International Association of Hydrogeologists

AUSTRALIAN NATIONAL CHAPTER

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NEWSLETTER

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IAH-AUSTRALIA PRESIDENT'S MESSAGE

It is now about two years since Queensland accepted responsibility for the National Executive of the IAH, two very busy years, especially for Secretary Rob Ellis, Treasurer Peter Evans and Newsletter Editor Mal Cox. It is a lot of work to keep the books of the Association up to date, keep track of members (they do move around a lot) and keep members informed of what is happening.

The Association is still in growth mode in Australia. This is evidenced by increasing membership, which now stands at about 400. International recognition of Australia's importance in the IAH is shown by the election of Professor Michael Knight as International President.

The importance of groundwater both as a resource and as a key environmental factor is becoming increasingly recognised. Public awareness has increased significantly in the past few years and educational opportunities have likewise increased.

The "once every three years" groundwater schools of the past have had a change, with the Centre for Groundwater Studies trialling three in just over one year; Perth in September 1995, Brisbane in November 1995 and Melbourne in November 1996. Each school has attracted more than 50 participants. More universities now offer post-graduate courses in hydrogeology. More conferences have groundwater themes included. Dedicated groundwater conferences are becoming more regular as the need to seek and share knowledge on the subject becomes more apparent. The recent Groundwater and Land Use Planning Conference in Perth, the AGSO Anniversary Conference and the Mesozoic 96 Conference in Brisbane are examples.

LWRRDC, the major Commonwealth research funding body for Land and Water Resource issues, now has a separate Groundwater Research Program.

Recently, the Prime Minister's Science and Engineering Council had their 14th meeting, with the theme "Managing Australia"s Inland Waters". For several hours practitioners had the ear of the Prime Minister, some 7 Members of Cabinet plus senior departmental officials, and were able to put water resource issues to them. The areas chosen for presentation were the Great Artesian Basin and the Murray Darling Basin, in which groundwater is of major importance in resource and environmental issues. The raising of groundwater issues in such a forum can only create further awareness by government and managers. A total of 33 recommendations were put forward to the Council, many of them relating to groundwater.

The IAH has a role to play in this increasing awareness of groundwater. We should have input wherever we can!

Let me here express to you my personal best wishes for the holiday season, as well as those of the IAH National Executive. We are all very pleased to see the growth in the IAH in Australia, and the real interest shown by the members. We are in particular keen to develop links and members in our offshore neighbours.

John Hillier
President IAH-Australia

INCREASE IN FEES

Note from Treasurer and Secretary

The meeting of the IAH Council held in Beijing on 5 August 1996 decided to put a resolution to the General Assembly meeting held on 7 August to increase membership fees. The following is the background to this resolution, quoted from meeting notes:

The losses in 1995 and 1996 were being met from the Associationís significant reserves, but this could not continue. A new contract for the journal, increased journal content and increased postage costs all made an increase in fees necessary, the first since 1993. Income and cost projections for each class of member had been prepared by the treasurer and are shown in Annexure 3. The recommendation of the executive was that the fees should increase from DM70/40 to DM80/45. On discussion it was felt that it would be better to continue to hold low income/student fees at DM40 and recover the additional income from full paying members.

Therefore it was agreed that the resolution to be put to the General Assembly would be that the fees from 1997 should be DM82/40.

This recommendation was approved by the General Assembly without dissent.

It follows that the Australian Chapter is obliged to increase the fees in a similar manner. The National Executive has approved an increase from $80 to $90 (slightly less than the international increase).

Those who have paid in advance for 1997 will not be affected by the increase.

Editor's Comment

This is the last newsletter for 1996. I wish every reader all the best for the summer season, a good break, and a happy new year. Next year we will again attempt four issues, the first one in mid February, so deadline will be sometime like the first week of February. I will send out a reminder fax.

