400 km — of the same order as some GCM grid squares — so may be more useful. There is at present a whole order of magnitude difference between observed and modelled data — a gap that is proving very difficult to bridge.

In subsequent discussions it was agreed that process researchers were a long way from providing all the necessary surface data that modellers will require for detailed studies, but it was important that meteorologists and climate modellers meet together to discuss their work and needs. It was hoped that the very important mesoscale processes could be incorporated into future models.

Dr. M. Frere from FAO in Rome gave the first of two more practical papers entitled 'The FAO method of crop monitoring and forecasting'. (31 years previously Dr. Frere had shared an office with John Monteith in Howard Penman's department at Rothamsted). The first FAO work described covered the assessment of land use potential. There was a need for an inventory of present and potential land use to help work on the resources of the tropics available to support its growing population. Ranges of crop suitability maps have been produced for many areas and have been incorporated into a comprehensive agroclimatological data base. The volume covering Africa has already been published and those for other areas will follow soon.

The second role of FAO described was agricultural monitoring and forecasting. Much suffering can be saved if an early warning can be provided that unfavourable weather conditions are likely to result in a bad crop. Charts of precipitation, crop coefficients, ET etc., are used to determine water requirements for each crop. Calculations of precipitation minus water requirements then gave the reserve and an index of 'water satisfaction' as part of an FAO early warning system. Crop production depends critically upon the even distribution of rainfall during the season as well as on the total annual amount.

Dr. Frere ended his presentation with an additional section stressing the vital role of crop monitoring and the relevance of remote sensing techniques for this purpose.

In the final presentation of the afternoon **Dr. M. Carr** of Silscoe College gave a paper entitled 'The practical use of evaporation estimates in irrigation'. For many farmers the problem of irrigation scheduling i.e. how much water to apply, when and to which crop, was of paramount importance. Irrigation has taken off in the UK especially since the mid 1970s when pressure systems and hose reel winders became common. The quality as well as the quantity of the crop depends upon irrigation practice, and water needs to be applied at precise times. There are two methods to test for irrigation requirement: field assessment of soil moisture with its associated point sampling problems; or crop water balance such as either the UK Met. Office MORECS system for 40 X 40 km grid squares, or a more localised approach using a dedicated local computer system. There are many complex factors to be taken into account such as how much water is actually applied, soil crusting problems, uniformness of water application etc., and the critical soil moisture deficit for irrigation need which depends on crop type and time of year. Even if all the problems can be dealt with there need to be very careful financial checks on the value of expensive irrigation schemes which are simply not worthwhile for some crops.

In a joint discussion period following the last two papers Dr. Carr re-emphasized how much the different value of a crop depended on its quality and agreed that the policing of water use by farmers was very difficult. Dr. Frere discussed the problems of incorporation of conceptual rainfall variability into the FAO crop limit and yield studies. It was also suggested that at present the NOAA vegetation index is difficult to interpret, especially near arid areas, due to the large pixel size of the data.

In closing the meeting the new president of the BHS, **P. Johnson**, thanked all the lecturers for their useful contributions and **Dr. J. Shuttleworth** from the Institute of Hydrology for helping with the organisation of the scientific programme.

The Society apologises to the speakers and participants that some of the speakers' notes that had been sent in were not available for distribution at the meeting. Copies of the papers by **Drs. Calder** *and* **Henderson Sellers** *are available from the BHS office on request (enclosing SAE for 22p, please).*

H.R. Oliver

Working Party on Regional Activities

Background

When the Society was inaugurated in November 1983 there were uncertainties about the best way in which regional activities should be developed and the interaction between these and those of the Institution of Civil Engineers' (ICE) three Regional Hydrological Groups (Pennines, Scottish and Welsh). The wish was to ensure that all BHS members, particularly those in the more remote areas, should benefit fully from the Society's activities whilst avoiding conflict with or duplication of the Groups' activities. Accordingly, the Society set up in March 1984 a Working Party consisting of the following members to look into this matter:—

M. Mansell-Moullin
(President)
W.L. Jack
(Representing the Welsh Hydrological Group)
R.J. Sargent
(Representing the Scottish Hydrological Group)
P.D. Walsh
(Representing the Pennines Hydrological Group)

The present situation is summarised in this note and proposals are made.

Present position

The members of the Working Party have exchanged ideas and held meetings and discussions. Proposals made to meetings of the Society's Main Committee and subsequent developments have led to the evolution of the following:—

a) Friendly working relationships with each of ICE's three Regional Hydrological Groups.

