

The International Association of Hydrogeologists (IAH): reflecting on 60 years of contributions to groundwater science and water management

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Abstract The 60th anniversary of the founding of the International Association of Hydrogeologists (IAH) is an important milestone that allows pause for reflection on how the association has evolved over the years and the contributions it has made to groundwater science and water management. IAH was founded in 1956 at the 20th International Geological Congress and developed rapidly during the 1980s and 1990s in response to a growing global interest in groundwater mapping and in sound approaches to resource protection and sustainable aquifer management. Incorporated in 2000, IAH has now secured its position as the world's leading international association specialising in groundwater with over 4,100 members in 131 countries. Much credit for this success must go to members, past and present, whose individual efforts and collaboration with sister institutions are documented here. These members have shaped the association's goals and contributed selflessly to its scientific programmes, publications and educational and charitable activities. Looking ahead to the next 60 years, it is essential that IAH does not rest on past achievements but listens and adjusts to the needs of members while continuing to pursue its mission of furthering the understanding, wise use and protection of groundwater resources throughout the world.

Keywords History of hydrogeology · Organisations · Groundwater management · Hydrogeology Journal

Introduction

Founded in 1956, the International Association of Hydrogeologists (IAH; <https://iah.org/>) enters its 60th year in 2016, an important milestone on a journey that officially began in Mexico City during the 20th International Geological Congress (IGC). Today, IAH has emerged as the world's leading international association specialising in groundwater, with over 4,100 members in 131 countries, more than 40 national chapters, 14 commissions and networks, 2 book series and an outstanding scientific journal—*Hydrogeology Journal*.

Anniversaries are a time for celebration; however, they also provide an important opportunity to reflect on past history, influential players, key events and the contributions that have been made to science and society. It is also an opportunity to look towards the future. This article begins by looking back at 60 years of successful development. It starts with a historical review of the association's formative years including the events and individuals that shaped its early beginnings, and continues with an examination of the 1980s and 1990s, two decades of continuing international growth and productivity. It then explores events surrounding the incorporation of IAH as a limited company in 2000 and the succeeding early years of the new millennium that lead to the present day. It is a story of success, but it is also a tale of hard work and selfless dedication by many association members, both nationally and internationally. The article ends with some thoughts on the future of the association and the challenges that may lie ahead. The 60th anniversary is a very important milestone for IAH, but the journey continues and much work remains to be done.

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Table 1 IAH councils and senior officers

No. and dates of IAH councils	President	Secretary	Treasurer
1st: 1956–1960	P Fourmarier/Belgium F Penta/Italy (1960)	L Dubertret/France	G Castany/France
2nd: 1960–1964	F Penta/Italy (–1962) G Georgalas/Greece	L Dubertret/France	G Castany/France
3rd: 1964–1968	H-J Martini/FR Germany	L Dubertret/France G Castany/France	W Fricke/FR Germany
4th: 1968–1972	B Řezáč/Czechoslovakia	L Dubertret/France G Castany/France	PE Groba/FR Germany
5th: 1972–1977	S Buchan/United Kingdom	L Dubertret/France G Castany/France	PE Groba/FR Germany
6th: 1977–1980	PE LaMoreaux/USA	L Dubertret/France (–1979) G Castany/France	PE Groba/FR Germany
7th: 1980–1984	G Castany/France	E Romijn/The Netherlands	PE Groba/FR Germany
8th: 1984–1989	MR Llamas/Spain	E Romijn/The Netherlands	PE Groba/FR Germany
9th: 1989–1993	E Romijn/The Netherlands	AC Skinner/UK	B Schwerdtfeger/FR Germany
10th: 1993–1996	JE Moore/USA	AC Skinner/UK	B Schwerdtfeger/Germany (–1994) WF Struckmeier/Germany (1994–1996)
11th: 1996–2000	MR Knight/Australia	AC Skinner/UK	WF Struckmeier/Germany
Incorporation of IAH in 2000 creates new Council and Executive structure including a new Science member			
12th: 2000–2004	E Custodio/Spain	AC Skinner/UK	WF Struckmeier/Germany P Bennett/USA (Science)
13th: 2004–2008	SSD Foster/UK	M Veselic/Croatia (–2006) WF Struckmeier/Germany (2006–08)	J Sharp/USA J Krasny/Czech Republic (Science)
-	-	-	VP Finance & Membership and VP Science & Programme after Rule change at Lisbon, 2007
14th: 2008–2012	WF Struckmeier/Germany	S Puri/UK	A Chambel/Portugal KWF Howard/Canada
15th: 2012–2016	KWF Howard/Canada	S Puri/UK	B Misstear/Ireland A Chambel/Portugal

Updates can be found on the IAH website (IAH 2016); *VP* vice president

The formative years: 1956–1979

Establishing the association

As reported by Day (1992), the seeds of the association were sown in August 1948 during a hydrogeological excursion at the 18th International Geological Congress (IGC) in London, UK. These early post-war years were very difficult for scientists interested in fostering international co-operation, especially at the global scale. However, an exchange of ideas between Stevenson Buchan, a Scot working at the British Geological Survey (Gray and Mather 2004), and Georges Drouhin, the head of the hydraulic service in Algiers (Algeria), laid the foundations for an IAH organising committee (“Provisional Board”) that convened for the first time at the following IGC meeting in Algiers in 1952. It was this committee, chaired by Drouhin and with Marcel Gautier as secretary, which prepared the way for the formal establishment of IAH on 8th September 1956 at the 20th IGC in Mexico City.

The original aims of the association, as set out in the statutes of 1957, were defined as “uniting all scientists interested in hydrogeology; holding scientific meetings and publication of worthwhile scientific results”. The revised statutes of October 1975 slightly modify this as “to promote co-operation between geologists and specialists in all disciplines who are interested in hydrogeological problems”. Thus, while hydrogeology was obviously at the core of IAH’s activities, it was recognised from the beginning that collaboration with colleagues from other disciplines would enhance the association’s ability to contribute to improving the scientific understanding of hydrogeology.

During the IGC, Paul Fourmarier of Belgium became IAH’s first president (Table 1). Other members of IAH’s first Council included Luis Blasquez (vice-president) from Mexico, Louis Dubertret (secretary general) and Gilbert Castany (treasurer), both from France. Total membership at this time was around 260, representing 35 countries. Most were European with French, Italian, Belgian and German

hydrogeologists being the most numerous. In fact, more than three quarters of the initial membership was from France or the French colonies and protectorates (primarily Algeria), and it was only natural that Paris became the association's first administrative centre.

The first independent meeting of IAH, i.e. the very first IAH Congress, was held in June 1957 at the Sorbonne University in Paris and was attended by 62 members including 41 French scientists, 7 from Belgium, 4 from Germany, 3 from Switzerland and 1 delegate each from Cyprus, Czechoslovakia, Japan, The Netherlands, Turkey, USSR and Yugoslavia. The primary purpose of the meeting was to develop the objectives and statutes of the association and to decide upon operational and administrative matters such as fees and member services. One outcome was an agreement that the Council of IAH should include at least one representative for each of the official languages of the IGC, i.e. French, Italian, Spanish, German, English and Russian. As a consequence, Hans-Joachim Martini (German) and Grigori Kamensky (Russian) were elected to Council, as was Georges Drouhin.

Activities in the early years of IAH

In terms of member services, it was agreed to provide all members regularly with printed annual information bulletins (*Bulletin d'Information*) as well as monographs and proceedings of IAH meetings (*Compte rendus* and *Memoires*). Given that the principal language of IAH at the time was French, much of the material including IAH's information bulletins from 1958 (no. 1) to 1977 (no. 20) were published almost entirely in French with occasional articles in English. Lists of all printed publications provided to IAH members, together with the comprehensive history from which this article is drawn, can be found on the IAH website's History section (IAH 2016).

