THE NEWSLETTER OF THE BRITISH HYDROLOGICAL SOCIETY

Circulation

No. 5 **February 1985**

First Annual General Meeting

MINUTES

PRESIDENT'S INTRODUCTION

The President opened the AGM by referring to the aims of the Society and the extent to which they had been reached during its first year. The aims, as set out in the draft statutes, are "to promote interest and scholarship in both the scientific and applied aspects of hydrology and to foster the involvement of its members in international activities". At present, the total membership is over 400, of whom 45% come from Water Authorities, consultants and similar organisations and 40% from the teaching profession and research organisations. These proportions represent a healthy balance between the scientific and applied aspects of hydrology. The Society's present links with about 20 other organisations have been effected largely through an exchange of literature and correspondence. The Newsletter is now distributed to hydrological societies and associations in Australia, Canada, China and the USA as well as several United Nations and other international organisations. Further contacts are being developed.

Very good working relations have been established between the Society and its two associated organisations: the Institute of Hydrology and the Institution of Civil Engineers. Earlier concern by some members that the independence of the Society might be reduced as a result of these associations has proved to be unfounded. The Society has established two Regional Sections, in the Midlands and in the South, and its relations with the ICE's three Regional Hydrological Groups (Pennines, Scottish and Welsh) are proving to be most satisfactory. Joint meetings with them and other organisations have been held or arranged.

A report based on a recent questionnaire on Professional Status and Qualifications will be prepared early in 1985. A Hydrological Directory will be produced in 1985. The annual Membership Directory will also be prepared.

The Society's Main Committee members have played an important and major role in running the Society and in laying sound administrative foundations. With a comprehensive programme of meetings arranged for 1984/85 there will now be more time to plan for future meetings. The emphasis of the meetings in the forthcoming year will be on events run jointly with other Societies. The Society's first year had been successful and members could regard the future with confidence.

REPORT OF THE HONORARY SECRETARY

In the first year the Main Committee had held six meetings, the main item of business being the programme of technical meetings. Without the benefit of prior planning, the mounting of the year's National Meetings had involved considerable effort but had been rewarded by good attendances. Reports on all National and Regional events had been included in the Newsletter, which had proved to be particularly useful in communicating with members.

REPORT OF THE HONORARY TREASURER

The Society's expenses had been modest in the year under review. A number of items of expenditure are not likely to be repeated in 1985. However, a rise in the meeting expenses may be anticipated. Application had been made to the Charity Commissioners for the Society to be given charitable status.

A motion by the President, seconded by **Dr. I.D. Cluckie**, for the adoption of the accounts was carried without dissension.

REPORT OF THE EDITOR OF THE NEWSLETTER

During the year, four editions of the Newsletter "Circulation" had been published. In all four issues and in future ones the aims were, and will be, to be topical; to give information on personalities; to be original and to act as a shop-window for the Society.

Members' comments on the Newsletter were welcomed by the Editor.

STATUTES

The Initial Planning Group had prepared draft Statutes for the Society and these had been in use during the first year. The Main Committee had reviewed these in detail, some changes had been discussed and a final draft agreed. This had been circulated to all members. No comments had been received. On a proposal by the President, which was seconded by **Professor P. Novak**, the revised statutes were adopted without dissension.

PRESIDENT'S CLOSING REMARKS

There being no further business, the President closed the meeting after thanking the Honorary Officers, the Editor of the Newsletter, the members of the Main Committee and its supporting staff, the organisers of the Regional Sections for their successful and strenuous work during the past year. He also thanked all those who had contributed to meetings and provided facilities for them.

A vote of thanks to the President was moved from the floor by **Mr. F.V. Appleby** and carried without dissension.

The meeting was attended by 55 members.

★ **HAVE YOU PAID YOUR SUBS?** ★

A gentle reminder to all members who have not yet renewed their subscriptions -- you are holding up the publication of this year's Membership Directory as well as depleting the coffers.

NATIONAL WEATHER RADAR NETWORK

(If you want to know more about this topic, please note the BHS Southern Section's meeting "The London Weather Radar Project" on 11 March and the BHS/WMO/NWWA Weather Radar Consortium's meeting 'Weather radar and flood forecasting" at Lancaster University on 16-18 September.)

The London weather radar, at Chenies in the Chilterns, came officially on-line on 16 January, to provide the latest link in the integrated nation-wide weather radar network. This new installation is a Plessey 45C radar, with a range of up to 130 miles to cover southeast England.

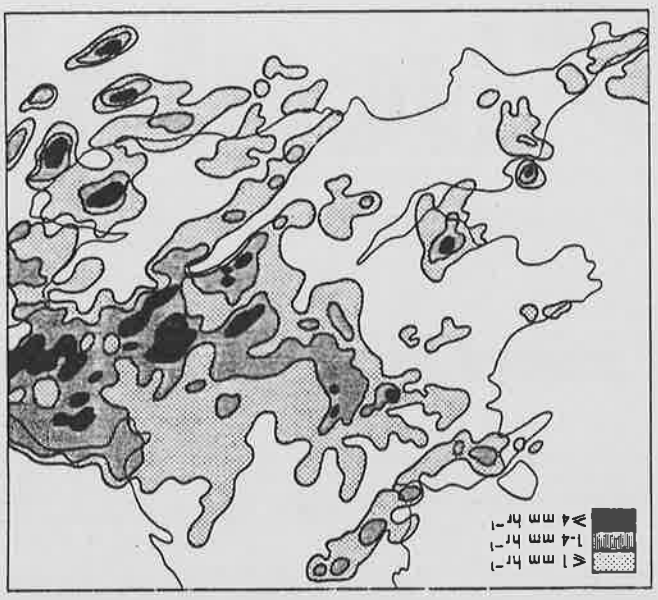
Each radar in the network has its own on-site mini-computer which is used to accept the raw data, apply various corrections, and output the data in a number of formats to a variety of locations. A field of surface precipitation is transmitted from each radar site every 15 minutes. Data from individual radars are supplied in a 3-bit format to a number of Met. Office locations and Water Authority users. Data from the individual radar site computers are also fed to a compositing centre, presently at Malvern but soon to be at the Met. Office in Bracknell.

Further extensions to the network have been considered by a joint Met. Office/Water Authorities Assn. working party. This group has proposed a cost-beneficial way of continuing with radar installations in England and Wales and the potential benefits of radar to Scotland are being investigated.

Exchange of data between the UK and other countries is taking place under an EEC project, with the UK acting as the centre for producing, on an experimental basis, a picture combining radar and satellite data using radar data from the UK, Switzerland and France, and later, it is hoped, from the Netherlands. Such real-time data exchanges have now begun. If the utility of a European composite picture is demonstrated, a fully operational system may follow.



Coverage of the weather radar network at present. Radars are at: (1) Camborne, Cornwall; (2) Upavon, Wiltshire; (3) Clee Hill, Shropshire; (4) Hameldon Hill, Lancashire; (5) Chenies, Buckinghamshire; (6) Shannon, Republic of Ireland; (7) Brest, France, and (8) Dammartin en Goelle, France. The circles show the range of generally useful coverage for each radar (around 150 km). The maximum range is 210 km.



An example of the instantaneous rainfall distribution, as observed by the radar network, showing light, moderate and heavy rainfall. This example is based on data collected using five of the radars ((1) to (5) in Figure 1) at 2030 GMT on 23 November 1984.

Main Committee's Activities

The Seventh Meeting was held on 30th October 1984. The arrangements for the first AGM on 10th December were finalised. An important part of the AGM would be the adoption of the Society's Statutes. Some changes in the initial draft Statutes had been discussed in recent months and a final form was agreed for submission to the AGM. The accounts for the first financial year, to the 30th September 1984, which showed a credit balance of £850, were agreed and submitted for auditing, prior to circulation to all members. Much of the remainder of the meeting was taken up with the planning of the programme of technical meetings and reviewing the success of recent meetings. Any views of members on the arrangements for meetings would be most helpful.

The Society's brochure had been completed, under the guidance of **Des Walling**, and was now in use. Copies are held by **Norman Tyler** and all Committee members. The analysis of the questionnaire on Professional Status and Qualifications was continuing. Much of the most valuable information was in the form of opinions and suggestions, which were difficult to categorise. However, **Bob Sargent** was examining these and would be reporting his findings to the Committee, who would then decide on the next step.