In January 1984 each Group was invited to propose a member whom the Society could invite to represent it on the Main Committee. Mr. W.L. Jack, who was already an elected member of the Society's Main Committee, was nominated to represent the Welsh Hydrological Group. Mr. R.J. Sargent and Dr. P.D. Walsh were nominated by the Scottish and Pennines Hydrological Groups respectively and were co-opted on to the Main Committee for a period of two years.

This arrangement was completed in early 1984 and has ensured close initial co-operation and understanding between the Society and the Groups; including the avoidance, as far as possible, of clashes in the dates of meetings.

b) Joint meetings.

The Society agreed to try to hold at least one joint meeting with each Group annually. In practice, there have been the following joint meetings up to October 1985:—

Pennines Group	1	(September 1985)
Scottish Group	1	(September 1984)
Welsh Group	2	(October 1984, May 1985)

Thus it appears that this target may be difficult to achieve. This may be due partly to the relatively small numbers of BHS members likely to be able to attend meetings in the three regions, in view of the concentration of members in the southern and central parts of the country. However, the principle of joint meetings is established. Topics on broader issues than on those related to engineering hydrology, which the Groups tend to arrange are preferable for joint meetings.

c) Free and open co-operation.

This is being achieved in a variety of ways, including the circulation of the Groups' programmes of meetings to all BHS members through the Society's quarterly newsletter 'Circulation'. The Groups know all about the Society's activities through their representatives on the Main Committee and through the important contributions to the Society's activities made by those who are members of both a Group and the Society.

d) Complementary regional activities.

The Society has already established two Regional Sections, Southern and Midland. These meet the local needs of many members. Some members in other regions have taken part in the ICE's Regional Hydrological Groups' meetings.

Proposals

The Working Party proposes that, in view of:—

- the good relations established between the Society and the Pennines, Scottish and Welsh Hydrological Groups of the ICE;
- the development of successful regional activities by the Society;
- the success of the Society's arrangements to hold technical National Meetings countrywide;
- the successful but limited number of joint meetings which have been held by the Society and Groups together

the Society's Main Committee should:-

- continue and foster liaison with the Regional Hydrological Groups and maintain good relations with them;
- continue to arrange joint meetings with the Regional Hydrological Groups;
- review the arrangements for representation of the Groups on the Society's Main Committee;
- continue to review the Society's regional activities;
- send a report on the Society's regional activities to all members through the Society's newsletter and send copies to the Chairman of the ICE's Regional Hydrological Groups for their information.

NEWS FROM MEMBERS

REORGANISATION

In North West the integration of Rivers Division and Head Office will combine, from 1st April, hydrology, hydrometry, licensing, water archive and flood warning into a single section, to be based at New Town House, Warrington. **Peter Walsh** has been appointed the principal and will advise us of the other senior appointments for inclusion in the next issue.

Margaret Fallon writes to tell us that Yorkshire Water's Rivers Division is being reorganised (having got off lightly in 1983). Most people are now in post, but have not yet moved offices. There will be two land drainage area offices, instead of the current four, at York and Doncaster. These will deal with maintenance work and planning liaison, with design and construction carried out by a central team, in Leeds.

The Water Resources Section will be split into Hydrometrics, Groundwater, and Water Management and Licensing, as at present. Hydrometrics are losing the Instrument Technicians to a central unit, and the two hydrologists to a Special Projects Group. This Group will be involved with hydraulic and hydrological modelling, flow forecasting, and hydrological analysis, among other things. Work has already started on implementation of the Division Telemetry Scheme, with the preparation of a draft functional specification.

MEMBERS ON THE MOVE

Anglian Water Authority have closed down their Boston office. The Hydrology Section of the Lincs Division have now gone to Waterside House, Lincoln (Tel: 0522 25231) and the Water Resources Section have gone to Harvey Street, Lincoln (0522 39221).

Faith Church, a hydrogeologist with the Colchester Division, has left AWA to join the Environmental Studies Group of British Gas.

John Sutcliffe, who left IH late last year, seems to be as busy as ever, with trips to China, Botswana, Ethiopia, and Senegal, and commitments at both Reading and Southampton Universities.