Also discussed at the first congress was the relationship between IAH and the International Commission on Groundwater (ICGW), a commission formed under the umbrella of the International Association of Hydrological Sciences (IAHS), established in 1922. It was concluded there was very little overlap or potential competition between IAHS and IAH, because the IAHS-ICGW originated from a purely physical and mathematical scientific background, whilst IAH mainly represented applied geologists focussed on the relationship between groundwater flow and geology. While this somewhat narrow perspective on the role and practice of hydrogeologists could be challenged today, the relationship between IAH and the IAHS-ICGW has remained strong over the years. IAH was fully functioning by the late 1950s and published its first membership list in May 1959, providing the names and addresses of around 350 individual and 33 corporate members in 44 countries. France was best represented

with 121 individual and 11 corporate members, followed by Algeria (40 individual+12 corporate), Italy (34 individual), Belgium (27 individual+4 corporate), FR Germany (18 individual+1 corporate), French West Africa (13 individual+3 corporate), USA (12 individual), and Spain (10 individual). The United Kingdom and Australia had just three individual members each. The annual membership fee for individuals was US\$3 (or 15 Swiss Francs or 17 French Francs). In 2016 terms, US\$3 would be about US\$24.

The founding phase of IAH was strongly supported by UNESCO, who in the early 1950s had proposed the creation of an International Union for Geological Sciences (IUGS). However, IUGS, to which IAH is affiliated, was only created in 1961, whilst IAH was recognized and fostered by the Water Sciences Division of UNESCO from its early days. Many projects of the IAH commissions and working groups have since received substantial support from UNESCO funds through its International Hydrological Programme (IHP). The field of hydrogeological mapping which emerged in the 1960s can be cited as a prominent example continuing until today with the World-wide Hydrogeological Mapping and Assessment Programme (WHYMAP). A report summarizing 50 years of close cooperation in hydrogeological mapping was published in 2014 (Gilbrich and Struckmeier 2014).

The main focus of IAH during its formative years was the advancement of science through the creation of commissions. The first of these was the Commission on Hydrogeological Maps, established in 1959 in Madrid (Table 2). Two more were added in 1968—the Commission on Mineral and Thermal Waters, and the Commission for Karst Hydrogeology. Figure 1 is a photograph of some of the stalwarts of IAH's formative years on a Karst Commission field visit to the Dinaric region. By the early 1980s, the number had grown to include commissions for 'groundwater protection', 'volcanic terrain hydrogeology', and the 'hydrogeology of mining areas' (Table 2). These themes are not surprising; during the years of post war reconstruction and economic growth, which were also IAH's formative years, much of the emphasis in hydrogeology was on investigating the availability and suitability of groundwater to assure high-quality supplies for domestic, industrial and agricultural uses. Improved mapping of aquifers and the three-dimensional understanding of complex geological environments such as karstic and volcanic terrains was crucial to provide the technical basis for such development. The International Legend developed jointly by IAH and UNESCO in the 1960s still serves as a model for thematic hydrogeological maps throughout the world (Struckmeier and Margat 1995).

Advancing the science of hydrogeology was not, however, the new association's only activity. From the beginning, developing a strong professional network and community of like-minded colleagues was a key objective and the establishment of IAH national chapters was an essential part of this.

Table 2 IAH commissions and working groups, 1959–2015

Name	Year started	Chairs	Remarks
Commission for Hydrogeological Maps (COHYM)	1959	H Karrenberg, FR Germany to 1982. WF Struckmeier, FR Germany, 1982–2011	Phased out at Review of Commissions (ROC) in 2011
Commission on the Geology of Mineral and Thermal Waters (CMTW)	1968	K Fricke, FR Germany. H Schmassmann, Switzerland. B W Zuurdeeg, The Netherlands. J Dowgiallo, Poland. W Balderer, Switzerland	Renewed in 2011 as the Commission on Mineral and Thermal Waters, chaired by J LaMoreaux, USA, and A Porowski, Poland
Commission for the Hydrogeology of Karst	1968	A Burger, Switzerland. H Paloc, France. H Hoetzl, FR Germany. N Goldscheider, Germany	Renewed in 2011 as the Commission on Karst Hydrogeology, chaired by N Goldscheider
Commission on Groundwater Protection	1979	J Vrba, Czechoslovakia	Phased out at 2011 Review of Commissions
Working Group on Remote Sensing	1980	M Deutsch, USA	Uncertain when it ceased to be active
Commission on the Hydrogeology of Volcanic Terrains	Early 1980s	A Aureli, Italy	After almost a decade of work, the final manuscript of a monograph on volcanic rocks was stolen from Aurelio Aureli's car in Naples. There was no copy to replace it and the commission never recovered
Commission on the Hydrogeology of Mining Areas	1982	R Fernandez-Rubio, Spain	A commission that started with great enthusiasm. Later the International Mine Water Association was created with Fernandez-Rubio as first president
Commission on the Hydrogeology of Coastal Areas	1983	V Cotecchia, Italy	Ceased activity in the late 1980s and terminated by Council in 1990, revived by G Baroccu, Italy (see the following)
Commission on the Hydrogeology of Hazardous Waste	1986	P LaMoreaux, USA. J Vrba, Czechoslovakia	Active for a few years
Burdon Commission on Hydrogeology in Developing Nations	1987	S Foster, UK, to 1997. David Ball, Ireland, to 2005. Then A McDonald, UK	Renewed as a network at the 2011 ROC and now renamed Burdon Groundwater Network for International Development
Commission on Education and Training	1993	JE Moore, USA. R Aldwell, Ireland	Terminated by decision of Council in 2005
Commission on Urban Groundwater	1993	D Lerner, UK, to 1997. Then K Howard, Canada	Renewed in 2011 as the Urban Groundwater Network
Commission on Groundwater and Aquatic Ecosystems	1993	R Llamas, Spain	Not active by 1999. Revived in 2003 as Groundwater Dependent Ecosystems by C Colvin (see the following)
Commission on Hydrogeology in Arid Zones	1993	J Lloyd, UK	Active very briefly
Commission on Hydrogeology and Computers (CHCOM)	1996	GD Moore, USA	Active for 2–3 years
Commission on Hydrogeology of Hard Rocks (started as a working group)	1996	J Krásny, Czech Republic	Renewed in 2012 as the Network on Fractured Rock Hydrogeology, chaired by U Troeger, Germany
Commission on Transboundary Aquifer Resource Management (TARM)	1999	S Puri, UK	Phased out at the ROC in 2011 and re-established in 2015 with same chair
Commission on Managed Aquifer Recharge (MAR) (Working Group on Artificial Recharge from 1996)	2000	I Johnson, USA. P Dillon, Australia	Renewed in 2011 with the same name and chair
Commission on Groundwater and Climate Change	2002	A Issar, Israel, until 2008. Then R Taylor, UK	Renewed at the 2011 ROC with the same name and chair
Commission on Groundwater Dependent Ecosystems	2003	C Colvin, South Africa	Re-established at 2011 ROC as Network on Groundwater and Ecosystems, chaired by J Gurrieri and M Wireman, USA
Commission on Aquifer Dynamics and Coastal Zone Management	2003	G Barrocu, Italy	Re-established at 2011 ROC as Network for Coastal Aquifer Dynamics and Coastal Zone Management (CAD-CZM), chaired by G Barrocu, Italy
Early Career Hydrogeologists Network	2009	J Flugge, Germany. V Re, Italy	New network set up in 2009 and formalized at 2011 ROC

Table 2 (continued)

Name	Year started	Chairs	Remarks
Commission on Groundwater Outreach	2011	A Stone, USA	New commission established at 2011 ROC
Commission on Regional Groundwater Flow	2011	J Mádl-Szőnyi, Hungary	New commission established at 2011 ROC
Working Group on Education	2014	B Misstear, Ireland	Responds to IAH Forward Look objectives; unrelated to previous commission
Commission on Groundwater and Energy	2015	G Ferguson, Canada	-

Updates can be found on the IAH website (IAH 2016)

The first national group was set up by Paul Fourmarier in Belgium in 1958 and chapters in France, Spain, Italy, Czechoslovakia, Germany and Yugoslavia followed in the early 1960s. Technical meetings and field visits organised by the chapters in the national language enabled the association to reach, support and encourage many more hydrogeologists and, like the commissions, chapters quickly became an important component of the overall benefits of IAH membership.

