– not just high flows. They became available around 1990 (so they have been around for a while now) and have potential for improving statistical linkages between rainfall–streamflow model parameters and catchment physical descriptors (regionalization). Although this advance in the application of UH theory, and its potential for regionalization, have been well-documented in the literature — before, during and after the PUB Decade, e.g. see Chapter 7 in Rodda and Robinson, 2015 (reviewed below) and references therein — it continues to be under-exploited. Chapter 8 of the P3 book is certainly not the only place in the literature where restricted notions concerning the UH are presented. Techniques for the application of UH theory have been demonstrated throughout the PUB Decade to have moved on. However, many researchers and practitioners seem to be clinging on to the notion of an old-fashioned UH concerned only with a rather poorly defined fast component of streamflow, identified from and applied over separate storm events.

Two minor editorial comments about the P3 book occurred to me. First, the upper case Chapter titles are rather inelegant, and those containing acronyms, e.g. "... SNODAS ESTIMATES OF SWE ..." (p231) are confusing and uninformative at first scan. (I admit to a pathological aversion to the over-use of acronyms and would rather not see them at all in book chapter/journal research paper titles, or as keywords after Abstracts.) Second, I would like to have seen colour Figures. The editorial team did a great job by making P3 available also in PDF format (http://www.cwra.org/en/resource-center/publications/bookstore/20-publications/245-putting-prediction-in-ungauged-basins-into-practice, accessed August 2015), which also shows Figures in black and white. I guess black and white Figures kept hardcopy production costs down but some require colour for ease of interpretation. Assuming authors supplied colour Figures it would have been good to see them in the PDF version (presumably at little or no extra cost), with a cross-reference to the PDF version in the hardcopy.

I commend the P3 book to you as an excellent record of the Canmore workshop. A hardcopy has been placed in the CEH library, Wallingford.

*Ian Littlewood*

### (2) Progress in Modern Hydrology: Past, Present and Future.

J.C. Rodda and M. Robinson (Eds), 2015. Wiley Blackwell, 384pp.

Over the last 50 years hydrologists at Wallingford have played a central role in many aspects of British and international hydrology. This new book charts the advances in hydrological research, technology and application achieved by the Hydrological Research Unit (HRU, 1962–68), Institute of Hydrology (IH, 1968–2000) and then Centre for Ecology and Hydrology (CEH-Wallingford) over these five decades.

The first chapter presents a chronology of events leading to the formation of these institutions and their activities stemming from the initial drivers of a need to: (1) improve flood estimation in the UK, and (2) quantify afforestation impacts on upland water resources. The chapter highlights the breadth of activities that expanded well beyond those needed to address the initial research issues, to cover sensor developments necessary to quantify processes and change in experimental basins; to advances in our understanding of fundamental evaporation processes and water quality dynamics; to improved flood and drought estimation across the UK. This section serves as an introduction to the subsequent chapters that focus on particular areas of hydrology presented via personal perspectives, case studies (undertaken in the UK and tropics) and reviews of published work.

Chapter 2 initially covers the establishment of the Plynlimon experimental catchments in upland Wales and the key findings published from many hundreds of publications. In the early years of experimental hydrology, 'off-the-shelf' instruments were not considered sufficiently accurate or reliable to provide the quality of time-series needed to address the questions at Plynlimon or other experimental sites established by IH. As a consequence, IH devoted considerable resources to developing the new sensors, data-loggers and telemetry systems necessary to study hydrological processes. The work developing Automatic Weather

Stations is of particular note, with advances in such technologies providing the impetus for companies such as Campbell Scientific in the USA to manufacture ever-better sensing systems for hydrologists. The development and evaluation of these sensor systems at IH are also detailed in Chapter 2.

In parallel with the work on experimental hydrology, IH developed and applied a suite of tools for estimating floods across the whole UK, culminating in the publication of the *Flood Studies Report* in 1975. These tools were developed further into the Flood Estimation Handbook published in 1999. Chapter 3 provides an excellent summary of these two comprehensive manuals, together with the subsequent developments to maintain IH's techniques as the national standard for flood estimation in the UK.

The research on experimental subsurface hydrology by IH scientists at Plynlimon, Thetford Forest and in the tropics, has given new insights into the way subsurface processes should be described. Of note is the seminal experimental work on natural soil piping at Plynlimon, in the context a ground-breaking review demonstrating the significance of soil macropores by former IH scientist Keith Beven, and the more recent work on the impact of deeper water-pathways in rock fractures on stream-water chemistry. This work is summarised in Chapter 4.

Research into evaporation processes by IH scientists such as John Stewart, Jim Shuttleworth, John Gash and Ian Calder has had a huge international impact. Chapter 5 provides a wonderful insight in to how these achievements were made over numerous campaigns in the UK and internationally. The personal reflections are particularly enlightening. The importance of sensor developments at IH in the early years of this research, are again highlighted.