John's post at IH has been taken over by **Tony Debney** who, as Assistant Director — Research Marketing, has to try and keep the Institute commercially solvent to satisfy NERC's financial gurus. NERC's Second Corporate Plan is at a late draft stage and we note that the emphasis on shedding manpower is still a key component of the perceived strategy for survival.

Ben Piper and **Chris Green**, both of IH, are about to leave the UK for a year, Ben to Thailand and Chris to the Yemen.

Stuart Pomeroy of YWA has gone on sabbatical for a year to Canada. He will be doing research into real time modelling for an MSc in Hydraulics and Hydrology at the University of Calgary.

RESOURCES

David Evans of Anglian Water Authority tells us that Colchester Division have completed test pumping for the Stour Augmentation Groundwater Scheme, a rather unusual augmentation plan where groundwater storage is available for surface reservoirs in dire need — so long as the demand is only once every 10—15 years because recharge rates are very slow.

Cathy Glenny's news from Thames Water is that a project has begun with CIRIA called 'Rising groundwater levels in the London Basin and the engineering implications'. The main consultants are Ove Arup and Partners, with Halcrows also having an interest. Thames are providing the hydrogeological data and the model which is being developed by WRC, as reported in the previous issue of *Circulation*.

'South West Water has recently commissioned a £230,000 study of the potential water resources of East Devon, reports **Neil Whiter**. The study will be carried out by consultants, Mander, Raikes & Marshall over the next 18 months. At present, East Devon is mainly dependent on groundwater, but the study will examine all available options including pumped augmentation of the river Axe and the more flexible use of Wimbleball Lake on Exmoor. The study, which will include an environmental impact analysis, has been prompted by the increasing demand for water in the region and the rising level of nitrates in the groundwater.

'It was the East Devon area that suffered during the recent flooding along with the staff of the Land Drainage Group who had to remain sober whilst manning the Flood Warning Office on Christmas Day! Most of the flooding appears to have had return periods of between 5 and 10 years.'

BHS National Meetings

Many Members may have noted from the Diary section in previous issues of 'Circulation' that BHS was hoping to participate jointly with the Remote Sensing Society and the British Geomorphological Research Group in a meeting on 'Remote Sensing Applications in Geomorphology and Hydrology', to be held during the Annual Conference of the Institute of British Geographers at Reading on 8/9 January 1986. When arrangements for this meeting came to be finalised during the Autumn, the Main Committee were very concerned to find that the local organisers of the IBG Conference were intending to charge BHS Members who only wished to attend the joint meeting the full conference registration fee of £25. The Main Committee felt unable to endorse this proposal, and, after representations to the organisers had failed to result in any concessions for BHS Members, withdrew the Society from co-sponsorship of the meeting.

Since no further national meetings were scheduled until mid-April the Main Committee have therefore organised an additional meeting on 'Hydrological Data Management in the United Kingdom, to be held at the Institution of Civil Engineers in London on Monday, 17 February 1986 starting at 11.00 a.m. Further details of this meeting will be distributed to members shortly, along with booking forms.

STOP PRESS!

The Society is planning to hold a National Meeting on 'The Social and Environmental Aspects of Water Resources Projects' in 1987.

If any members have important expertise in this topic and would like to contribute to the meeting, would they please write to the organiser, Mike Mansell-Moullin, care of the Society.

BHS Membership

We welcome the following new members to the Society:—

O.O. ADEBOWALE	Department of Water Res. Nigeria
A.O. ADIGUN	Student
M.C. AGER	Student
K.H. BISHOP	Research Student, Cambridge
M. BOISSON	Student
L. HAMILL	Lecturer, Plymouth Polytechnic
P. McGRORY	Sales Engineer, DRS Ltd
G. Parissopoulos	Student
S.C. ROSE	Student

IAHS Scientific Assembly 1986

Prospective participants in the IAHS Scientific Assembly to be held in Budapest from 2 to 10 July 1986, who are normally resident in the UK, are of postdoctoral status and are not in Government or Research Council employ, are advised that applications for financial assistance (with travel and subsistence cost) from the Royal Society should be received by *28 February 1986.*

Financial assistance for young scientists, including postgraduate research students, resident in the UK will be available from the IAHS Assembly Fund administered by the Royal Society; applications should be received by *1 April 1986.*

Requests for application forms should be made as follows:

(a) *For grants from the Royal Society*, to:
Miss B. de Vere
The Royal Society
6 Carlton House Terrace
London SW1Y 5AG
(tel: 01-839 5561 ext. 222)

(b) *For grants from the IAHS Assembly Fund*, to:
Mr. C.R. Argent at the same address as above (tel. ext. 249).