The printing and distribution of publications had been an important objective for IAH presidents and councils since the very beginning of the association. Moreover, publication of scientific achievements in which IAH was involved needed to be brought to the professional world both inside and outside the association. Provision of publications was seen as an important benefit of membership but the increasing printing and global distribution costs were becoming a growing concern. The early technical volumes, which consisted of the proceedings of IAH congresses (usually published locally by the organisers on behalf of IAH), and other occasional publications, were distributed free of charge to IAH members (Table 3). The early IAH congresses featured important hydrogeological themes of the time, including the groundwater balance and reserves of aquifers, methods for applied groundwater studies,

applied hydrogeology and civil engineering, hydrogeological maps and karstic hydrogeology. This general outline was followed in each congress and occasionally supplemented by other, frequently regional, themes such as volcanic rocks at the Rome congress in 1961. The French titles of the early volumes in the table reflect the dominant role in IAH played by French-speaking hydrogeologists at that time. After 1990, congress proceedings were only distributed to participants.

Expansion and challenges in the 1970s

The 1970s proved to be a critical period for the fledgling organisation, a time of increasing membership and a widening of its geographical basis, shown by the establishment of new chapters in Ireland, the USA and Canada. Together with growth in scientific activities and the development of closer ties with other organisations, this started to put a strain on resources and tested the character of some of its leading figures. Increased expectations of the membership were beginning to expand the workload for Council, putting particular stress on the IAH Secretariat and the Treasurer. Towards the end of his 4-year term as president (1972–1976), Stevenson

Fig. 1 1973 IAH Karst Commission field visit, Kotor, Montenegro (photo courtesy of Petar Milanovic)

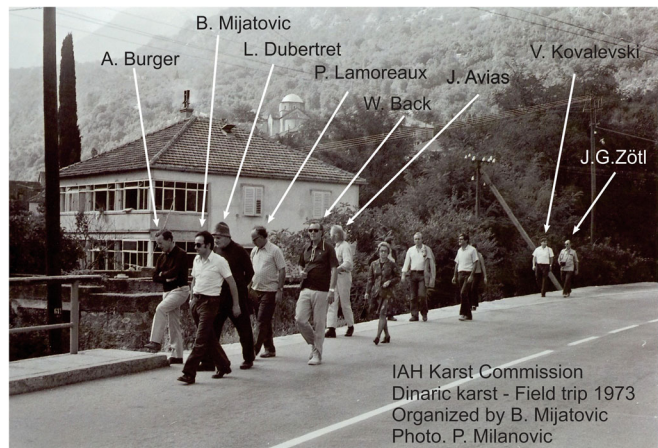


Table 3 Proceedings (memoirs) of IAH congresses 1957–1990

Number	Year of Publication	Theme and number of IAH Congress and year
Tome 1	1959	Réunion de Paris, 1st IAH Congress, 1957
Tome 2	1959	Réunion de Liège, 2nd Congress, 1958
Tome 3	1961	Réunion de Madrid, 3rd Congress, 1959
Tome 4	1962	Réunion de Rome, 4th Congress, 1961
Tome 5	1964	Réunion d' Athènes, 5th Congress, 1962
Tome 6	1966	Réunion de Belgrade, 6th Congress, 1963
Tome/vol 7	1967	Réunion de Hannover, 7th Congress, 1965
Tome 8	1967	Réunion d' Istanbul, 8th Congress, 1967
-	1970	International Legend for hydrogeological maps (IAH, IAHS and UNESCO)
Tome/vol 9	1972	Tokyo, 9th Congress, 1971
Tome 10	1974	Congrès de Montpellier, France (10th), 1974
-	1975	Hydrogeology of karstic terrains (IAH and IUGS)
Volume 11	1975	Congress of Porto Alegre, Brazil, (11th), 1975
Volume 11	1978	Hydrogeology of great sedimentary basins, 14th Congress, Budapest, 1976
Volume 12	1977	Proceedings of the 12th Congress, Karst Hydrogeology, Huntsville, USA, 1975
Volume 13	1977	Optimal development and management of groundwater, 13th Congress, Birmingham, UK, 1977
Volume 14	1978	Budapest conference
Volume 15	1979	Methods for evaluation of groundwater resources, 15th Congress, Vilnius, 1979
Volume 16	1982	Impact of agricultural activities on groundwater, 16th Congress, Prague, 1982
Volume 17	1985	Hydrogeology of rocks of low permeability, 17th Congress, Tucson, 1985
Volume 18	1985	Hydrogeology in the service of man, 18th Congress, Cambridge, 1985
Volume 19	1987	Integrated land use planning and groundwater protection management in rural areas, 19th Congress, Karlovy Vary, Czechoslovakia, 1986
Volume 20	1987	Rome, 20th Congress, 1987
Volume 21	1989	Karst hydrogeology and karst environment protection, 21st Congress, Guilin, 1988
Volume 22	1990	Water resources in mountainous regions, 22nd Congress, Lausanne, 1990

Buchan remarked that despite the very favourable signs of growth, “running the association is now becoming quite a heavy task”. The increasing burden of work on the Secretariat and Treasurer became a recurring concern in subsequent decades as the association grew.

As evidence of the mounting pressure, information bulletins began to appear with less frequency during the 1970s and concerted efforts were made to limit the association’s rapidly expanding scientific programme “to ensure that the activities of IAH are kept within its financial and other capabilities” (Information Bulletin Nos. 17–19). The association also struggled to collect annual fees from members in countries that had restrictions on obtaining and transmitting foreign currency and this had a constraining effect on the expansion of membership and consequently on the finances of the association. In the late-1970s, only 800 of the 1200 members were regularly paying fees which by that time had risen to 30 DM (17 \$ US or 50 FF). In 2016 terms, US\$17 would be about US\$55.

Despite these difficulties, IAH continued to push forward due to the diligent work and strong commitment of its elected

officers. In 1977, Phil LaMoreaux of the USA was voted president of a new Council (Table 1) at a well-attended congress in Birmingham, UK, and during the event the association celebrated its very first general assembly outside the confines of the IGC, a true sign of its maturity and growing independence. Unfortunately, when IAH seemed to be progressing well and ably coping with some of its inevitable “growing pains”, tragedy struck. On an extended field trip following the 1979 congress held in Vilnius, the Lithuanian Republic of the USSR, IAH Secretary General Louis Dubertret sadly died.

Louis Dubertret, founding member and first secretary general of the association from 1956 to 1979 had been one of the principal drivers behind IAH during the first two decades of its life. Without his untiring work, thousands of letters, contacts and negotiations, and his unfailing presence at international meetings, the association would never have attained the enviable international reputation it began to enjoy during the late 1970s. Dubertret had been a pivotal figure in putting IAH on a sound footing, and his death brought to a close a crucial phase in the association’s development.

The international growth years: 1979–2000

Rapidly growing membership

The sudden death of Louis Dubertret hit the association and its Secretariat very hard. However, President Phil LaMoreaux found an enthusiastic and energetic successor as secretary general in the person of Erik Romijn from the Provincial Agency of Gelderland in The Netherlands. Romijn brought renewed vigour to the association at a time when, by good fortune, the global need for groundwater mapping and sound approaches to resource protection and sustainable aquifer management was rapidly accelerating. As a result, the association entered a period of very strong international growth (Fig. 2). In 1980, IAH had 1,032 members from 53 countries. By 1996, membership had increased to 3,523 individual and corporate members representing 118 countries. The broadening geographical spread was reflected in new European chapters including Norway, Switzerland, Poland and Romania and further afield in Argentina, Australia, Chile, Egypt, India, Korea, PR China, Mexico and South Africa.