The best way to send Newsletter items is direct to the editor, either by email (which I can extract and reformat), or mail it in a camera-ready form of A4 size (which will be reduced to A5). Don't need bromides, just a good clear copy. To:

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Non-groundwater bore

REPORTS FROM IAH BRANCHES

AUSTRALIAN CAPITAL TERRITORY

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

The Australian Geological Survey Organisation (AGSO) has experienced major changes, including a restructure during the last few months. To quote from the AUS.GEO News No. 36, October 1996:

The Government has taken a number of decisions which will enable AGSO to focus more efficiently on its core business of geoscience mapping and spatial information management supported by specialist research and capabilities that are not readily accessible elsewhere. In pursuing its mission, AGSO will be increasingly involved in networks and partnerships for providing the national geoscience framework for sustainable development of Australia's mineral, petroleum, water, and soil resources, and the mitigation of geological hazards.

In addition to the previously announced support for AGSO - including approval for the new $ 109 million headquarters at Symonston, ACT - the Government provided further support for AGSO in the 1996-97 Budget by funding a new program to map Australia's ocean territory (the AOT Mapping Program), designed to meet the nation's commitments to define the extent of Australia's jurisdiction under the United Nations Convention on the Law of the Sea by the year 2004. (This Program will save a number of jobs previously earmarked for elimination).

As part of the 1996-97 Budget, reductions are taking place across the entire Federal Public Service to increase efficiency through a general reduction in operating costs. AGSO's share of these reductions has been achieved through voluntary redundancy, which will see a permanent-staff reduction of 48. A number of non-permanent and contract positions will also be cut as AGSO is reorganised to better focus on its core activities.

These activities are geoscience survey work in support of :

- mineral and petroleum exploration in Australia, including the mapping of the nation's offshore jurisdiction,

- management of Australia's groundwater and soil resources, and

- mitigation of geohazards in Australia.

In sharpening AGSO's focus on these activities, aspects of research on climate change, coastal geoscience and early Palaeozoic palaeontology/biostratigraphy are being discontinued.

AGSO's new structure and managerial arrangements were implemented in September 1996, and include the Petroleum and Marine Division, the Minerals Division and the Geohazards, Land and Water Resources Division. In addition there is a Research Development Division and a Science and Survey Support Division (including Engineering, Information Technology, Spatial Information and Mapping, and Corporate Services).

The Geohazards, Land and Water Resources Division is responsible for the Geohazards Program, comprising urban risk and vulnerability assessment, earthquake research, nuclear monitoring, and geomagnetic research; and the Land and Water Resources Program, comprising groundwater research and land degradation studies to provide the geoscientific information in support of integrated land management.

The Groundwater component consists of the Murray-Darling Basin Hydrogeology, Groundwater in Aboriginal Lands, Australian Groundwater Quality Assessment and Hydrogeology of the Great Artesian Basin Projects.

JUBILEE SALE OF AGSO PUBLICATIONS

To celebrate AGSO's Jubilee Year (1946-1996), a large number of AGSO products (BMR/AGSO Bulletins, Reports and Maps) are offered at reduced prices (see list in AUS.GEO News 36, October 1996), and the following publications (all reduced to $ 10.00) might be of interest to IAH members:

Bulletin 227 - 1987
Hydrogeology of Australia (text + hydrogeological map of Australia at scale 1 : 5 000 000)

Bulletin 263 - 1987
Hydrogeology of the ACT and environs

Bulletin 221 - 1989
Hydrochemistry of the Upper Hunter River Valley, NSW

Bulletin 230 - 1989
Hydrogeology and groundwater resources of the Lake Amadeus and Ayers Rock region, NT

Contact: AGSO Sales Centre, GPO Box 378, Canberra, ACT, 2601
phone 06-249 9519, fax 06-249 9982, email sales@agso.gov.au

New Publications:

Hydrogeology of the Darling River Drainage Basin Map at scale 1 : 1 000 000, produced by AGSO, in collaboration with the NSW Department of Land and Water Conservation and the Qld Department of Primary Industries for the Murray-Darling Basin Commission's Natural Resources Management Strategy

AGSO Record 1995/43 - The Scotia groundwater discharge complex, Murray Basin, SE Australia. An exhaustive study of a groundwater discharge complex in the Murray Basin, a guide to prospective sites for storing saline water.