Information circulars can be obtained from Dr. A. Szöllösi-Nagy, Executive Secretary, 2nd IAHS Scientific Assembly, Water Resources Research Centre (VITUKI), H-1453 Budapest, PO Box 27, Hungary.

Publications

BHS Additions to IH Library

1. Scottish Forestry — January, April 1984; January, April, July October 1985.
2. US National Committee on Scientific Hydrology (Symposia conferences, meetings, courses, seminars) — April 1985 and November 1985.
3. USGS — Water resources research programme 1983.

Other publications

We should like to draw your attention to two other publications whose details have been submitted to us recently.

The first is **Managing Wastes: The Duty of Care*** — the eleventh report of the Royal Commission on Environmental Pollution. The Report's principal recommendation, reflected in its title, is that all those who produce waste should have a duty of care to ensure that their wastes are subsequently managed and disposed of without harm to the environment. The duty of care requires that security of waste stream is maintained through an unbroken chain of accountability and responsibility — from producers, via handlers and transporters, to disposers — so that the risk of pollution does not occur, and that final disposal is by the best practical environmental option.

Areas are identified where the environment is at risk from pollution by wastes because adequate standards are either not established or not enforced. The Report makes recommendations for remedying these deficiences and for enhancing the status and professionalism of waste management and pollution control in the UK to secure the high standards of environmental protection that the public expects.

There are specific recommendations (68 in all) for avoiding waste or reducing the waste stream by recycling and reclamation of materials, for good practices in waste disposal by landfill and incineration, and for providing more public information about waste to encourage more responsible attitudes and to enable us all to make a positive contribution to the task of reconciling national and local priorities in waste management.

**Cmnd 9675, HMSO. £12.50.*

The second is a new directory called **World Vision Europe Resource Directory.** The aim is to draw attention to existing important information available to individuals/agencies involved in development work in Third World Countries.

The Directory consists of eight sections — Development, Relief/Disasters/Refugees, Health, Water/Sanitation, Agriculture, Technology, Logistics and Recruitment/Orientation. Each section is divided into sub-sections dealing with specialised agencies, training courses and publications; cross-references to other existing information sources are given when known.

Copies available from: World Vision Europe, 146 Queen Victoria Street, London EC4V 4BX.

Price £3.50 (single copies) or 50p per section, plus postage.

BOOKS

Water Balances

New Approaches in Water Balance Computations, edited by A. Van der Beken and A. Herrman. IAHS publication 148, 1985. 167 pages, paperback, $20.

These proceedings of a workshop in Hamburg (1983) contain five keynote lectures, two general reports on papers presented and six of those papers. An interesting snapshot of the current state of part-of-the-art, the book suffers from the usual diseases of conference proceedings. It is neither complete nor consistent, and contains nothing radically new or very useful. The workshop was probably stimulating and worth attending because of the diversity of delegates and the candid reviews of papers made in the general reports; this does not mean the proceedings are worth publishing.

One interesting paper extolls the virtues of *World Water Balance and Water Resources of the Earth*, published in Russian in 1947, and in English by UNESCO in 1978. The interest is in the unasked question 'why bother?'. The global balance is dominated by the oceans (97%), the world freshwater balance by glaciers and snow pack (69%). Despite the care obviously taken over the atlas of water resources, the maps are at a scale of 1: 10 000 000 and rely on indirect estimates of resources for much of the world. Surely the results can be no more accurate than a local hydrologist could guess by visiting the catchment?

The other papers use a conventional approach to water balances, with soil moisture storages depleted by potential evapotranspiration. None seem to tackle the two fundamental difficulties: (1) How do we move from point to areal estimates? (2) With the high errors in measuring any component, and the apparent sensitivity of unmeasurable components like recharge, can we ever expect to make good estimates from few data? Or phrasing the question more optimistically, is there feedback anywhere in the soil-plant-water system that makes any component stable and so a better candidate for estimation?

As the proceeding have been published, borrow it from a library for two papers:

(1) Wheater and Sherratt on field validation of soil moisture models ;

(2) Bergström and Sundqvist on water balance mapping in Sweden.

David Lerner

Climatology and Meteorology

Climatology — An Introduction, by J.E. Oliver and J.J. Hidore, Charles E. Merrill Publishing Company, Columbus, Ohio, 1984. 381 pp. £25.95.