The first Membership Directory had been well received and it was decided to produce this annually. Over the previous few months, discussions on the possible production of a British Hydrological Directory had been in progress and this was agreed. Initially, it would consist of about 20 loose-leaf pages, so that it could readily be changed or expanded in the future. About 10 sections were envisaged, including information which it would be helpful to have on hand such as summaries of the locations, telephone numbers, roles, etc. of relevant Institutions, Societies, Water Authorities, Purification Boards, Research Institutes, Universities, Private Sector Employers, International Organisations and others. The possible inclusion of a section on instruments and equipment was being considered. **Logan Jack** (Welsh Water Authority) was co-ordinating the inputs, which are being prepared by Main Committee members, and any suggestions from the Society's members would be most welcome. They should be sent to him. We plan to complete the Directory in the autumn of 1985.

The President and Secretary of the Institution of Civil Engineers held a meeting in the autumn with the Chairmen of all the societies associated with the Institution and **Mike Mansell-Moullin** attended this. There are nine such societies, the BHS having the fourth largest membership. A useful exchange of views on the activities of the various societies took place and the ICE's President (**Tony Gaffney**) praised their work, One of the outcomes of the discussions was the notice in the November issue (No. 4) of *Circulation* on the publication of papers in the Proceedings and the call for referees.

During the first year, Main Committee meetings were needed at about two-monthly intervals in order to establish the Society's activities and administration. Now that this hectic period is over, meetings will be held about quarterly; much to the relief of the more-distant members! Let us know about any ideas, suggestions, or other matters which you would like to be considered.

Deforestation and Salinity Problems in Western Australia

In southwestern Australia, westerly winds bring brine-laden air over the scarp of the Darling range. The salty rain infiltrates to the kaolinite clay underlying the metre or so of topsoil but the soil water content and water table are kept low by the deep rooting cover of Jarra forest. When the forest is clear felled for agriculture, or so the theory goes, rising water levels intersect with the streams and are responsible for both land and stream salinisation.

Several groups are studying the phenomenon and exploring alternative theories in an attempt to develop optimum corrective management policies. Bob Hebbert, Senior Lecturer at the Dept. of Civil Engineering, University of Western Australia, working with Roger Smith of the US Agriculture Research Service at Fort Collins, Colorado, has developed a two-dimensional model, HILLS, to simulate the movement of water and salt in the type of profile typical of the region, i.e. a shallow surface soil underlain by a relatively impervious subsoil.

Passing through the UK in January, Bob gave a seminar at IH and explained more of the problem and his model.

The model simulates both saturation and Hortonian overland flow, vertical flow in the unsaturated soil profile and lateral Darcian flow in the saturated portion of the shallow surface soil. Seepage is also accounted for, either to or from a deeper aquifer. The model is designed to study the interaction of these components and in particular the development of surface seepage areas at the bottom of the hillslope. Levels of salt concentration are attached to the three major flow components to simulate the movement of salt.

Recent modifications of the model have included the addition of an evaporation subroutine and a facility to accommodate hillsides with variable slopes.

To date the model has been used to simulate streamflow from a small experimental hillslope section, the rise and fall of a perched aquifer and the changes in stream salinity during a storm.

Whilst awaiting a fuller understanding of the processes involved, the State Government has elected, in particularly sensitive areas, to attempt reversal of the land use change. Replanting the forest cover (and compensating the farmer) may be the answer, equally, it may not be that simple; the research continues.



Salinity sensitive area of Western Australia. (Courtesy: Public Works Dept., Western Australia.)



Typical salt-affected stream showing fatal effect on trees and ground cover.

SHAKE-UP FOR NERC

The Natural Environment Research Council has revealed a new Corporate Plan to its Council members — described as yet as a "draft" and, at the time of writing, still not released to all staff — which has proposals for streamlining the NERC to make it better able to cope with the realities of expected diminished Government support for environmental science in the near future.

The first public glimmerings of the existence of the Plan came at NERC's Press Conference to launch its latest Annual Report when Chairman Hugh Fish outlined his ideas about the future direction of Council support. We understand that:

(1) it is NERC's intention to extend support for the universities from the present 12% up to 21% by 1989 (*Good!*)
(2) overhaul the NERC research programme so that support goes to key areas of science; this will regrettably mean cutting back on "less-essential" work (*Hmmm . . .*)
(3) increasing support services to scientists (*Lovely!*)
(4) however, all these things can only be done by getting NERC staff numbers down at a rate much faster than the present decline — subsequent press leaks say that this is to be a 30% cut over the next four years (*Oh dear!*)

When pressed further on the amount of money needed for reorganisation, Mr. Fish said he thought that "£2-3 million should be needed to implement the restructuring". (*Redundancy pay?*)

While the cloak of confidentiality is upon the Plan, there's very little to add at this stage but BHS members should be aware that changes in the support for hydrological research may be in the offing. Water Industry members in particular may take some comfort in the fact that "reorganisation/rationalisation" hits at other professional hydrologists too.

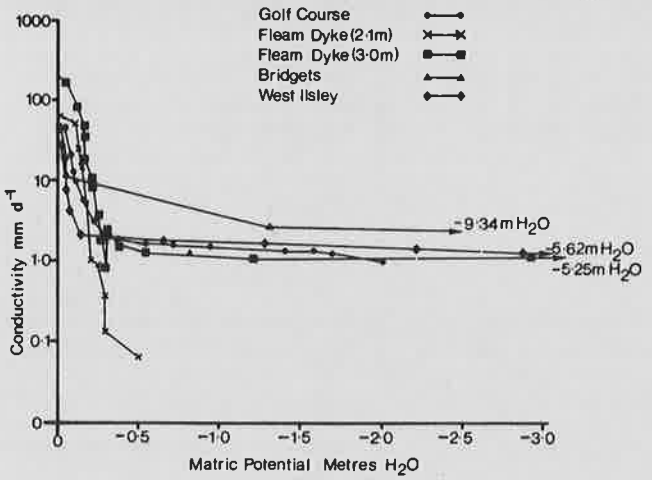
Editor

CHALK HYDROLOGY

BHS Southern Section Meeting 15 October 1984

It is a measure of the importance of the chalk aquifer to the water resources of Southern England that over 90 people turned up to this meeting at Wallingford.

David Cooper (IH) started his talk on the flow processes in the unsaturated zone of the chalk by showing a series of slides of the weathering profiles which varied from 0.8 m on the Berkshire Downs to nearly 2 metres near Cambridge. Beneath the weathered profile chalk demonstrates a remarkably uniform pore size of around 1 μm. Laboratory derived hydraulic conductivities are in the range of 1 to 10 mm/day and agree well with most field measurements, but, field observations indicate infrequent rises in hydraulic conductivity of up to 100 mm/day and these have been ascribed to fissure flows. The extraction of water within the chalk pores is well within the range of most plants and can result in water movement upwards from as deep as 10 metres below ground level. So chalk soils are not prone to droughts. Chalk soils do not waterlog either — when the chalk matrix potential becomes limiting water flows in the fissures.



Plot of unsaturated hydraulic conductivity measured in situ at 2.1 m depth (Fleam Dyke also at 3 m) at four grassed Chalk sites. The curves illustrate the constant conductivity and low matric potentials due to the Chalk matrix and higher conductivities at high potentials contributed by the fissure system.

Mike Price (BGS) then embarked on a "first principles" search of the missing transmissivity (T) within the English Chalk. The search started with the coccolith graveyard of the chalk matrix, the permeability of which could only yield a miserly T of 0.3 m^2/day. The primary fractures within the chalk mass contribute something more "passable" with a T of 30 m^2/day. In desperation one can invoke a chalk rubble horizon (such as exists in the Norfolk Chalk) to wring out a transmissivity of 50 m^2/day. To get the high T's associated with all our favourite pumping tests we need that special ingredient within the chalk — solutionally widened fissures. Just one fissure can produce a transmissivity of 200 m^2/day. Fissure sets can be picked out by packer testing, T.V. logging and even associated with specific heights above ordnance datum. Fissures can also be detected by plane hopping hydrogeologists in grey suits in adits!!

The clarity and simplicity of Mike Price's presentation seemed to be a direct result of the wealth of evidence the BGS team has collected on flows in saturated chalk.