Digital Elevation Model for the Australian Continent - A digital elevation model (DEM) has been produced for the first time for the whole of Australia. **Geodata 9-second DEM** has a grid spacing of 9 seconds (roughly 250 metres) in both latitude and longitude. Its source data have an accuracy of better than 10 metres, and include the continents's drainage network as a contribution to the gridding algorithm. **Geodata 9-second DEM** was prepared by AGSO in collaboration with the Australian Surveying and Land Information Group (AUSLIG), the Australian Heritage Commission, and the Centre for Resource and Environmental Studies (CRES) at the Australian National University, Canberra.

The Prime Minister's Science and Engineering Council held its 14th Meeting at Parliament House, Canberra on 13 September 1996. One of the main topics on its Agenda was the Water Resources of the Murray-Darling Basin and Great Artesian Basin.

A publication - **Managing Australia's Inland Waters - Roles for Science and Technology** - 148 p., which deals with the Water Resources of the Murray-Darling Basin and Great Artesian Basin, was prepared for the Meeting by authors from Commonwealth and State Government Authorities and Universities, and published by the Department of Industry, Science and Tourism, Canberra.

NEW SOUTH WALES

Branch Meeting

Since the last newsletter, NSW Branch have held two Group Meetings both of which created a high level of interest. Both were held at the Ruby Club in downtown Sydney.

On 28 August Colin Mackie provided an excellent presentation entitled "Planning for water management in the Hunter Valley - A challenge for hydrogeologists". The presentation attracted a high level of interest and discussed ESD principles, highlighting some difficulties in providing defensible hydrogeologic argument in respect of the Precautionary Principle and the Principle of Intergenerational Equity. Both of these principles have significant bearing on the mining industry especially in regard to the Bengalla coal mine development where extensive legal argument prevailed prior to development approval, and the Lake Cowal copper gold prospect where approval was not granted based on the Precautionary Principle.

Groundwater is perhaps one of the most difficult issues (in a planning context) due to the need to address a wide ranging parameter base, the high cost of sampling, limitations in data analysis and a poor understanding of subsurface flow processes by the wider community. Bengalla coal mine provided an example of the depth of study required to ensure defensibility - multi layered numerical model simulation with a 21 year mine plan and dynamic modelling of the various mine catchments (including groundwater model output) using the full 100 year daily rainfall record to generate water management simulations of such things as dam storages, and potential mine water releases.

Student Night

A student night was held on October 17. Two students (one from UTS and one from UNSW) were nominated to provide presentations. Kayleen Walsh's presentation was entitled "Understanding the biodegradation of chlorinated aliphatic hydrocarbons". Bioremediation has proven to be a feasible and generally cost effective technology for organic and inorganic contamination but careful monitoring is required to characterise the process and maintain efficiency in the field. The presentation provided a detailed discussion of current research being undertaken by Kayleen, with an overview of the development of cause and effect relationships.

Land and water contamination present unique problems to landowners, consultants and regulatory authorities. Complex questions are often posed and solutions sought on a national basis. Toni Recsei presented his current development of an information management system for contamination. Toni has developed a decision support system which aims to provide an optimal balance between heuristic and quantitative aspects of contaminant assessments thus providing a measure of practical support for decision makers.

The evening proved to be an interesting and a valuable forum for those wishing to brush up on where research is heading.

Interstate members are welcome at Group Meetings which are sponsored by various companies.

The next meeting is scheduled for December 5th.

QUEENSLAND BRANCH

Branch meeting Tuesday, 12 November 1996

Magdalena Riesser-Steffens of Environmental Groundwater Consultants Pty Ltd spoke on environmental management systems. The talk was very well attendeed and produced some good questions

Electronic Environmental Management System
Environmental Groundwater Consultants in partnership with BP developed a comprehensive Electronic Environmental Management System for the Bulwer Island Refinery, near the mouth of the Brisbane River. EEMS draws together data on a number of key environmental areas including air, effluent, ground and surface water, solid waste and noise. It also incorporates detailed maps of the site and the surrounding area indicating sensitive features such as residential areas, transport links and sites of ecological importance. The computer software allows data to be plotted on maps or tabulated according to any criteria. Satellite images, aerial photographs, base maps and monitoring points can be superimposed on each other creating an easily understood visual guide to the refinery.