The authors, who are both members of United States' universities, aimed to provide an up-to-date, easily understood account of the causes and effects of climate. They have achieved this with an interesting, very readable book which is well illustrated with clear maps and diagrams.

In the first and longest part the physical processes causing climate are outlined. This is followed by a description of regional climates, in which the world is split into tropical, mid-latitude, polar, highland and North American climates. The third part covers past climates, the causes of climatic changes and forecasts of future conditions.

An appendix gives further information, mainly on physical laws.

Each chapter contains a summary; also an example of the way in which the topic discussed in the chapter has been used to solve real problems. This is a good approach which emphasises the many practical aspects of climatology. As the media expose increasing numbers to world events such as acid rain,

typhoons, the Sahel drought and televised meteorological satellite images, so must the interest in climatology and its practical role grow.

The relatively few references in the book are mainly to American work and most of the examples and maps feature north American conditions and studies. However, there are also maps showing global features. Many unusual pieces of information are included; oxygen level variations in geologic time, the widely varied impacts of a winter storm in Illinois and the issuing of frozen chunks of wine to troops in Flanders in the severe winter in 1468! Readers will neither find details of local climatic conditions nor of scientific research but all, and particularly hydrologists, will have their ideas and interest broadened wherever they live or work. Some chapters might be selected as having particular interest to hydrologists but it would be better for each to look through it for himself; probably in a library in view of its relatively high cost.

Mike Mansell Moullin

Meteorology, by A. Miller and R.A. Anthes, Charles E. Merrill Publishing Company, Columbus, Ohio, Fifth Edition, 1985. 169 pp. £8.95.

This slim book deals with atmospheric processes in the lowest 10 km. Written by two members of the US National Centre for Atmospheric Research, the main topics are the properties and physics of the atmosphere, although there are also chapters on climate and weather forecasting, which includes a short section on weather modification. Applications of meteorological knowledge are only mentioned briefly. Most of the examples given are from the North American continent.

The preface does not state for whom the book is intended but the style and the problems at the end of each chapter suggest that it is for students in the United States who are starting to study meteorology. It is likely to have limited interest to others.

Mike Mansell Moullin

Urban Hydrology

Urban Hydrology, by Michael Hall. Elsevier Applied Science Publishers, 1984. Hardback, £28.00.

This is a scholarly review of the principles and practices of urban hydrology and related topics. The form of the book invites continuous reading and its concise form makes this possible. Comprehensive indices by subject and by author are provided for the majority who will dip into the book in search of specific information. The range of authors cited is impressive, and references are complete, so that library search for sources should be easy.

Work in the UK and US is well-covered in the references, but other geographical areas find few references. This may reflect the balance of effort but much has been done on the mainland of Europe also.

Dr. Hall has worked on urban hydrology for many years in the University and in consulting practice. He was closely involved with the work described in the 'Guide to the design of flood storage ponds', 1976.

The academic connections of the author and his book are stated in the Preface. The text has been prepared from lecture course material to post-graduates and practising engineers. The reader who wishes to become involved in planning and engineering schemes will find that the book provides a sound background and guidance to methods and to references which lay out procedures in detail and worked examples. The book does not give or set examples of the procedures required. This makes for brevity and clarity of argument, but will limit the appeal to some readers. Flow diagrams are well-used to illustrate the text.

Water quality changes resulting from urbanisation and approaches to modelling are also covered. This relatively new and highly complex topic is reviewed well, with description of the models available and their strengths.

The parts of the book which deal only with urban hydrology are the chapters on urban climate, (Chapter 2), Part III, dealing with hydrological problems of urban areas, (Chapters 8 and 9) and Chapter 12, stormwater management. Other parts of the book cover other areas of hydrology and statistical techniques which relate to urban problems or are useful in urban hydrology, but not specific to it. I find these other sections of interest, for they are well-written and well-balanced. I wonder whether, within the 300 pages, a much-expanded treatment of the strictly urban hydrology would have been more appropriate, with the material of more general use being dealt with by reference? The book would then have been quite different. Perhaps there is room for another on the topic to follow this one?

I recommend the book to all who have to deal with applied hydrology of urbanised or urbanising catchments. The book deserves a wide readership as it is both instructive and very readable. By contemporary standards, the price is not excessive.

Paul Helliwell

Urban Drainage Systems, edited by R.E. Featherstone and A. James. CML Publications and Pitmans, 1982. 520 pages, paperback, £28.00.