Membership growth also promoted greater scientific activity with the creation of new commissions for ‘remote sensing’, ‘hydrogeology of coastal areas’, and ‘hydrogeology of hazardous waste’ (Table 2). During this period, groundwater quality issues and the need to protect aquifers from pollution from human activities became a major focus of IAH’s scientific efforts. Intensive agriculture had been identified as a major source of groundwater pollution and a search was beginning for safe and secure underground storage repositories of hazardous radioactive waste from the nuclear industry. Hydrogeological attention turned on the one hand to shallow aquifers most vulnerable to land use change and, on the other, to non-aquifer formations of very low permeability.

The activity and productivity of a number of the commissions was further strengthened by the valuable support of UNESCO in aspects of hydrogeology which had close links to the themes and tasks of the IHP. At this time, these particularly focussed on karstic regions, on the contributions of the Commission on Hydrogeological Maps and on groundwater protection. The work of the commissions greatly contributed to scientific meetings on these subjects (Table 3); the IGC (held every 4 years) and the more regular IAH congresses and symposia also helped to establish the IAH “blue” book series (IAH International Contributions to Hydrogeology) and a little later the “green” book series (IAH Selected Papers).

Establishing IAH’s books and journal

Egon Groba, IAH Treasurer from 1968–1989 (Table 1), must be given great credit for the association’s publication initiatives during the early 1980s; however, good fortune also played a key role. Groba, it seems, was hospitalised when he happened to meet Christian Heise who was confined to a neighbouring hospital bed. Heise owned Heise Verlag (publishers), a major printing company in Hannover, Germany, that was seeking to expand into the publishing of science books. Both gentlemen seized upon this opportunity and entered an agreement that would serve both parties well for many years to come. IAH would prepare and deliver copy-ready manuscripts of the International Contributions to Hydrogeology and Heise would publish, print and distribute them free of charge to IAH members, while retaining the right to sell additional copies on the global market. In addition, Christian Heise generously agreed to print the Information Bulletins and Membership Directories at no cost to IAH.

The Selected Papers series was started by Andrew Skinner and Ian Simmers in 1990. This was a response to the decision

Fig. 2 IAH membership growth between 1956 and 2015

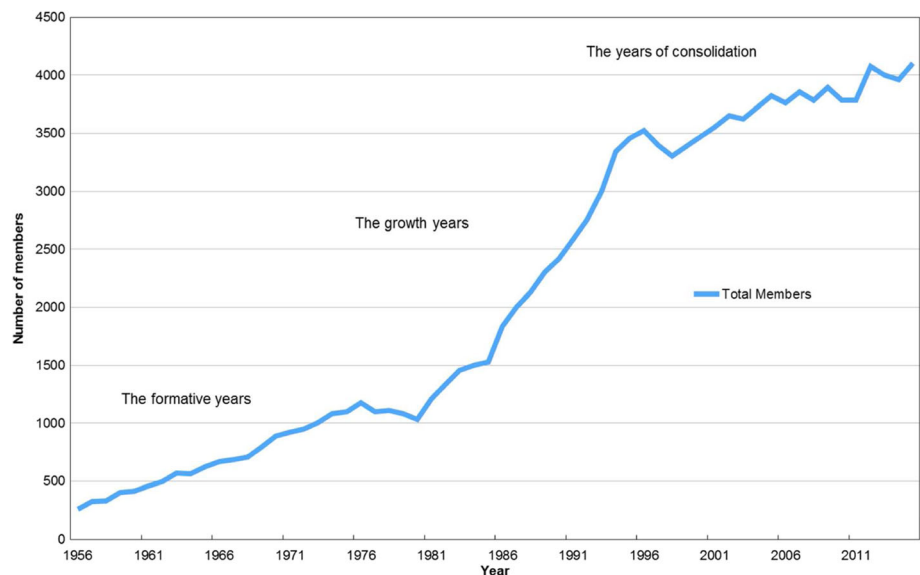


Table 4 IAH International Contributions to Hydrogeology (“blue” book series)

Volume	Year	Theme
1	1984	Hydrogeology of karst terrains: case histories ^{a,b}
2	1986	Hydrogeology of limestone terranes: annotated bibliography of carbonate rocks, volume 3 ^{a,b}
3	1984	List of the terms of hydrogeology, geochemistry and mineral and thermal waters ^{a,b}
4	1984	Hydrogeology of the Dinaric Karst ^a
5	1986	Impact of agricultural activities on groundwater ^{a,b,c}
6	1985	Theoretical background, hydrogeology and practice of protection zones ^{a,b}
7	1985	Hydrogeological mapping in Asia and the Pacific regions: proceedings of an ESCAP workshop, Bandung, 1983
8	1990	Groundwater recharge: a guide to understanding and estimating natural recharge ^{a,b}
9	1989	Well logging in groundwater development ^b
10	1989	Hydrogeology of limestone terranes: annotated bibliography of carbonate rocks, volume 4 ^a
11	1991	Hydrogeology of salt water intrusion: a selection of SWIM papers ^{a,c}
12	1990	Hydrogeology and management of hazardous waste for deep-well disposal ^{a,b}
13	1992	Hydrogeology of selected karst regions ^{a,d}
14	1993	Annotated bibliography of karst terranes, volume 5 ^{a,b}
15	1994	Hydrogeothermics ^a
16	1994	Guidebook on mapping groundwater vulnerability ^{a,b}
17	1995	Hydrogeological maps: a guide and standard legend ^{a,b}
Balkema takes over Heise and continues publication of ICH series		
18	1998	Shallow groundwater systems ^c
19	1998	Recharge of phreatic aquifers in (semi-) arid areas ^b
20	1999	Karst hydrogeology and human activities: impacts, consequences and implications ^a
21	1999	Groundwater in the urban environment: selected city profiles ^c
22	2002	Managing water well deterioration
23	2003	Understanding water in a dry environment: hydrological processes in arid and semi-arid zones ^b
24	2003	Urban groundwater pollution ^{a,b}
25	2005	Introduction to isotope hydrology: stable isotopes of hydrogen, oxygen and carbon
Taylor and Francis takes over Balkema and continues publication of ICH series		
26	2007	Methods in karst hydrogeology ^a
27	2011	Climate change effects on groundwater: a global synthesis of findings and recommendations ^{a,b}
28	2012	History of hydrogeology

Notes:

^a Output from the work of an IAH commission^b Directly linked to projects within UNESCO IHP^c Drawn from conference or congress proceedings^d Linked to IUGS-IGCP

Updates can be found on the IAH website (IAH 2016)

to discontinue the distribution of congress memoirs to all members and was designed to provide a means of publishing papers of merit which would otherwise be lost in congress proceedings of variable quality and accessibility in the pre-digital age. By 1996, when Balkema Publishers took over the two IAH book series from Heise, 17 volumes of the International Contributions to Hydrogeology (ICH) had been published (Table 4). The publisher Taylor & Francis took over Balkema in the early 2000s and continues to publish the book series today.

Many of the IAH blue books enabled the work of the commissions to be published as contributions to the groundwater science topics of the time, for which the series was intended. The themes are listed in Table 4, indicating those which arose from the work of the IAH commissions and those which were directly linked to specific activities within IHP and/or supported by UNESCO. The titles show that, for the most part, during the 1980s and 1990s, investigating and describing the geological settings in which aquifers and groundwater resources could be found remained a dominant emphasis for IAH and its

Fig. 3 Ian Simmers, Andrew Skinner, Eugene Simpson and Christian Heise at the Sherlock Holmes Hotel, London, in 1991 (photo courtesy of Andrew Skinner)



commissions. In particular, the joint scientific endeavours of IAH commissions and IHP working groups on karstic aquifer systems (volumes 1, 2, 4, Table 4), on groundwater vulnerability and protection (volumes 6 and 16), the international map legend (volume 17) and agricultural and urban impacts on groundwater systems (volumes 5 and 24) were well-recognised contributions in their respective fields of hydrogeology. Further details of all of these publications can be found on the IAH website along with information about how to obtain them.