John Barker (BGS) then speculated about how pollutants might move through the saturated zone of the chalk. Simple (*sic*) one-dimensional models of chalk flow were constructed. Dispersion coefficients were disregarded in this instance. A simple plane parallel fissure geometry was assumed and values ascribed to the matrix porosity and fissure separation. Diffusion coefficients were provided by courtesy of the Letcombe Laboratory. Such a model gave some insight into what order of pollutant movement might be expected in the chalk. 10 metres in 10 years. For one kilometre the average movement time is 1,000 years.

These results prompted a discussion on the interpretation of C^{14} results of which we will no doubt read more in future.

The break for T (cups/day) produced a change of scale in the presentations. **David Oakes** (WRC) stressed the need for field measurements to obtain a better understanding of flow mechanisms with a view to calibrating and building better groundwater models. The first problem was how to characterise the lag between recharge and the watertable response. This could be anything up to seven months depending on the depth and configuration of the unsaturated zone. A transfer function was used to describe this time lag and had been used successfully to model a stage of the Great Ouse groundwater scheme. One-dimensional solute transport models had been applied to the downward migration in the unsaturated zone of nitrates and tritium with a good correspondence between compiled and observed values. The problem of accommodating variations of permeability and storativity with depth in saturated chalk was reviewed. Of particular note was the success of the Rushton radial flow model in modelling the Thames Chalk. The success of two-dimensional solute transport models applied to the saturated chalk was demonstrated by an example of the spread of saline minewater discharge on the Kent Chalk.

The discussion centred around the role of fissures in contributing to the chalk transmissivity and the meaningful time step required for a chalk solute transport model — unresolved.

Brian Greenfield (TWA) first described with the aid of annual hydrographs and downstream flow accretion/loss diagrams, the range of hydrological conditions associated with chalk and clay catchments within the Thames area. The lump modelling of chalk river flows has been developed to include a soil moisture accounting procedure followed by two stores in series — one linear and one non-linear. The soil moisture accounting procedure is basically a water balance along the lines of that developed by Penman in the 1940s. Two important modifications were made to this following the drought of 1976. Percolation is allowed as a fixed percentage of daily effective rainfall and actual evapotranspiration is considered to be at 0.3 of potential evapotranspiration during increasing soil moisture deficits.

The same model has also been successfully applied to generating runoff from clay catchments. Consequently in catchments of both clay and chalk, a hydrograph can be generated by the sum of two separately calibrated lumped models.

In some chalk catchments, particularly those subject to extensive groundwater abstractions, there are considerable lengths of river channel from which flow is lost to the underlying strata. Realistic modelling of river flow over those sections required that flows were generated for the section upstream of the influent reach and then routed through a leakage model. Leakage from the river channel was considered to be a function of water depths in the channel and the initial "dryness" of the river bed.

The chairman **Howard Headworth** (SWA) introduced the discussion on all the contributions by the question that all the water resource vultures had been waiting for: when could the plot scale findings of the Institute of Hydrology, that were obviously at variance with the much abused Penman model, be applied at the catchment and resource unit scale? David Cooper was guarded but optimistic in his reply. He felt that plot findings could be extrapolated but only from several plots and after a lot more data collection. David Oakes confessed that he was a Penman addict and the Penman model with a 15% rapid recharge successfully modelled tritium and nitrate profiles. The presence of a rapid recharge system in the chalk was echoed by Brian Smith. Howard Headworth concluded that there seemed to be an increasing agreement between plot scale experiments and the catchment scale models in chalk hydrology which promised to be more successful in the future.

David Burgess

Environmental Problems and Water Quality Management

BHS Southern Section Meeting
19 November 1984

In introducing the speakers, Howard Wheater commented that hydrologists were increasingly faced with complex environmental problems with implications for water quality management. Such problems required a multi-disciplinary approach, and posed difficulties in the methodology of research required and the management of policy decisions. It was hoped that the two speakers would illustrate these issues and provide guidance for research management and decision making.

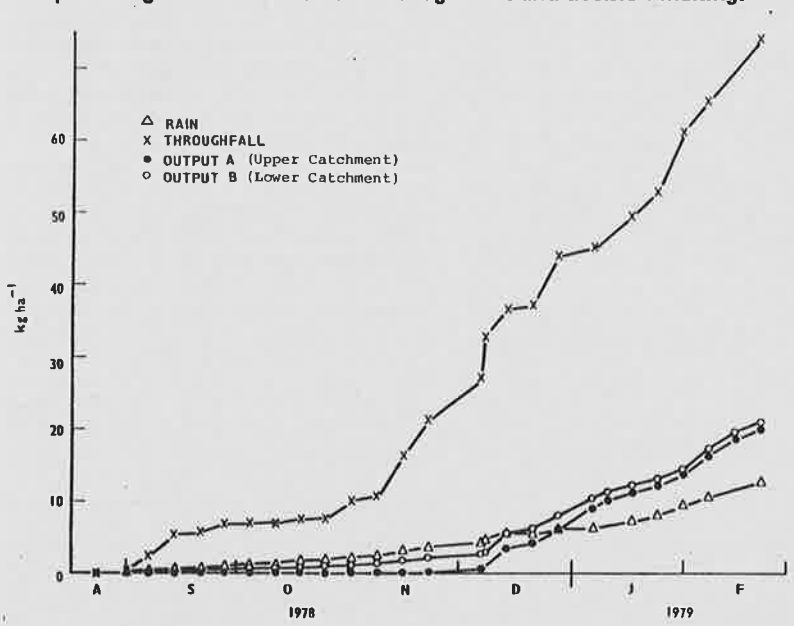


Fig. 1 Cumulative sulphate outputs and inputs.

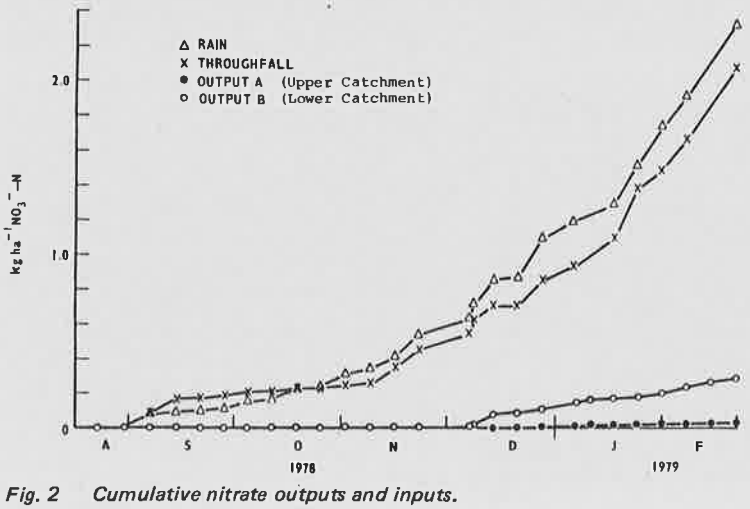


Fig. 2 Cumulative nitrate outputs and inputs.

Richard Skeffington of the CEGB presented a talk entitled "To what extent does acid rain affect water chemistry?". The work he described was based on studies of rain and streamflow quality in the Tillingbourne Catchment, a tributary of the Wey, near Dorking, Surrey, and dealt with the problem of chemical transport associated with acidic rainfall. This is a particularly important ecological issue because of the possible effects on fish life, and an issue with major policy implications for the CEGB.

The Tillingbourne catchment has an area of about 1 km^2 and is mainly forested (Silver Birch, Oak and Scots Pine) with about 70% bracken cover. It has the distinction of currently having the most acidic rainfall measured in rural Britain, with a mean pH of 4.15. The catchment has been instrumented with two flow gauges and two rainfall collectors, and water quality measurements have been made on a weekly basis over a period of 3-4 years.

Cumulative fluxes of N (NO_3^-, NH_4^+), SO_4^{2-} and H^+ entering and leaving the catchment demonstrate quite different responses (Figs. 1 and 2). Evaporation would be expected to increase residual ion concentrations, but cumulative nitrogen outputs are much less than inputs due to absorption by vegetation and soil. In contrast, calcium and aluminium outputs far exceed inputs due to ion-exchange and weathering processes, although little information is available to quantify exchange kinetics and weathering rates. Al^{3+} is of particular concern since it is highly toxic to organic life forms, and this ion is particularly sensitive to low pH values due to the response of the aluminium buffer system. The mobility of SO_4^{2-} was also discussed. Inputs are complex, including dry and wet deposition which is difficult to separate from vegetation recycling, and the transport of acidity (H^+ and Al^{3+}) to streams SO_4 is held to be dependent on the mobility of anions, particularly SO_4^{2-}.