The book is a collection of papers presented to a conference in 1982. The aim of the organisers, working under the auspices of the Computational Mechanics Centre, Southampton, was 'to provide a forum for presentation and discussion of the latest advances in the techniques of analysis and design of urban drainage systems including water quality aspects with particular reference to mathematical modelling'.

The organisers are to be complimented on assembling a lively set of contributions across the field. The greatest number of papers are on case studies, but there were also no less than ten papers on Stormwater Quality Models.

The Section on Storm Inputs attracted only two papers. This seems to be commonly the case in such gatherings. It is not clear whether there is nothing further to be said on this topic, whether workers in the topic seek other outlets, or whether there is no news. As the first of these reasons is unlikely, there is cause for concern in this imbalance.

Sections on Planning, Optimisation and Management and on Structural Design and Physical Modelling attracted ten authors between them. Papers came from Europe (the Editors obviously think that the UK is not in Europe, as it gets separate mention in their Preface), North America and Japan, with one paper from India.

The discussion is not recorded, so we must make our own decisions on the merits of the papers and manage without contributions from the floor. Publication without discussion removes a great burden from Editors and one which I also avoided after my own Conference on the subject. In my case Peter Colyer, then of Hydraulics Research, circulated a separate summary of discussion to delegates and anyone else who discovered its existence. I am not aware that this invaluable addition is available for the work under review.

The absence of authors from the core group involved in the Wallingford Procedure is not too serious, as that work is thoroughly described and publicised in other works. In fact the absence of this major group gives greater opportunity for other lines of work in the UK to be presented in their own right.

The book provides ideas and demonstrations, albeit without criticism, except that favourable criticism is implied by acceptance by the editors. It should take its place among the literature on the subject and is well worth acquiring to set with amongst others, the Proceedings of the International Conferences and the Wallingford Proceedure set.

Paul Helliwell

Groundwater

Flow Phenomena in Porous Media, by Robert A. Greenkorn. Marcel Dekker Inc., New York and Basel, 1983. 550 pages, hardback, $90.

This is a review of research into flow in porous media written by a Professor of Chemical Engineering with interests in oil production. To be more precise, it reviews laboratory and mathematical research of the 1960s and 70s, and contains virtually nothing on phenomena observed in the field. Written in 1978 it has taken some time to appear in print. This is unfortunate, at least in the groundwater sections, as there has been much interesting work on stochastic descriptions of aquifers and dispersion phenomena in the intervening years which would have fitted well.

The first five chapters are the theoretical basis, dealing with single fluid, multi-fluid immiscible and miscible flows. The sixth chapter deals well with similarity, scaling and the basis of modelling. The last three chapters are devoted to Applications in Petroleum Engineering, Groundwater Hydrology and Soil Science. If the Groundwater chapter is representative, then all three are relatively lightweight and of little use to practitioners.

Overall, a book only of interest to researchers interested in academic descriptions of flow in porous media at the laboratory scale. And at $90, a book to be borrowed, not bought!

David Lerner

Correspondence on book reviews (comments, suggestions for books, offers of help) should be addressed to: David Lerner, Department of Geological Sciences, University of Birmingham, PO Box 363, Birmingham B15 2TT. Tel: 021 472 1301 ext. 2560.

FORTHCOMING EVENTS

Meetings

INTERNATIONAL CONFERENCE ON WATER QUALITY MODELLING IN THE INLAND NATURAL ENVIRONMENT BOURNEMOUTH 10-13 June 1986

Technical sessions will run for three half-days and will focus on the following aspects:

- surface flows and pollutant transports;
- transport of pollutants through the saturated and unsaturated zone;
- integrated water quality modelling of the land phase of the hydrologic cycle;
- pollution processes in large inland water bodies;
- effect of polluting discharges on receiving waters.

Further details from: Ms Jacqueline Pounsford, Conference Organiser, BHRA, The Fluid Engineering Centre, Cranfield, Bedford. Tel: 0234 750422. Telex: 825059.

SYSTEMS ANALYSIS IN WATER QUALITY MANAGEMENT IAWPRC SYMPOSIUM IMPERIAL COLLEGE, LONDON 1-3 July 1987

The programme will comprise three types of sessions: a number of sessions on the key theme of the meeting 'Systems analysis — from theory to practice'; two sessions of topical interest (information technology and acid rain); and several workshops. A Software/Systems exhibition is planned.