It had long been an ambition of the association to produce its own scientific journal to complement the well-established book series, and approval to establish an IAH journal was given by Council at the Guilin congress in 1988. Heise was also behind the 1992 launch of the journal, *Applied Hydrogeology*, publishing it four times each year under the editorship of Eugene Simpson. The agreement to establish the journal was concluded in the summer of 1991 at the Sherlock Holmes Hotel in Baker Street, London, between Eugene Simpson, Christian Heise and IAH Secretary General Andrew Skinner (Fig. 3). In 1995, when Cliff Voss and Bill Wilson began as editors, the title was changed to *Hydrogeology Journal*. The title *Hydrogeology* was not available, to avoid any confusion with the existing journal *Hydrogéologie* published by BRGM in France. In 1997, Springer took over as publisher and the journal flourished, expanding to six issues per year from 1999. Over the years, *Hydrogeology Journal* has emerged to become one of the association's great success stories.

Broadening the scope of IAH activities in the 1980s

During this period, the familiar shield-design logo for IAH came into being (Fig. 4), reflecting the strongly geological origins of the association. This distinctive emblem was proposed by Jaroslav Vrba for the 1986 congress in Karlovy Vary and drawn by a Czech artist who normally worked on designs for postage stamps. Taking the explanation of the logo from a letter from Jaroslav Vrba to Erik Romijn in February 1985, the

crosses in the lowermost part of the shield use the established geological notation for crystalline igneous rocks. The bands of blue and yellow across the centre of the shield represent sedimentary formations containing water and the uppermost solid part of the shield represents the soil and an impermeable confining layer. The blue symbol in the centre represents a drop of water moving through this sequence. Thus, the logo encapsulates the very essence of hydrogeology; understanding and depicting the subsurface, recognising aquifers and non-aquifers and the way in which groundwater derives from infiltration from the land surface. The logo was published for the first time at the top of the News and Information newsletter in May 1985 and widely used at the 1986 congress, for which the first logo lapel badges were produced. In 1989 “aih” was added to the logo. Using both “iah” and “aih” balanced the logo design and indicated the association's name in the principal IAH languages of the time. Subsequent IAH councils and members have wished to retain this strong link to those responsible for the founding and growth of IAH during its formative years. For the 60th anniversary, minor amendments have been made to improve the clarity of digital reproduction of the logo in a range



Fig. 4 Logo of the International Association of Hydrogeologists (IAH)

of formats and a birthday sash superimposed for use during the year (Chilton and Howard 2016).

The principal focus of IAH's charitable activities, the Burdon Fund, came into being at this time. The fund was a legacy established in memory of David Burdon, a long-time member of the Irish national group and one of those present at the initiation of IAH in 1956. The associated Burdon Commission (now the Burdon Groundwater Network for International Development, Table 2) was set up in the mid 1980s specifically to support IAH members in lower income countries. At the initiative of Ramon Llamas and Erik Romijn, president and secretary general at the time (Table 1), a sponsored membership scheme was proposed by the Burdon Commission in 1987 and formalised and launched in 1989. This, one of the first such schemes established by a professional association, enabled individual members, national chapters and central funds to support colleagues who, for economic or administrative reasons were unable to pay for their own membership. There were 20 subscribers in the first year and numbers stayed fairly static until in 1993 when administration of the scheme was transferred to the IAH Secretariat.

The achievements of the association should not be measured only in numbers. Much of the success of IAH throughout its life has come from the personal commitment to the expanding community of groundwater colleagues shown by people who had given, and still give, hours of their time over many years. To recognise this, the Council of IAH established the award of Honorary Membership in 1982 and the Presidents' Award in 1995. The former is intended to reflect sustained commitments to the work of the association and the latter is given for a combination of contribution to the science of hydrogeology and to the work of IAH. The first awards (Fig. 5) recognised many of those who had contributed most substantially to the early years of the growth of IAH, and the full list can be seen on the IAH website (IAH 2016).

Erik Romijn's role as secretary general came to a close in 1989 when he was elected president (Table 1). At this time, IAH was evolving rapidly with membership doubling in a decade, many new national chapters being formed and a

blossoming array of publications and membership services. The stated aim of the association was to "further hydrogeological science by promoting cooperation between hydrogeologists of all nations and practitioners of other disciplines concerned with hydrogeological problems." This was to be achieved primarily by collaboration in research, publications and conferences with other scientific associations (Day 1992). This restates the original objectives but recognises the broadening global reach and expanding membership of IAH.

Reviewing IAH's plans and strategies in the 1990s

It was clearly time to pause for thought and plan more strategically. IAH's first meeting specifically for this purpose took place in Prague in May 1992 and it is worth recording that its genesis came partly from contemporary world events. The so-called Velvet Revolution had taken place in the then Czechoslovakia in 1989, following events in Poland and the former East Germany. The IAH Czechoslovak National Committee held funds in non-convertible Czechoslovak Crowns which were very likely to lose value with the financial changes taking place as the new Czechoslovak state was formed. Jaroslav Vrba therefore approached IAH Vice President John Day with a plan to utilise the funds in Prague by hosting the strategy meeting, and Day recommended this invitation should be accepted. The opportunity was timely in the light of the changing circumstances of IAH and with the need to react to the international priorities arising from the UN Water Conference in Dublin earlier that year. In all, 24 IAH members from the Council of IAH and its advisors, national committees and commissions were joined by representatives of sister societies, IAHS and the International Association of Engineering Geology (IAEG), and from UNESCO IHP, whose fifth phase was to start in 1995 and would be strongly influenced by the outcome of the Dublin conference.

The group met over 4 days to consider the outcome of the Dublin conference, to review the current organisation of IAH, to review the work of IAH in developing countries and to

Fig. 5 IAH President John Moore giving the 1996 Presidents' Award to Yuan Daoxian (photo courtesy of Andrew Skinner)



Table 5 Regional IAH membership, 2002–2015

REGION	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Sub-Saharan Africa	165	167	159	206	202	204	200	247	231	233	267	265	281	277
North Africa and the Middle East	75	77	86	84	78	90	90	74	99	97	101	94	109	117
Asia	243	218	218	238	265	263	288	214	191	191	229	259	300	316
Australasia and the Pacific	389	426	455	502	477	496	493	599	582	656	799	697	589	708
Eastern Europe	242	217	235	338	351	365	355	145	125	122	124	141	136	140
North America	754	720	697	704	695	685	669	672	654	632	659	574	602	583
Latin America and the Caribbean	309	300	300	213	211	207	194	177	177	197	179	182	197	229
Western Europe	1,473	1,496	1,573	1,539	1,485	1,545	1,496	1,766	1,726	1,656	1,716	1,685	1,747	1,733
Total	3,650	3,621	3,725	3,824	3,763	3,857	3,786	3,894	3,785	3,784	4,074	3,897	3,961	4,103

draw up an action plan. The plan focused on the 5 years from 1992 to 1997 and addressed both the priority technical areas on which it was believed IAH should concentrate its resources and also the key organisational needs which the group identified. Much of the scientific and technical work of the association was to be covered by two principal themes: developing technical understanding in key topic areas in hydrogeology and increasing public understanding of groundwater issues. At the time the former were identified as:

1. Better management of groundwater resources in urban areas to prevent overuse and contamination from inadequately controlled land use practices
2. Sustainable management of groundwater resources in arid and semi-arid regions, either alone or in conjunction with surface waters; quantification of recharge and understanding of flow processes to help achieve this
3. Methods for protecting the quality and quantity of groundwater, including a methodology for monitoring, identification of the susceptibility to human impacts and integration with land-use planning
4. Methods of management to ensure sustainable use of groundwater in harmony with aquatic ecosystems that depend upon groundwater; improved understanding of the sensitivity of ecosystems to changes in the quality and availability of groundwater

The plan was accepted by Council at its meeting in September 1992. Efforts were subsequently made in the period up to the new millennium to encourage new commissions to take up some of these challenges (Table 2), and the book themes in Table 3 also reflect this evolving emphasis.