Considerable temporal variability of response is observed, with large storm events yielding low pH values and high SO_4^{2-} levels. Knowledge of hydrological pathways is important, but generally unquantified in acid rain studies, and spatial variability of response is clearly demonstrated by contrasting data from the two gauging stations, indicating, for example, the effect of saturated near-stream areas.

In summary, sulphur deposition is seen to be a potentially important influence on stream quality, but chemical and hydrological processes interact to give a complex response. Research is required to establish kinetic exchange and weathering rates and these must be assessed in terms of hydrological pathways.

The second speaker of the evening was **Bruce Beck**, from the Civil Engineering Department of Imperial College, who spoke on his experiences in the use of modelling and systems analysis gained as a member of a team commissioned to study the process of eutrophication in Lake Balaton (Hungary).

The basic problem was that overfertilization of the surrounding agricultural land was causing stimulated growth of algae within the lake. This was resulting in undesirable effects such as problems with water quality odours and filter clogging and was also detracting from the natural beauty of an important tourist attraction. Lake Balaton is Europe's largest freshwater lake having dimensions of 80 km by 10 km but with a mean depth of only 3-4 m.

The approach adopted by the project

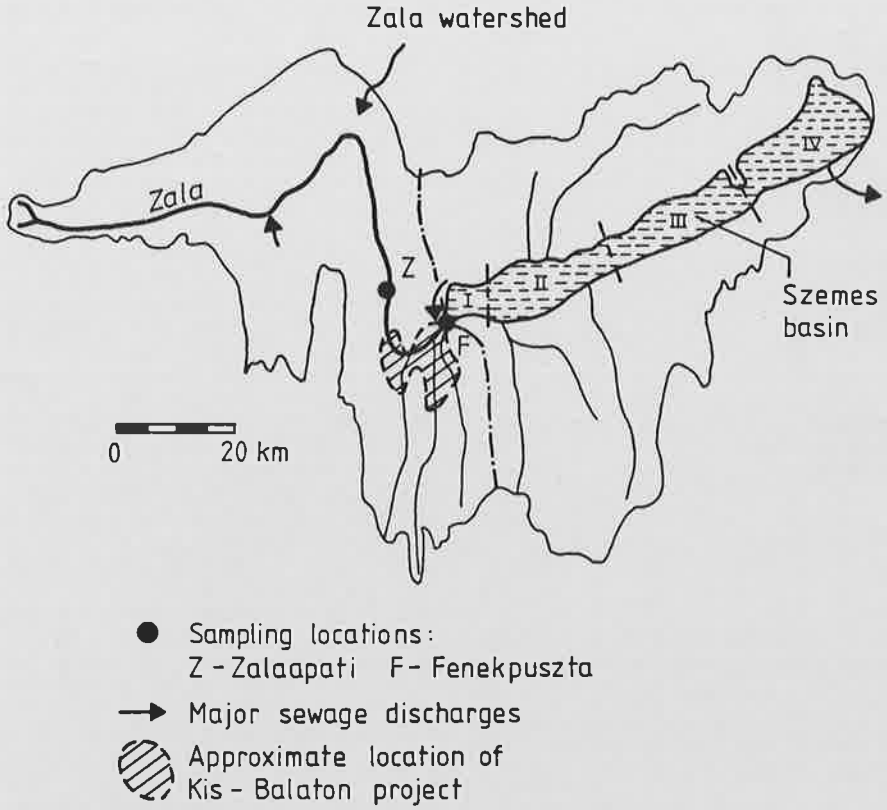


Fig. 3 Map of Lake Balaton.

team was to assemble a "check list" of individual sub-problems arranged in a hierarchical fashion. It was then felt that of these component problems one of the most important to be studied was that of nutrient loading. Measurements made of precipitation, total phosphorous and suspended solids in the major tributary of the lake were used to develop a time series model of nutrient loading. This immediately led to the surprising result that the most important source of phosphorous was from two sewage discharge outlets (point sources) rather than, as had been assumed, the runoff from agricultural land. The result of these analyses showed that a large precipitation event induced a response over a period of hours or days due to rural and urban effects whilst a continuous and extremely wet period in addition gave a significant medium-term response over a period of weeks due to marshland drainage. Although this model helped to provide insight into some of the processes taking place within the catchment it was also important to study the release of phosphorus within the lake itself. It was thought that wind-induced mixing causing sediment resuspension might also be important. Thus measurements were taken of wind velocity and the concentration of suspended solids at 5 levels within the lake. The process of subsequent resuspension was modelled by a set of ordinary differential equations and model coefficients were obtained from the measured data using recursive parameter estimation. When used against test data the model performed well but in places gave a larger predicted accumulation of phosphorous than was actually observed. Two reasons for this result were given. First that the resuspension process depended on the direction of the wind and re-analysis of the data using wind components along the lake did give an improved fit. A second reason put forward was that decay of biomatter in the Autumn caused solid matter in the lake sediments to coagulate and therefore made resuspension by wind action less easy.

At a less detailed, more management-oriented level, it was possible to model the lake as a set of 4 well mixed tanks and then represent the eutrophication process using a linear load-response model developed from the component analysis. This model was used to determine the decisions which should be made in order to best deal with the problem, although as is often the case, it was found that these then had to be altered in the light of political considerations.

Conclusions drawn from the analysis were that modelling had at the least measurably improved understanding of the lake's behaviour and had probably also influenced the decision-making process. The project showed the value of planned experiments and that one should always be prepared in the light of subsequent finding to have one's prior assumptions overturned.

A.P. Butler

CLIMATIC CHANGE AND WATER RESOURCES

Joint Royal Meteorological Society/BHS Meeting 29 October 1984

This meeting, held at the Institution of Civil Engineers, brought together meteorologists and hydrologists to describe their work and views on this topical subject. Over 150 people attended, many with the UK water shortage of the 1984 summer and the continuing Sahelian drought in mind.

The morning session, chaired by **Mr. R.A.S. Ratcliffe**, was devoted mainly to meteorological aspects. **Professor J. Dooge** (University College, Dublin) commenced with an overview of climatic change and its relationship to water resources and the efforts being made by the international scientific organisations to co-ordinate studies. **Dr. T.M.L. Wigley** (University of East Anglia) spoke next introducing the one observation about which there was little disagreement — that CO_2 in the atmosphere is increasing at about 0.7% per year, resulting from burning fossil fuels. Globally this implies increases of atmospheric temperature of 1 to 4°C and corresponding changes in the earth — atmosphere water balance between now and the year 2050 due simply to circulation changes. Vegetation introduces further complexity indirectly as increased CO_2 produces less evapotranspiration and water take-up in plants and hence more run-off. Models of two vegetated river basins showed that doubling CO_2 concentration increased run-off by 10-30% in February and 60-100% in the autumn. **Dr. P.R. Rowntree** (Meteorological Office) then gave a description of the use of General Circulation Models in investigating climate change and particularly how the hydrological cycle is modelled. The

morning session ended with **Dr. J.G. Lockwood** (University of Leeds) describing some detailed work on the effect of vegetation changes in hydroclimatology; the results showed that man's impact in altering soil moisture and run-off through deforestation could rival, and mask, changes brought about by climate effects.

It was the turn of the hydrologists to speak in the afternoon session, chaired by **Dr. J.C. Rodda** (Institute of Hydrology). **Mr. M. Beran**, of the same Institute, opened, revealing that he had been converted to a belief in detectable climatic change in historical run-off records. However he urged caution to hydrologists not to attribute a change in water balance as necessarily being generated by climate change; all manner of peripheral observations must confirm the conclusion. The next speaker was an engineering hydrologist, **Mr. T. Evans** (Sir M. Macdonald and Partners), who stressed the difficulty in obtaining a clear climate-change signal in hydrological data; he quoted an example of a river whose (apparently) steadily rising levels were actually caused by sinking of the bed and banks by abstraction from an underlying aquifer. Not all hydrological problems have obvious solutions – the speaker told of Lake Chad in Central Africa which is contracting rapidly and rendering ineffective an associated, and much-needed, irrigation scheme of local land. The river Chari which feeds the lake has lost 80% of its flow but there does not appear to be a reduction in the rainfall in the tropical forests which feed the river. The final contribution came from **Mr. R.J. Sargent** (Forth River Purification Board) and **Dr. D.C. Ledger** (University of Edinburgh) who stressed the localised nature of drought (Scotland had near-normal rainfall in the summer of 1976 for instance) leading to difficulties in identifying small trends based on wide-area indices. They showed a long series of river run-off records, deduced from historical records of sluice-gate openings, which displayed signs of persistence over a few years but no consistent trend over 100 years.