Further details from Dr. M.B. Beck, Dept of Civil Engineering, Imperial College, London SW7 2BU. [Note that abstracts are required by 30 April 1986.]

IAHS AT IUGG VANCOUVER 1987

XIX GENERAL ASSEMBLY OF THE INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS UNIVERSITY OF BRITISH COLUMBIA VANCOUVER, CANADA 9-22 August 1987

The aim of the IAHS General Assembly is to promote the advancement of the hydrological sciences, to review new developments in selected fields, and outline new directions for future research.

The main themes include: Climate/hydrology interactions with emphasis on climate change; Transport and movement of pollutants in surface and subsurface hydrological systems; Snow and ice studies; Environmentally sound methods of water management, including sediment studies.

Call for Papers: Full details of the Symposia and Workshops planned are obtainable from the IAHS Office, c/o Institute of Hydrology, Wallingford, OX10 8BB.

Extracts of papers are required by **15 May 1986** for IAHS Symposia and for **30 September 1986** for IAHS Workshops.

COURSES

GROUNDWATER POLLUTION 21-25 APRIL 1986 UNIVERSITY OF BIRMINGHAM

A five-day course emphasising the practical aspects of groundwater pollution studies, designed for both technical staff and decision makers in water authorities, the waste disposal industry, and consultants. Features of the course include field visits, workshops and illustrations with UK and overseas case histories.

Booking forms from: Mr. D.N. Lerner, Dept of Geological Sciences, University of Birmingham, PO Box 363, Birmingham B15 2TT. Tel: 021-472 1301 ext. 2560.

APPLICATIONS OF SURFACE GEOPHYSICS IN HYDROGEOLOGY 21-25 APRIL 1986 UNIVERSITY OF BIRMINGHAM

Aimed particularly at hydrogeologists, hydrologists, pollution specialists, and personnel in the extractive industries; non-mathematical and no previous experience in the use of geophysical techniques is required. Includes a two-day practical session.

Booking forms from: Dr. R.D. Barker, Dept of Geological Sciences, University of Birmingham, PO Box 363, Birmingham B15 2TT. Tel: 021-472 1301 ext. 3137.

Diary

12 February
Pennines Hydrological Group/Lancs Branch of ICE.
North West Centennary Lecture 'Water Management for the Future' — Mr. Bryan Oldfield, Chief Executive and Deputy Chairman, NWWA.
Council Chamber, County Hall, Preston. 17.00 h for 18.00 h.

17 February 1986
BHS National Meeting.
'Hydrological data management in the United Kingdom'.
Institution of Civil Engineers, London, 11.00 a.m.
(*Further details to be posted to members shortly*).

7 March 1986
Scottish Hydrological Group.
"Groundwater for rural water supplies in Scotland." Introduced by N. S. Robins.
No. 2 Lecture Theatre, McCance Building, Strathclyde University, 18.00 h for 18.30 h.

20 March 1986
The Hydrographic Society.
'Recent developments in hovercraft technology with particular reference to surveying' — B. Russell, ARE Hasler.
'The Weir' Public House, Sunbury Lane, Waltham-on-Thames.
Contact: Michael Boreham, Manager, The Hydrographic Society (01-597 1946).

20 March 1986
Welsh Hydrological Group.
"Operational catchment modelling in real time." Introduced by Dr. I. D. Cluckie.
Welsh Water Authority, Becon, 16.30 h for 17.00 h.

17 April 1986
British Hydrological Society.
"Process studies and their application." BHS National Meeting.
Dept. Geography, University of Bristol.

23 April 1986
Pennines Hydrological Group.
AGM followed by "Economic design of stream-gauge networks". Introduced by Dr. D. Ball.
University of Newcastle-upon-Tyne, 14.00 h.

28 April 1986
BHS Southern Region.
'Overseas research and development in surface water resources — current research and future needs' — S. Pond (IH), K.S. Sanmuganathan (HRL), M.J. Hall (Sir W. Halcrow & Partners) and T. Evans (Sir M. McDonald & Partners).
Hydraulics Research Ltd., Wallingford, 2-5 p.m.

14 May
BHS National Meeting.
"Design and Operation of Water Resource Systems."
Loughborough University.

15-16 October
Scottish Hydrological Group/Royal Society of Edinburgh.
'Hydrology in Scotland'.
Edinburgh.

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