Organising the Prague meeting was one of the first major responsibilities for Andrew Skinner, the incoming secretary general who had inherited this role from Erik Romijn in 1989. At the meeting, the fragmented nature of the IAH administration and consequent inefficiencies were discussed.

The new secretary general presented a plan to Council in Karlsruhe in September 1992 and the Secretariat settled in the United Kingdom in 1993. The association needed a careful hand on the tiller during these demanding but exciting times, and Skinner fitted that bill perfectly. A small team of part-time administrative assistants was appointed and he set about turning IAH into a modern, efficient, professional organisation with a management structure and governance appropriate for a membership that was fast approaching 4,000 (Fig. 2). Working closely with Council led by Michael Knight of Australia, President from 1996 to 2000 (Table 1), Skinner was able to ensure that IAH began the new millennium as a fully incorporated limited company and registered charity with a rigorous set of association rules and articles. Thus, from the 12th Council of IAH (Table 1), council members also became directors of the company and trustees of the charity. After 10 years of unprecedented growth, incorporation provided IAH with a sound foundation on which to build a sustainable future and Emilio Custodio, the first IAH president after incorporation (Table 1) was responsible for setting the association off on its new path. He firmly supported the use of English as the primary working language for IAH but also helped to make the outputs of the association available in Spanish and Portuguese. IAH owes much of its strength in Iberia and Latin America to his status and influence and he continues to support members and chapters during his travels to Latin America.

Consolidation and adapting to change: 2000–2016

Membership broadens rather than grows

This most recent period of IAH's history has been one of consolidation rather than expansion of membership, of responding to evolving scientific directions in hydrogeology and of adapting the management, administration and means of communication of the association to contemporary needs. The

membership of IAH reached 3,750 in 1995 (Fig. 2) and has increased only gradually since then, passing 4,000 in 2012 and again in 2015. During this time, IAH has gained and lost 300–400 members each year, with the precise annual balance between these determining whether a small overall increase or decrease is seen (Fig. 2). The association now has members in 131 countries, and the number of chapters has grown to over 40 including new chapters in Denmark, Hungary, Morocco and Portugal and most recently in Sweden, New Zealand, Iraq and Turkey. Regional membership trends are shown in Table 5. While some regions have shown steady growth over this period, others have seen fluctuations which often reflect regional economic ups and downs. The sharp jump in members in Western Europe and equivalent decline in Eastern Europe in 2009 resulted from a transfer of national chapters and members with the accession of new countries to the European Union and its consequent expansion eastwards.

The character and composition of the association has continued to broaden, with successive presidents and councils encouraging membership from outside what might be termed classical academic hydrogeology. Many new members were drawn from public sector regulatory agencies and the private sector as well as the more traditional sources in universities and geological surveys and are working in groundwater investigation, protection and management from a much wider range of disciplines. The broadening professional range and greater geographical reach has certainly strengthened IAH's ability to live up to its title and to speak with greater authority for groundwater globally. This was reflected in adoption by IAH of the strapline "Worldwide Groundwater Organisation" in 2005. Moreover, some of the established IAH chapters such as those in Australia and Ireland have been particularly effective in capturing a broader range of disciplines, enabling them to have a much more effective groundwater voice at a national level.

The books and journal flourish

Hydrogeology Journal has continued to flourish under the steady hand of Executive Editor Cliff Voss and his team. The number of manuscripts submitted has grown steadily to more than 400 per year, producing a significantly increasing editorial workload and the journal team was augmented by two part-time editorial office staff, one from 2001 and one more from 2005, and four managing editors from 2005. The published journal increased to eight issues per year from 2006 and now contains about 130 published articles and 1,800 to 1,900 pages annually. The team prides itself on the broad geographical spread of content and authors which is nevertheless balanced by a steady increase in impact factor to 1.97 in 2014 (Springer 2016). The theme issues of the journal reflect very well the evolving focus of groundwater research during this period (Table 6), and the fact that theme issue papers are amongst the most

cited in the journal is an indication of their contribution to current hydrogeological science. The journal has also needed to respond to the broader evolving environment of scientific publication and the changing requirements of IAH members by introducing on-line access to the journal in 2007 and an open access option for authors from 2014. The journal will celebrate its 25th anniversary in 2017 in several ways, including publication of a full historical article in this journal.

Publication of the two IAH book series has continued, firstly under the guidance of Ian Simmers and, since 2006, of Nick Robins. Finding authors willing and able to commit the substantial time required to write or edit an IAH "blue book" has become much more difficult and the series has faltered somewhat in recent years (Table 3). This is a broad issue affecting book publication by many professional associations; academic priority is to devote the time to papers for publication in cited journals. The Selected Papers green book series continues to provide participants at IAH congresses and other conferences with opportunities for topic-based groups of papers developed from their presentations to be published (Table 7). Further details of these publications can be found in the 'Publications' section of the IAH website (IAH 2016) with information about how to obtain them.

Congresses have continued to provide an important focus for the association's activities. Congress themes over the past 60 years (Tables 3 and 7) reflect the evolution of the science of

Table 6 *Hydrogeology Journal* theme issues

Year	Theme title
1996	Urban groundwater
1997	Groundwater processes in land and water salinisation
1998	Tribute to Eugene S. Simpson
1999	Groundwater as a geologic agent
2000	Groundwater and microbial processes
2001	Confining units
2002	Groundwater recharge
2003	Hydromechanics in geology and geotechnics
2004	Groundwater: from development to management
2005	The future of hydrogeology
2006	Social and economic aspects of groundwater governance
2007	Remote sensing and GIS in hydrogeology
2009	Hydrogeocology and groundwater dependent ecosystems
2010	Saltwater and freshwater interactions in coastal aquifers
2011	Insights from environmental tracers in groundwater systems
2012	Economics of groundwater management
2013	Hydrogeology of cold regions
2014	Hydrogeology of shallow thermal systems
2015	Optimization for groundwater characterization and management
2016	Land subsidence processes

Updates can be found on the IAH website (IAH 2016)

hydrogeology into new areas and the increasing importance of protecting and managing groundwater in response to growing quantity and quality pressures on aquifers. They also reflect the growing appreciation of the economic and social dimensions of groundwater and the need to use hydrogeological knowledge, skills and tools as a basis for improved management of groundwater resources. Beijing in 1996 was the last time IAH gave precedence to the four yearly IGC cycle in arranging its congresses; and, from the 27th in Nottingham (UK) in 1997 to the 42nd in Rome in 2015 (Fig. 6), congresses have been held almost every year. As well as the opportunity for both IAH members and non-members to present the findings of their own research in the technical sessions, they have also provided an essential opportunity for the IAH commissions and networks to describe their current and planned activities and attract new participants. Many productive research partnerships have originated from

discussions at congresses. Local organising committees, supported by the IAH Executive and Secretariat, have improved the professionalism of the congresses, strengthening the scientific quality but at the same time striving to keep costs as affordable as possible. This has seen attendances regularly top 600 and reach almost 1000 in Niagara Falls, Canada, in 2012. Although sadly increasing time pressures on working people and financial constraints have combined to lessen the part that the traditional post-congress field trips have played, overall the congresses still provide a vital part in the life of the association and the best opportunity for the global IAH “family” to meet.