Chapter 6 returns to the issue of hydrological extremes. In addition to providing UK governments with the tools for estimating flood flows, IH and then CEH scientists have developed and applied tools for estimating the low flows that underpin water resource assessments. The methods of characterising low flows are summarised, as are the advances that have become possible with the greater availability of digital spatial data. Additionally, Wallingford has had a significant role in water resources assessments within many tropical countries and these are detailed in a series of case studies.

Contributions of Wallingford scientists to dynamic hydrological modelling have paralleled and indeed have been enabled by those in experimental hydrology and statistical hydrology. Chapter 7 provides a review of some of the catchment models developed by the institute in collaboration with overseas researchers covering systems models such as IHACRES (Identification of unit Hydrographs And Component flows from Rainfall, Evaporation and Streamflow data) and physics-based models such as IHDM (Institute of Hydrology Distributed Model) and SHE (Systèm Hydrologique Européen). This valuable role in model development has continued with the development and application of the JULES (Joint UK Land Environment Simulator) land-surface model detailed in Chapter 10 and the water quality modelling mentioned in Chapter 8.

The Plynlimon experimental basin has also provided a platform permitting research into water quality dynamics and their controls within upland systems. This work was undertaken in close collaboration with the Institute of Terrestrial Ecology (ITE) who became part of the same organisation (CEH) following the merger in the year 2000. While maintaining work in the uplands, CEH later addressed questions of water quality within the lowlands, and throughout supported observations with modelling. Chapter 8 provides a very clear summary of this research for a wider readership. IH's important contributions to the physical characteristics of water quality, notably suspended sediment and bedload processes are, however, absent from the discussion.

River water quality in addition to riverflow statistics, are key determinants of the ecological status of rivers. Wallingford's role within the emerging science of river eco-hydrology is discussed in Chapter 9 with reference to their involvement in UK and overseas projects. This work now complements the long-term work on forest eco-hydrology detailed in Chapters 2 and 5.

The JULES land surface model noted earlier developed as a result of expertise in both evaporation and modelling at CEH (Chapters 5 and 7) and from collaborations with the Hadley Centre, following the formation of the Joint Centre for Hydro-Meteorological

Research (JCHMR). Wallingford's role in the formulation of this model combined with its decades of activity characterising the impacts of climate change on hydrological systems in the UK, are discussed in Chapter 10. From the early days of collecting time-series data at Plynlimon, by staff such as John Smart, there has been an appreciation of the need for utilisation of the most rigorous procedures for sensor calibration, data-logger interrogation, data checking and data storage. From 1982, IH became responsible for holding a digital archive of the UK's riverflow records (National River Flow Archive, NRFA). As a result, they became responsible for developing procedures for checking these data and associating them with the necessary metadata. Given this experience and expertise, they have provided support to measuring agencies in the optimisation of the UK river gauging network, and more recently in hosting the UK Environmental Information Data Centre (EIDC). As part of EIDC, the CEH Information Gateway now provides access to the unique long-term records collected at Plynlimon and elsewhere. Moreover, it also provides access to recent research data collected from across many of the UK Natural Environment Research Council's ongoing science programmes. Chapter 11 focuses on the development of these sophisticated data management systems, particularly with reference to core activities within the NRFA, where the utility of the data are also demonstrated.

The final chapter highlights some of the key drivers and research programmes that have shaped the history of hydrological research at Wallingford; before discussing some of the future national and international challenges that a multidisciplinary organisation such as CEH has the potential to address. Given the breadth of Wallingford's contributions to hydrological science and the ever changing focus of funded research over the last five decades, the editors had set themselves a challenging task to synthesise the findings within a single text. Their combination of material contributed by 71 Wallingford researchers, past and present, has not surprisingly resulted in chapters written with very different objectives and structures, sometimes highlighting the significance of the work, sometimes not. Despite this, the legacy of 50 years of research undertaken by Wallingford scientists and associated staff shines through. I believe that all young British Hydrological Society researchers and practitioners in the UK water sector could benefit their work by reading this text to learn from the way that current thinking in British hydrology has developed from Wallingford's scientific endeavours.

*Nick A Chappell*
*Lancaster University*

# Forthcoming events

*26–27 May 2016*
**Peter Wolf Young Hydrologists Symposium**
*University of Bristol*

*13th June 2016*
BHS National meeting
**Land Use Impacts on River Flow Extremes**
Loughborough University
Call for abstracts coming soon.

*30th Aug– 1st Sept 2016*
**4th BHS International Conference**
**Cranfield University**

## Upland hydrology in the Rosebowl

19 Janary 2016, Leeds
This conference will focus on:
Water colour and carbon
Natural flood risk management
The water industry and the upland economy

**Call for posters and Submissions**

Please submit abstracts (<100 words) using the form on the water@leeds website by 4.12.15. Notification of acceptance by 31.12.15