The main conclusion from the meeting is that it is difficult to identify a clear unambiguous sign of a climate-induced change in water-related parameters amidst many other influences. Longer records and more sophisticated analysis is required, but can those who have to make the practical decisions about management of this vital resource wait long?

B.R. May

Control Rules for Water Resources Systems

BHS Midlands Section Meeting 5 December 1984

An audience of over fifty met in the Civil Engineering Department of the University of Birmingham, to be entertained by presentations by three of the Water Industry's leading exponents on water resources control rules.

Coming so soon after the end of the drought, it was fascinating to hear from **Peter Walsh** how the North West's resources had behaved during the summer. In particular, it was reassuring to others in the field to know that the control rules had provided valuable guidance on the use of resources during the drought, and on the timing of measures to conserve stocks. In a presentation amply illustrated by slides taken of the various reservoirs during the summer of 1984, Peter showed how severe conditions had been, particularly in the reservoired catchments of the Lake District, where less than 40% of average rainfall had fallen in the seven months between February and August.

Having made telling use of control curves during the period of drawdown to protect the most vulnerable sources, it was interesting to see the shift of emphasis once the drought had broken, towards the equalisation of refill probabilities. The same control curves which enable large savings in running costs to be made in more normal years had come through a drought more severe than any previously experienced in the north-west with flying colours.

The Lancashire Conjunctive Use Scheme, which played a significant role in North-West's drought strategy, was quoted as a prime example of the place of groundwater in conjunctive source operation by **Andrew Skinner** of Severn Trent Water Authority. He began his presentation by comparing the different ways that groundwater can be used in conjunction with surface sources, and emphasised the capital cost advantages of groundwater developments compared with the provision of surface storage. Dr. Skinner's presentation then concentrated on the Shropshire Groundwater Scheme, part of which was commissioned a year ahead of schedule to help the heavily abstracted Severn to survive the drought. He illustrated the need for robust control rules in this situation where groundwater is used in conjunction with Llyn Clywedog to augment river flows. The conflict arises because, although groundwater storage is effectively infinite, the restriction of installed borehole pumping capacity limits the maximum rate of discharge. Thus, for the system to be effective, groundwater has to be discharged over a long period, whilst much cheaper water is held back in Clywedog for later use. This extra cost of pumping early on in the course of a summer has to be balanced against the probability of surviving throughout the season using surface storage alone.

Dr. Skinner emphasised the connection between the surface and subsurface elements of the water cycle, and recommended caution in groundwater development. He decided the types of model analysis that had been undertaken during the planning and promotion of the Shropshire scheme.

The afternoon was rounded off with an enlightening presentation from **Alan Lambert**, whose "patch" in north Wales had also borne the brunt of the recent drought. Having started by saying how invaluable control rules had been during the drought, Alan concentrated on the savings that could be achieved not only on the large scale but also to make the best use of lesser known sources. He pointed out that by adapting flexible operating rules for small local sources, not only was he able to make financial savings, he was also able to increase the commitment and job satisfaction of the local operators.

Returning to the 1984 drought, Alan described the sequence of events on the regulated River Dee, indicating the value of the existing control curves in determining the timing of hosepipe bans, of residual flow reduction and finally of Prescribed Uses Orders. A wide ranging presentation was rounded off with a description of the Clwyd scheme, which more than makes up for its small size by its incredible complexity, and by its potential for cost savings through optimisation of use of the various elements of the scheme.

Chris Folland of the Met. Office opened the discussion with a plug for a new generation of medium and longer term weather forecasts, which would of course be a god-send to drought management if they were sufficiently accurate. He claimed a significant breakthrough in accuracy had been achieved over

the past couple of years: something for water resources managers to keep on eye on! He also commented on the apparent change in weather patterns in recent years, with a tendency towards drier summers. So far these had been balanced by early and wet autumns, but what, he asked, if they weren't?

Much of the remaining discussion revolved around the range of applications of resources system simulation in the various Water Authorities and Companies represented at the meeting. Several speakers explained their own use of these techniques for deriving optimal control strategy and drought management rules. Though these rules normally included recommendations for demand reductions, experience during 1984 showed that sizeable reductions in consumption could only be achieved with very large and continuing publicity campaigns.

The afternoon succeeded particularly by bringing together the theory of control rule derivation and the practical experience of operating through the recent drought. After '76 and '84, roll on 1992 — we'll be ready for you!

J. R. Douglas

Hydrological Education and Training in the 1980s

National BHS Meeting 10 December 1984

Education and Training can mean many things depending on whether you are participant, teacher or employer. As regards hydrology it is further complicated by an identity problem which is compounded by the career paths open to those who wish to practise the subject.

The aim of the national meeting was to identify the role of education and training within both the water industry and academic institutions where hydrology is taught. At the same time such a theme was bound to highlight problems that face individuals in pursuing a hydrological career and this proved to be the case.

The morning session covered the state and status of hydrological education within universities and polytechnics. **Professors T. O'Donnell** and **R.C. Ward** presented the results of a survey circulated to all Departments of Civil Engineering, Environmental Sciences, Geography and Geology in 1984 compared to a similar exercise in 1976. The survey attempted to indicate the distribution of hydrology teaching throughout undergraduate courses, the significance of hydrology to individual courses, the number of graduates taking courses and the type of employment they subsequently enter.

The results of any survey depend on firstly the questions and secondly the response. It was noted that several Civil Engineering departments prominent in hydrological work did not reply!

Points brought out by the authors were that:

(1) Hydrology appears to be downgraded in significance for undergraduate courses in 1984 compared to 1976 – particularly in engineering departments.

(2) Hydrology constitutes a wide range of topics and undergraduate teaching varies widely in its content, although textbooks and journals used have not changed much between surveys. As a subject, it is found in all three years of Environmental Science and Geography degrees compared to the second and third year for Civil Engineering.

(3) Few courses are intended to produce graduates directly employable as hydrologists.

(4) The water industry is absorbing up to 50 graduates a year who have hydrological teaching in their degree. (To some extent this statement was contradicted by the afternoon sessions, particularly in terms of those practising their hydrology.) Research Institutes take an additional small number per year, whilst many undergraduates go onto higher education. The survey questions on this aspect of employment may have benefited by being more specific.

(5) Little change in course content was contemplated in the future.

Overall it appears that Hydrology is losing ground in engineering departments and Professor Ward posed a fundamental question to the audience "For what purpose is hydrology being taught in university departments?" This in turn leads to a supplementary question "What aspects of hydrology should be taught?"

Drs H. Wheater and **I. Cluckie** then presented a paper on postgraduate courses which went some way to defining which aspects of hydrology need to be taught for hydrological training, in relation to perceived problem areas in Britain and overseas.

Dr. Wheater reviewed the range of UK postgraduate courses relevant to the training of hydrologists. The backgrounds, numbers and subsequent employment of students from the course was indicated. Again there appeared to be an increase in the number with geography/ES background compared to engineering. This may be directly related to career prospects in the UK industry where career entry and then progression are often dependant on having an "engineering background". Perhaps, as was shown in later papers, a career path needs to be developed more formally for the non-engineer.

Dr. Cluckie, drawing from past surveys on UK hydrological education, showed that in the recent past the water industry (excluding consultants) has demonstrated a need for only a small number of people directly employing hydrological skills. Postgraduate courses are producing numbers in excess of requirements. Obviously many students do go into consulting but others must be using their skills elsewhere and not directly in hydrology. Changing requirements of the industry has led Birmingham University to review and change the MSc courses. The revised courses attempt to meet the need for a broader training rather than specialised hydrology with emphasis on developing areas such as systems engineering. Dr. Cluckie concluded by indicating problem areas where BHS could take an active role. These are:

(a) Encouragement of manpower planning in the UK water industry in order to give guidance to universities on their education and training roles.

(b) Ensuring close contact between the practising industry and universities etc., in all relevant areas. In particular BHS should show an active interest in the complete range of hydrological training including technician level.