Further strategic review

Incorporation provided a sound governance and administrative basis for the association to move into the new

Table 7 IAH Selected Papers (“green” book series)

Volume	Year	Theme
1	1990	Selected papers on hydrogeology from the 28th IGC, Washington, DC, 1989
2	1993	Hydrogeology of hard rocks, selected papers originating from the 24th IAH Congress, Oslo, 1993
3	1992	Selected papers on aquifer overexploitation from the 23rd IAH Congress, Tenerife, 1991
4	1993	Selected papers on environmental hydrogeology from the 29th IGC, Kyoto, 1992
Balkema takes over Heise and then becomes part of Taylor and Francis with an interruption to the series		
5	2005	Nitrates in groundwater; papers from a Euromeet at Wisla, Poland in 2002 ^a
6	2005	Groundwater and human development, selected papers from the 32nd IAH Congress, Mar del Plata, Argentina 2002
7	2005	Groundwater intensive use, selected papers from SINEX, Valencia, 2002 ^a
8	2007	Urban groundwater: meeting the challenge, selected papers from the 32nd IGC, Florence, 2004 ^{a,b}
9	2007	Groundwater in fractured rocks, selected papers from the conference in Prague, 2003 ^a
10	2007	Aquifer systems management, selected papers from the IAH Symposium, Dijon, 2006
11	2007	Groundwater vulnerability assessment and mapping, selected papers from the conference in Ustroń, Poland, 2004
12	2008	Groundwater flow understanding: from local to regional scale, selected papers from the 33rd IAH Congress, Zacatecas, Mexico, 2004
13	2008	Applied groundwater studies in Africa ^b
14	2008	Advances in subsurface pollution of porous media: indicators, processes and modelling; selected papers from the EU COST-629 Final Conference, Barcelona, 2007
15	2009	Groundwater governance in the Indo-Gangetic and Yellow River basins: realities and challenges
16	2010	Groundwater response to changing climate, selected papers from the 36th IAH Congress, Toyama, Japan, 2008 ^{a,b}
17	2013	Groundwater quality sustainability: selected papers from the 38th IAH Congress, Krakow, Poland, 2010
18	2013	Groundwater and ecosystems: selected papers from the 35th IAH Congress, Lisbon, 2007
19	2013	Assessing and managing groundwater in different environments: selected papers from the Groundwater Division of the Geological Society of South Africa conference, Pretoria, 2011
20	2014	Fractured rock hydrogeology: selected papers from the Fractured Rock Conference in Prague, 2012 ^a
21	2014	Calcium and magnesium in groundwater
22	2016	Solving the groundwater challenges of the 21st century: selected papers from the 40th IAH Congress, Perth, Australia, 2013
23	2016	Karst without boundaries: selected papers from the Karst Conference at Trebinje, Bosnia and Herzegovina, 2014

^a Directly linked to UNESCO IHP projects

^b Outputs from the work of an IAH commission

Updates can be found on the IAH website (IAH 2016)



Fig. 6 Locations of IAH congresses

millennium but, as already mentioned, responding to rapid change needs opportunities to think strategically. A second IAH strategic meeting was held at Stana de Vale, Romania, in May 2002 at the invitation of Florian Zamfirescu and the Romanian National Chapter (Fig. 7). In all, 35 participants from 19 countries, again representing the Council of IAH, commissions and national chapters, discussed and set out some new strategic priorities for the association. The four days of meetings, presentations and field excursions provided an opportunity for in depth discussions on the challenges and priorities for IAH over the next decade. The meeting agreed the following topics should be among the priority actions for IAH over the following 5–10 years:

1. Collaboration with UNESCO in the 6th phase of the International Hydrological Programme (IHP)
2. Partnership with UN agencies to promote better understanding of the role of groundwater and to raise its profile in international water policy initiatives
3. Continue and develop special IAH initiatives in transboundary aquifer management; urban groundwater, groundwater and poverty alleviation; improved understanding and better characterisation of groundwater systems; understanding groundwater dependent ecosystems; groundwater and coastal zone management
4. Review the priorities and work of the Burdon Commission (now Network) and the use of the Burdon Fund

Fig. 7 Iancu Oreseanu (Romania), Jaroslav Vrba (Czech Republic), John Mather (UK), Florian Zamfirescu (Romania) and Michael Galabov (Bulgaria), in Romania in 2002 (photo courtesy of Andrew Skinner)



5. Develop income sources to supplement membership income through corporate sponsorship
6. Review the format and scheduling of congresses and the work of commissions and working groups in line with the objectives and priorities of the association

Again the areas of groundwater science, management and development listed in the preceding as No. 3 featured in the establishment of new commissions (Table 2) and in the work of existing commissions and in the publications (book series and *Hydrogeology Journal*). The IAH commissions have remained the focus of much of IAH's scientific activity. The evolution of scientific directions within hydrogeology has continued in the new millennium and the increasing importance of taking account of global change in managing groundwater resources and protecting aquifers from pollution was reflected in new commissions on 'groundwater and climate change' and on 'transboundary aquifers' (Table 2). The activities of many of the commissions and networks have benefited from IAH's close and long-term cooperation with UNESCO's IHP, as can be seen from the notes to the book lists in Tables 4 and 7.

Recognising that the recommendations of the previous strategic meetings had not been fully implemented, the 14th Council of IAH (Table 1) agreed at its first meeting on the need for a comprehensive review of the association's activities. The process was initiated by a discussion in Council in Hyderabad, India, in September 2009, followed by consultation with national chapters and by a member survey. In July 2010, a 3-day meeting was convened in Reading, UK, attended by 24 participants representing Council, chapters, commissions and the broader membership. Under the guidance of Secretary General Shammy Puri, strategic priorities for IAH up to 2020 were set out under five main headings: the internal development of IAH, education and professional development, informing and influencing global policy, enhancement of alliances and partnerships, and developing the science of hydrogeology (IAH 2010).

Adapting to evolving hydrogeological focus

An important recommendation of the Forward Look was to complete the reform of IAH's commissions and networks, a process that had been initiated on behalf of Council by Vice President for Programme and Science Coordination Ken Howard in 2008 and was inherited by António Chambel following the 2012 IAH Council elections. Some of IAH's commissions had been too dependent on the energy and efforts of individuals and in some cases the initial enthusiasm had not been maintained or passed on to others (Table 2). The objectives of this review were to enable the association to close commissions which had become inactive or whose themes were now less topical, to establish new commissions in new topic areas and to encourage wider participation of younger

professionals in their activities. As a result of the reform, some of the established commissions and networks have been closed and some rejuvenated and continue to prosper (Table 2). New commissions on 'regional groundwater flow' and on 'groundwater and energy' have added to the breadth of IAH's scientific endeavours.

Commissions which have contributed strongly to the science of hydrogeology through their meetings and publications include the Mineral and Thermal Waters Commission (Balderer et al. 2014), Managed Aquifer Recharge Commission chaired by Peter Dillon with its series of ISMAR conferences (International Symposium on Management of Aquifer Recharge), and the Karst Commission chaired by Nico Goldscheider with its meetings and publications. As an example of the latter, selected papers presented at the karst symposium in Malaga, Spain, in 2010 were published in a special issue of the journal *Carbonates and Evaporites* (March 2011, Issue 1). Commission outputs are also published both in *Hydrogeology Journal* (for example, Ghasemizadeh et al. 2012; Goldscheider et al. 2010) and as books (Kresic 2013).

The changing emphasis has also become embedded in the association's present mission, developed from the IAH Forward Look, to "further the understanding, wise use and protection of groundwater resources throughout the world". This evolution in emphasis is seen in the growing need for a responsible professional association to advocate for better awareness of groundwater amongst policy makers, the general public and professionals in other disciplines. This is achieved in several ways. One is through IAH's participation in the major global fora for water, such as the World Water Council (WWC) and the Global Water Partnership (GWP) and the events which these organisations convene such as the regular World Water Forum (Fig. 8) and Stockholm Water Week. IAH has built on its long-established links with UNESCO to become a partner in UN-Water, the umbrella grouping of all UN agencies which have an interest in water.