The general discussion at the end of the morning session showed clearly that the definition of hydrology and what it constitutes is poorly defined which in turn affects education, training and job prospects, let alone an employee's perceptions of "a hydrologist".

The second session starting after lunch consisted of two papers. Both in their own way challenged hydrologists — or rather those practising hydrology — firstly to find a clear identity for themselves and secondly to move into non-traditional areas where their skills have application.

Dr. P. Johnson (Northumbria WA) posed the question "Are British hydrologists an endangered species?" A brief historical review showed hydrologists to be employed in one or more of four areas within the industry: public water authorities, consulting, training and research. With the reduction in long term water resources planning, caused by a slowdown in the rate of increase in water demands, there has been little recent opportunity for "new" hydrologists to find employment. In addition in the public sector the last five years have seen critical self-appraisal by the Water Authorities of their prime functions and the need to perform work. Employment opportunities also exist within consultants but these too were perceived to be limited in the future.

A subjective model of the potential hydrologist's employment market was then presented and divided into the four areas employing hydrologists. This was of bleak

comfort to the undergraduate as the author perceived a very small future market in the short and medium term.

With the public water industry becoming increasingly multi-disciplined in nature and outlook, the relative importance of the specialist may diminish. Therefore, the author considered that training and education must give thought to a career structure in a multi-disciplinary industry. The British hydrologist must be prepared and able to leave his speciality and gain experience in other functions as well as obtaining understanding of the interplay of the host of outside factors e.g., economic, social, environmental. For those of us in the public sector this is becoming increasingly self-evident yet at the same time, as the author himself stated, the need for development of hydrological expertise will continue.

Whether individuals working in "hydrology" have as clear an identity as the "hydrogeologist" was one of the "tongue-in-cheek" questions posed by **G.P. Jones** in the entertaining presentation "Groundwater — is it a geologist's preserve?"

It would seem that the hydrogeologist can confidently recognise himself, his profession and the hierarchy of formal bodies representing his subject and profession. The poor hydrologist has difficulty in recognising himself (how many people put hydrologist on their passports?), has no clear professional body and a very complex system of representation for his subject and professional interests.

A picture of the super hydrogeologist of the future was presented. The necessary characteristics of numeracy, literary, confidence, versatility, etc., should not be restricted to hydrogeology since they apply to many areas of the water industry. In fact, groundwater is one of many areas where different disciplines can contribute including the humble hydrologist! The questions of identity, professional recognition and qualification are very real to a lot of people working in hydrology and ones which BHS may need to give consideration to in the future.

The final session covered training and development for the hydrologist in the public, private and research spheres.

P. Herbertson (Southern Water Authority) in his paper covered the public water authorities. The terms "converger" and "diverger" were defined in relation to hydrology. The convergent hydrologist is attracted to hydrology, as we know it, developing a career in a hydrology or water resources section. The divergent hydrologist would utilise hydrological skills in instrumentation, data processing, modelling, etc., in other functional areas, particularly Water Authority Operations.

To be successful, any hydrologist will have to possess high computing and systems engineering skills. There will be a need to train and develop both types of person for careers within the water industry. Career progression, however, will depend somewhat on professional qualifications. It was heartening to find a Water Authority that had an alternative for the non-engineer to progress through on a career grade to a professional qualification. In conclusion, the author made it clear that although hydrology in the Water Authorities has not escaped the continuing pressures of reorganisation, for those that survive, the work will be more demanding, varied and technically rewarding.

Within the private sector, hydrologists find employment usually with engineering consultants, and according to **Dr. David Lerner,** whatever their background, people are employed as engineering hydrologists, their working objective being to quantify water resources and floods.

No firm of consultants provide structured training for hydrologists. Most will provide training for a professional qualification but non-engineers again face problems in this respect. After qualifying, training will be "on the job" or by attendance on specialist courses. David Lerner praised hydrologists for being a bright bunch, who keep up with developments and are able to learn new skills; however, they are unlikely to reach the top with a consultant since they are regarded as specialists. Training could be better, offering in the ultimate a career from junior technical engineer to either senior management or advisory positions. This implies more formal management training.

David Lerner considered that university hydrological training does not fully equip people for consultancy work. Priorities for education and training were summed up as CEMPH where:

C = computer fluency
E = English ability, including good report style
M = mathematical capability, including statistics
P = problem solving methodology
H = hydrology

The final paper, presented by **Dr. M. Lowing**, covered training and development in research organisations, particularly at the Institute of Hydrology.

Since there is no graduate qualification in hydrology, there is a wide range of disciplines represented at IH. Many of the engineers and scientists arrive with a postgraduate qualification but others have little "hydrology" in their prime subject. All, however, must decide whether to become hydrologists or remain in their discipline working on hydrology. Again it is a question of identity.

Mike Lowing sent a questionnaire to the 100 engineers and scientists at IH. Replies indicated that only 30% wish to be recognised as hydrologists.

The replies to the questionnaire highlighted the lack of a structured training programme and/or career path. Self-education was considered by some to be a partial answer to this problem. Another view expressed by the replies was that there was little merit in being a specialist hydrologist. For a long term career it might be more sensible to safeguard one's basic discipline and concentrate more on developing skills in computing, project leadership and reporting.

The final discussion was led by **Professor O'Connell** who first painted a picture of the "1984" hydrologist (a multi-disciplinary creature from a variety of backgrounds) and then went on to identify areas that delegates and speakers had considered should be taught in the future, i.e., Management Skills, ICA, Data Management, Computing, Systems Engineering and Environmental Protection.

How are such requirements to be met? Is there a need for modification of existing MSc courses or perhaps a BSc in hydrology?

A variety of points were then raised from the quality of teaching to the contributions from the practising water industry in formal training and university courses.

Professor Hamlin in his summing up stated that the topic of hydrological education and training had many facets, not least because of the variability of the subject and the contribution hydrologists can make to the water industry as a whole.

It was clear that undergraduate education must teach skills to work in the industry, including management skills in terms of people and operational systems.

This leads one to the question of what do we define as the water industry? In its widest sense we must learn to recognise that it includes consultants, water authorities and research institutions, i.e., universities and polytechnics. In turn it may be necessary to strengthen the identity of hydrologists by promoting their professionalism and wide ability — surely a role for the British Hydrological Society! In this there are lessons to be learned from our geological colleagues — with one's tongue in one's cheek, of course!

It will be interesting to compare attitudes, prospects, training and education for hydrology in ten years time!

Tony Lewis

Members may like to know that WMO have just published the sixth edition of their 'Compendium of Training Facilities for Meteorology and Operational Hydrology'. The section on UK facilities is the second largest in the book, the USA having most to offer.

The Wallingford Procedure Users Group (WAPUG)

The Wallingford Procedure Advisory Group met for the last time in October 1984. A new group, The Wallingford Procedure Users Group, was initiated at a meeting held in Reading at the BHRA/WRC International Conference, in September. A small committee chaired by **Andy Eadon** of STWA, was formed and charged with organising membership and a programme of events for the Users Group.

At the first business meeting of the committee late last year, it was decided that membership would be free and open to all users of the Wallingford Procedure (the activities not being restricted to WASSP). It is hoped however that organisations will propose a single representative or a representative for each administrative area who will actively support the Group and provide effective liaison for other users in their area.

The first major events are to be organised for early in 1985 and thereafter at approximately six month intervals. A prominant part of these events will be a forum for users to comment on their experiences with the Wallingford Procedure.

Dates and venues for the first main events are as follows:—

Tuesday 2 April 1985 at ICE in London.
Wednesday 24 April 1985 at the University of Newcastle-upon-Tyne.

Both meetings will have the same format, which will include a presentation on recent amendments to the WASSP package by **Dr. R.K. Price** from Hydraulics Research Station, a Question and Answers session on Wallingford Procedure, a general discussion on the objectives and role of WAPUG and some short presentation papers.

LETTERS

Dear Editor,

There is an obvious and frustrating lack of information concerning hydrological research undertaken in institutes, universities and polytechnics, water authorities, consultancies, etc. All over the country BHS members and less gregarious hydrologists are beavering away on this or that project (often unpublished), usually in ignorance of complementary work elsewhere and of potential markets for their research.

A possible solution is to produce a special issue of *Circulation*, say once a year, that would precis current research projects. Contributions to this "research review" would be invited, solicited or extorted from everyone in the field. BHS membership would surely rise if its venerable organ provided such a service!