Adapting activities to the new millennium

One of the most successful innovations of recent years has been the establishment of an IAH Early Career Hydrogeologists' Network (ECHN). This arose initially from seeing a similar endeavour by IAHS at the joint IAHS/IAH symposium in Hyderabad in 2009 and the idea was developed further in the discussions at the Forward Look meeting in 2010. What started as an informal group at the Krakow Congress in Poland in 2010 quickly became a formal IAH network within the revised structure established in 2011 (Table 2). The ECHN grew rapidly under the guidance of its first director Judith Flugge and has continued to prosper, convening technical sessions and organising lunchtime meetings and evening social events at each IAH congress. This has

Fig. 8 Public discussion during an IAH/UNESCO session at the 2003 Kyoto World Water Forum, Japan (photo courtesy of Andrew Skinner)



greatly encouraged younger IAH members to participate in all of the association's activities, especially the other commissions and networks and the national chapter committees, setting up national ECHN groups and providing a welcome and much appreciated voice for early career professionals as an observer at Council meetings.

Following incorporation, Andrew Skinner continued to lead the IAH Secretariat and steer IAH confidently into the new millennium. However, recognising that his own capacity to do this on a voluntary basis would not necessarily be available to others and was not sustainable as the association and its activities and responsibilities continued to grow, Council appointed John Chilton as IAH's first paid executive manager in 2008. IAH has also needed to recognise the changing ways in which professional societies provide benefits and services to its members, and this was an important driver for some of the recommendations coming from the Forward Look. Over the early years of the new millennium, digital communication with members by email had gradually been replacing conventional mail, and online payment for new and renewing members had been established with the setting up of a website for the association. The database for managing IAH membership had also grown up in piecemeal steps with the changing membership structure and fee rates over this period. By the time of the Forward Look in 2010 it was recognised that both website and database were due for a complete overhaul to incorporate contemporary design features, applications and content management. Council approved a proposal to establish a new website in 2012, development was undertaken in 2013 and site went live in 2014. Along with the website, the association and its members are also making increasing use of social media to communicate and to facilitate networking. Immediately after the Forward Look meeting, one of the participants, Sophie Vermooten of The Netherlands National Chapter, set up a LinkedIn group for IAH which quickly grew to several hundred members and now has more than 1600.

Although IAH was already aware of its charitable and educational responsibilities, formal registration of the association as a charity brought them more sharply into focus. The

principal vehicle of IAH's charitable activities had been the Burdon Fund, and associated Burdon Commission (now the Burdon Groundwater Network for International Development). The Network supports IAH members in lower income countries, helping colleagues who sometimes feel rather isolated to become better informed and more confident in their work, encouraging professional contact and collaboration between countries and helping to stimulate the formation of new national chapters. IAH employs the Burdon Fund to provide regular free book distributions to members in Africa and to support attendance at IAH congresses. More recently, a Memorandum of Understanding has been established with the African Groundwater Network and funds used to provide partial support to some of their workshops on groundwater in integrated water resources management in African river basins. With the resources for more effective promotion, the sponsored members' scheme has grown much faster and now supports 265 colleagues.

The Hydrogeologists' Time Capsule, the inspiration of Craig Simmons and Philippe Renard, which they turned into a successful project in 2006, provides a substantial collection of video interviews of eminent hydrogeologists who have made a material difference to the profession (Simmons and Renard 2008). The recordings provide opportunities to understand personal motivations, aspirations and philosophies by hearing directly their own reflections on their work and its impact and their thoughts for the future. These recordings constitute an historical record for future generations, and many are augmented by profiles published in this journal (Bredehoeft 2008; Duncan and Voss 2013; Voss and Duncan 2013).

To be effective, advocacy and awareness-raising of course needs technically sound but appropriately written material. Examples of this include the brochure prepared for IAH's 50th anniversary in 2006 and policy briefs prepared jointly with UNESCO for the World Water Forum in Kyoto in 2003, both under the guidance of Stephen Foster. More recently, recognising the essential interconnections between groundwater and other sectors, to provide technical material to support the new Sustainable Development Goals and to mark the 60th

anniversary, Stephen Foster has led the production of the IAH Strategic Overview Series, which is available on the Knowledge (Learning Resources) section of the IAH website (IAH 2016).

This changing emphasis is reflected in IAH's international partnerships. One of the most productive was that between the IAH Commission for Transboundary Aquifer Management (TARM) and UNESCO's Internationally Shared (transboundary) Aquifer Resources Management (ISARM) Programme (Puri and Aureli 2005). The TARM Commission's hydrogeological knowledge underpinned the work of the UN International Law Commission (ILC), such that a set of draft articles for a law on transboundary aquifers has been accepted by the UN General Assembly and now awaits ratification by countries. IAH colleagues from chapters including the Czech Republic, Denmark, France, Ireland, Italy, Spain and the UK, played a prominent role in supporting the European Commission in preparing the Water Framework Directive and Groundwater Directive and the associated guidance documents, and subsequently implementing their groundwater management and protection provisions at national level.

Since 2012, IAH has been a partner with FAO, UNESCO and the World Bank in a Global Environment Facility (GEF) project on groundwater governance. The present status of the governance and management of groundwater was examined by a series of country case studies and thematic papers and five regional consultations. IAH members contributed (partly through the IAH commissions) to the preparation of the case studies and the writing of four of the twelve thematic papers and provided their experience at the regional consultations. IAH provided most of the drafting team for the main outputs of the project, a *global diagnostic* of the present state of groundwater governance, the *vision* for improved governance, and a *framework for action* by which steps can be taken to reach this vision (FAO 2015a, b; Foster and van der Gun 2016).

The future

Over the past 60 years IAH has developed into a strong international groundwater association with a broad membership base, a well-regarded journal, established books series and a full programme of scientific meetings and well-attended congresses. Great credit for this success goes to members past and present who have dedicated untold hours to further the association's aims and objectives, not only centrally within the IAH Council and the IAH Secretariat, but regionally within its national chapters, commissions and networks. Today, IAH plays an important role advocating for groundwater in the global water agenda and pursuing its mission to further the understanding, wise use and protection of groundwater resources throughout the world.

Demanding at times, it has been a successful journey, but the 60th anniversary year represents only a milestone on a path that

continues. Signs for the future are very positive but much work remains to be done to ensure IAH remains at the forefront, adapting both to the needs of its members and to those of society as a whole. The world is changing rapidly with population growth, pollution and a warming planet posing serious threats to the sustainability of water resources and water-dependent ecosystems. At its most recent meeting, IAH Council approved the birth of the Commission on Groundwater and Energy and these types of initiatives must continue. It is essential that the association's complement of commissions and networks remains responsive to the world's changing priorities and issues, contributing to the evolving science but also helping to meet related social and educational needs.

When Stevenson Buchan remarked back in 1972 that IAH was "reaching its maturity", he could hardly have foreseen the remarkable transformation IAH would undergo in the following 40 years. By the same reasoning, it is impossible for the current guardians of IAH to foretell what the next 40 years will bring. The association must strive to develop benefits which attract into membership the younger professionals whose active participation in all of IAH's activities is essential for the continuing health and strength of the association. Certainly there will be challenges, including the difficulty of providing attractive member services on a limited budget, which has been a recurring concern throughout the life of the association. Dedication, commitment and hard work will also be required. However, the association has gained good momentum over the past 60 years, morale is strong and optimism holds no bounds, especially given the injection of energy provided in recent years by the early career hydrogeologists in the ECHN, many of whom have taken on some important responsibilities within the IAH. These will be the new champions of IAH, and the future lies in their hands.

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