Steve Wiltshire
IH

NOTE: The British Library is currently compiling a research register "Current Research in Britain 1985" which is to replace the three-volume "Research in British Universities, Polytechnics and Colleges" (divided into Physical, Biological and Social Sciences). I am busy trying to compile the IH entry — we have some 60 active projects, each of which has to appear on a separate form. Contribution to this register is on a voluntary basis and one wonders how well "hydrology" will be represented. — Editor.

Dear Editor,

I refer to the article "Forth RPB tries the RAFT river gauging technique" which appeared in the September issue of the Newsletter.

When the RAFT system was purchased by Forth PRB and other Authorities in 1982 and 1983, it was made clear that the system had not been tested over the full range of conditions, because of its having been develproblems encountered by Forth **RPB** should be viewed in this light.

The "weedy" site appears to have been a severe test, as clearly with weed on or above the water surface, there is little likelihood of the bubbles being visible. The system had previously been checked where there was a thin cover of duckweed but not with a large-leaved emergent variety.

Regarding the low velocity site, a number of points were raised: the persistance of the bubbles on the surface in such conditions can be varied by altering the air pressure; if the bubbles are blown upstream by the wind, the relevant location becomes the downstream edge of the bubbles rather than the upstream edge (it is important in such conditions that this effect is noted in the field so that it can be allowed for at the processing stage); a small absolute error at low flows clearly causes a high relative error, a problem associated with all measurement methods.

The differences in results obtained by different operators is a cause for concern. There is a subjective element to the location of the bubbles on the photograph, but tests on this effect had demonstrated likely errors of only 2 or 3 per cent from this source. The training of personnel in both the field and processing procedures is important in this regard, for example in locating the correct point of bubble emergence under oped by a University Department with very limited resources. It was, therefore, to be expected that problems which were not apparent at that time, would come to light with wider, long term use of the equipment.

Most uses of the system, to date, as in Forth **RP**B's case, have been in problem situations in which current meter measurements are not possible, or at best unreliable, and for which no suitable flow measurement method had previously been available. The varying surface conditions such as the leading edge when downstream trailing occurs, centre line when no trailing occurs, etc.

Clearly any new technique will have problems, and it has never been claimed that this method answers all gauging problems. Rather it has been an attempt to develop a simple alternative method with advantages over the traditional techniques in some circumstances. It is perhaps unfortunate that attention has ben concentrated on using RAFT in problem situations, whereas it has considerable potential as an alternative to velocity-area gauging for routine use.

It is unfortunate that Forth **RPB** did not choose to discuss the problems they were encountering with the developers of the system, as such feedback could have been mutually advantageous.

Experience of using the technique is currently being gathered from other users, and the findings of this survey will be reported in due course.

D.M. Sargent
c/o Hydrology Branch
Snowy Mountain Engineering Corp
Cooma North
NSW 2630
Australia

NOTE: I have written back to Mr. Sargent saying that BHS members would like to hear more about the survey of user experience in due course. — Editor.

Dear Editor,

The recent joint meeting with the Royal Meteorological Soiety showed that hydrologists have a legitimate interest in "climate change"; even if the conference was concerned only with the present day effects of climate change on water resources.

Climate change is at the centre of much archaeological controversy. With rare exceptions hydrologists have not so far shown much interest and, again with rare exceptions, are not invited by archaeologists to contribute their mite to the controversy.

Of course hydrologists do not have to limit their contribution to weather/climate change for there are many other aspects of prehistoric environment that represent a challenge for us: for example evidence of floods, water borne sediment and so on. I merely mention climate change because I formed the impression that we more than hold our own with the Met. people and have, I think, the edge on them because we are more concerned with the effects of meteorology than with its causes. Prehistoric man, like most of his modern descendants, was mainly concerned with rain, hail, heat, cold, food and so on at ground level and a few feet above and below it: that is with the very tangible part of the bio-sphere that is affected by weather.

In the past most archaeologists faced with the possibility that some apparent event revealed by excavation had an environmental explanation (most often claimed to be climate deterioration or amelioration, whatever either may mean) have gone to climatologists or to geographers (mainly the old-fashioned type and not to those who, from geography, have become some of our leading hydrologists — it would be no more logical for archaeologists to go to civil engineers as such).

In some 30 years of working with archaeologists I have almost always found that a proper hydrological look at the circumstances (it would be wrong to write of data) opens up new and interesting possibilities which are quickly appreciated by archaeologists.

I have started tentative enquires among archaeologists, starting with the Council for British Archaeology, to find out whether archaeologists would welcome help from us: I have not so far approached bodies such as the Institute of Archaeology (which is a University faculty) or Museums. That can come later.

The response from the Director of CBA, Dr. Henry Cleere, PhD, has been sufficiently favourable that I am now taking the next steps of (a) informing hydrologists about what is going on and (b) asking any of them who are interested in prehistory to declare their interest. A few are already collaborating actively: if there are any others who would like to do so would they please write to the BHS, heading their letter simply "Archaeology" and briefly indicate what, if anything, they already know; what parts of the world and periods particularly interest them and whether, in principle, they would be interested in answering queries from archaeologists.

Originally Dr. Cleere was in favour of a simultaneous approach by him to archaeologists and by me to hydrologists. He is an extremely busy person with responsibilities covering the whole of Britain, while I live too far from London to be able to take advantage at short notice of his free moments. His most recent letter of 9th January reads: "as you know, I strongly support your proposal for providing expert hydrological advice for archaeologists. I still hope that we can get together . . . in the not too distant future to develop your proposal so that I can begin exploring this with the archaeological community". In my telephone talk with him he agreed that I should go ahead on my own: it could make his approach to archaeologists (who would, after all, be the clinet) easier if he were able to bring a copy of this letter to their attention.

Our President has assured me that he will make arrangements for a register to be kept and that he will send to me, for information, copies of any replies: this because I am in fact an archaeologist (Fellow of the Society of Antiquaries and author of several environmental archaeology studies and a book). I would be prepared to try to "marry up" requests for help with the hydrologist most likely to be able to give it.

In 1968, After an informal meeting at the ICE a register of Civil Engineers interested in archaeology (not just prehistory) was started with, as I recollect, an encouraging number of registrants. Unfortunately I was living overseas and unable even to try to ensure that some use was made of it. The register may be still in existence, but is to all intents and purposes dead.

Robert Raikes
Vine Tree Cottage
Llanvetherine
Abergavenny
Gwent NP2 8RD

NEWS FROM MEMBERS

We have had several protestations from our correspondents in the Water Industry that the pace of change is too slow to generate news every quarter. Experience has shown, however, that we cannot rely on anybody (except Frank Law) to send in news without being cajoled so, unless you can suggest a better system, our bullying reminders about approaching deadlines will continue.

At least we have published *some* news from members working for most public sector bodies. What about hearing from those of you in UK based consultants!

MEMBERS ON THE MOVE

Terry Eagling is retiring from his water resource planning job with the Colchester division of Anglian. **Tony Tollow**, hyrologist with their Oundle division, is leaving to take up a lecturing position in Durban. In Thames, most BHS members have successfully applied to "get their own jobs back" but there has been some switching. **Jane Allam** is now a Technical Development Officer in River Division with responsibility for developing a flood forecasting system. **Dave Rylands** has joined the data processing and development group (see below — "Data Processing").

David Archer is leaving Northumbrian for a year's secondment to work in Nairobi for Howard Humphries.

WATER RESOURCES

Anglian's Cambridge division have begun a three-year groundwater modelling project with Department of Civil Engineering at Birmingham University. The aim is to produce a distributed groundwater model of the Granta and Lodes catchments for optimum allocation of water resources. (Contact: **Gerry Spraggs**, Cambridge.)

Thames have sunk three abstraction wells, five observation boreholes and two in-situ sampler boreholes in the Enfield-Haringey artificial recharge area. Some abstraction tests have been carried out to determine aquifer and well properties. Recharge testing is about to begin. New sites are currently being evaluated.

South-West had a busy year coping with the drought (and applying for 49 orders!). Although, at worst, they recorded only 55% of average rainfall, by the end of the year this figure was back to 98%. As **Neil Whiter** remarks "makes you wonder what all the fuss was about". He continues: "The drought did highlight various weak links in the resource and distribution systems (mainly caused by the delay in getting approval for Roadford Reservoir) and consequently, several emergency drought schemes are likely to become semi-permanent. One such scheme is the transfer of water released from Wimbleball on the Haddeo (a tributary of the Exe) over the catchment divide for subsequent abstraction on the lower Taw.

Only two of our major reservoirs have not yet refilled; Stithians is now 83% full and Wimbleball 90% full. The new Colliford Reservoir on Bodmin Moor is 42% full. Nearly all the reservoirs in the South West are susceptible to single season droughts and also tend to refill fairly quickly. The 1984 drought did not affect groundwater resources as it occurred at a time when recharge normally ceases anyway.

Hydrological staff are once again free to devote their energies to an analysis of the SWW reorganisation which was so rudely interrupted by the 1984 drought."

DATA PROCESSING AND ARCHIVING

The data processing and development group at Thames (**Brian Greenfield, Cathy Glenny, Dave Rylands** and three others) are reviewing the hydrometric network, methods of data capture, methods of processing, and archiving philosophy. They are keen to discuss these aspects with others. [See Midland Section Meeting on April 17th — *Ed.*]

The Chenies radar is sending pictures to Thames and sub-catchment totals will be available soon (see also page 2). Access to their main Argus computer which receives all telemetered data (including the radar) will be via local micros.

In North-West, the recent purchase of a DEC Professional system will give similar communications — for a pilot study of their proposed quality assurance (data validation) system — to their ICL mainframe and PDP telemetry handler.

Yorkshire Water has a major project in progress for the extension of computer facilities available for users of their water quality archive. This will include within-laboratory data entry of all analytical results. **Tony Edwards** continues: "A series of statistical routines associated with the project will provide for the validation of data at the time of entry on the computer with the subsequent application of process appraisal, surveillance and compliance testing routines to the validated data as stored on the Authority's ICL 2970 computer. The validation routine is based on the use of 95% and 99.5% confidence limits whilst the process appraisal and surveillance procedures depend on the use of both Cusum and Trend plotting techniques. The range of materials covered include water for public supply, sewage treatment works influents and effluents and river waters.

The Water Archive will also form the basis of Yorkshire Water's register of effluent discharges required under Part II of the Control of Pollution Act which will come into being at the end of July 1985."

(Contact: Either **Tony Edwards** or **Derek Johnson** — Leeds (0532) 408201.)

IMPROBABLE MAXIMUM FLOOD CELEBRATIONS

On 29th November 1984, **Frank Law** reports, a 50th anniversary barbecue by the banks of the River Yarra in the centre of Melbourne, Australia, to celebrate the largest flood on record that occurred on that day in 1934. The original gauging book and historic press cuttings were on display and about 25 staff from the Bureau of Meteorology, Melbourne Board of Works, universities and consulting firms attended.

(Members are invited to submit forthcoming dates of similar significant hydrological anniversaries that could be celebrated nearer to home.)

☆ BOOK REVIEWS ☆

Book reviews will be a regular feature of *Circulation* from the next issue onwards. Authors please note — and ask your publisher to send a review copy to our "Book Review Editor", address below.

If you would like to do some reviewing — the only tangible reward will be keeping the review copy — send a note of your field of interest to:

David Lerner, Dept. of Geological Sciences,
University of Birmingham, PO Box 363, Birmingham B15 2TT.

Research Funding

Dr. P.A. Carling — Freshwater Biological Association, Windermere Laboratory
Field and laboratory investigations of the flow resistance in moorland and forest drainage ditches. *(SERC)*

Drs E.M. Morris & P.G. Whitehead — Institute of Hydrology (with D.A.F.S. & The Macaulay Institute)
Catchment studies in Scotland to monitor and model surface waters acidification. *(The Royal Society)*

ICSI UK Survey

The International Commission on Snow and Ice, Division of Snow Cover and Avalanches is conducting a pilot survey on snow research and applications in the UK. If you have an interest in snow please fill in one of the ICSI survey forms available from Dr. E.M. Morris, Institute of Hydrology, Wallingford, Oxon OX10 8BB.

FORTHCOMING EVENTS

Course

16-20 September 1985
Freshwater Biological Association — Specialist Course on the Population Ecology of Freshwater Fish.

River Laboratory, East Stoke, Wareham, Dorset.

The course is designed to provide practical instruction in modern methods of estimating fish populations and obtaining other information required for research in production ecology. There will be an opportunity for open discussion of individual problems. It will be especially useful to research students and junior officers in the fishery department of Water Authorities and other organisations. Students will be expected to have basic knowledge equivalent to that provided by an honours degree course in zoology.

Instruction will be carried out by **Dr. D.T. Crisp, Mr. R.H.K. Mann** and **Dr. C.A. Mills**, assisted by other members of the laboratory staff.

Further details and an application form can be obtained from the Secretary, Freshwater Biological Association, River Laboratory, East Stoke, Wareham, Dorset BH20 6BB. The closing date for applications is 13 May 1985.

Conference

WEATHER RADAR
& FLOOD FORECASTING
16-18 September 1985

University of Lancaster

A three-day conference sponsored by the North West Radar Consortium (NWWA, M.O., MAFF, WRC, DoE), IH, BHS, Pennines Hydrological Group and WMO. Papers on Day One will be devoted to Weather Radar and on Day Two to Flood Forecasting, with visits to NWWA installations on Day Three (part). There will be a Poster Session on one of the evenings, a Conference Dinner, and an exhibition of equipment. Expected fees will be about £100, to include meals and accommodation.

DIARY

5 February
BHS Southern Section jointly with IPHE (Metropolitan District).
"Hydrological and pollution aspects of airport drainage" — Introduced by J. Stewart and F.J. Kaul.
Imperial College, Civil Engineering Dept.
5.30 for 6.00 p.m.

8 March
Scottish Hydrological Group.
"The effects of upland management practices on water resources" — Introduced by R.E. Youngman.
Royal Society Rooms, George Street, Edinburgh.

11 March
BHS Southern Section.
"The London Weather Radar Project" — Speakers: G.A. Clift (Project Manager), C.G. Collier and B.R. May (Met. Office).
Poster session: The use of radar data for hydrological forecasting.
Instn. Civil Engineers.
5.00 for 5.30 p.m.

20 March
Welsh Hydrological Group.
"Sewer flow analysis" — Introduced by H.H. Jones.
University College, Cardiff.
5.30 for 6.15 p.m.

28 March
Pennines Hydrological Group and Historical Engineering Group.
"Problems during the construction of Victorian earth dams".
N. Hoyle.
Reynold Building, UMIST, Sackville Street, Manchester.
6.30 p.m.
(Please notify the Secretary if you will be attending.)

Copy Deadline for Issue No. 6 — Monday, 1st April 1985

15 April
BHS Southern Section/Water Engineering Group Management Board ICE.
"Sediment Transport in a Colorado Mountain River two years after a Dam Burst" — Speakers: J.C. Bathurst, G. Leeks, M.D. Newson (Unit of Fluvial Geomorphology, IH), C.R. Thorne (Queen Mary College).
Dept. of Geography, Queen Mary College, London.
4.30 for 5.00 p.m.

1-2 May
Two-day meeting.
"Scientific aspects of irrigation schemes".
The Royal Society, 6 Carlton House Terrace, London SW1Y 5AG.
Further details from the Royal Society, Tel: 01-839 5561.
(This meeting originally proposed by the Hydrology Subcommittee of the British National Committee for Geodesy & Geophysics.)

8 May
BHS National meeting joint with Welsh Hydrological Group and Institute of Biology.
"Management of Wetlands".
Wildfowl Trust, Slimbridge.

15 May
Pennines Hydrological Group.
Annual General Meeting followed by Dr. A. Johnston speaking on "Floods resulting from dam failure".
Dept. of Civil & Struct. Engineering, Sheffield University.
2.00 p.m.

19 June
BHS National meeting, joint with IAHR British Section.
BHS National Meeting.
"Modelling in flood plain planning".
Dept. of Civil Engineering, Birmingham University.

7-19 July.
International Symposium on Karst Water Resources.
Ankara, Turkey.
Organised by UNESCO and IAHS.
Details from: A.I. Johnson, 7474 Upham Court, Arvada, Co 80003, USA.

Circulation is the quarterly newsletter of the British Hydrological Society. It is issued free to members but is also available on an annual subscription of £10.00. Please address all correspondence to the Editor, Celia Kirby, Institute of Hydrology, Wallingford, OX10 8BB. Tel: 0491 38800 ext. 264.