The Chrsitmas Party will be held at the Irish Club on the evening of Thursday, 5 December.

Linda Foster, Secretary, Qld Branch, IAH

MESOZOIC GEOLOGY CONFERENCE, BRISBANE
23-26 September, 1996

The Conference was hosted by the Queensland Division of the Geological Society of Australia (GSA), and the IAH-Australia. Some copies of the proceedings (575 pages) are still available at a reduced price of $90 plus mail, from:
Warwich Willmot, Dept of Minerals and Energy,
GPO Box 194, Brisbane, QLD, 4001. Tel (07) 3237 1592.

Following is a list of papers that cover topics in hydrogeology:
Berry, Keith and **Armstrong**, D:
Eromanga water supply development for Olympic Dam operations.
Eadington, Peter, **Person**, Mark, **Toupin**, Denal and **Hamilton**, Joe:
An outline of paleoformation water compositions and flow patterns in the Eromanga and Cooper Basins through Mesozoic time.
Evans, Peter:
Fluoride anomalies in aquifers of the Queensland sector of the Great Artesian basin and their significance.
Giblin, Angela:
An application of groundwater geochemistry to the detection of prospective basement beneath Mesozoic cover.
Habermehl, Rien:
Groundwater movement and hydrochemistry of the Great Artesian Basin, Australia.
Hillier, John:
The Great Artesian Basin - management of the water resources after 100 years of development.
Horn, Tony, **Derrington**, Elizabeth, **Herbert**, Graham, **Lait**, Rob and **Hillier**, John:
The Mesozoic aquifers of Cape York Peninsula, Queensland.
Li, Jiaorong and **Cox**, Malcolm:
Chemical character of groundwater in the Walloon Coal Measures of southeast Queensland.
McMahon, Gerard and **Cox**, Malcolm: The relationship between groundwater chemical type and Jurassic sedimentary formations: the example of Sandy Creek catchment, Lockyer.
McNeil, Vivienne and **Cox**, Malcolm: Discrimination of groundwaters in the Great Artesian Basin, Queensland, using the Cl/Mg ratio.
Prowse, Geoffrey, **Jolly**, P., **Yin Foo**, D.A. and **Mathews**, I:
Cretaceous aquifers of the Northern Territory's Top End.

WESTERN AUSTRALIAN BRANCH

Elections were held and a new UWA Committee for 1996/7 was elected. Congratulations to the new office bearers:

Chairman	J S Throssell
Vice Chairman	Claus Otto
Secretary	Gary Meyer
Meetings Secretary	Sunil Varma
Education Representative	Dr Q Rathur
State Liaison Member	Philip Commander

BRANCH MEETINGS 1996

June 26th Annual General Meeting
Peter Goodall: Water and Rivers Commission and Tony Allen: Rockwater
Water supply to the Eastern Goldfields

September 3rd
Peter Thorpe: Golder Associates
Groundwater tracing and age dating using environmmental isotope techniques -practical applications for water wizards

October 7th (Joint meeting with AWWA)
Bob McGowan: Dames and Moore
Fremantle Tunnels remediation project

November 12th
Robert Bowyer: Water Corporation
Driller certification in Western Australia
David Holmes: Montague Drilling
The expert hydrogeologist versus the expert driller

FREMANTLE PRISON TUNNELS - REMEDIATION PROJECT
Bob McGowan

Beneath Fremantle Prison is a system of tunnels - water galleries excavated late last century along the water table in the limestone to provide a water supply for Fremantle. The tunnels actually extend beyond the prison walls, but the only access shafts are from within the prison! In 1989 the prison reticulation system started spraying oil onto the lawns, and it was discovered that the tunnels were full of diesel oil. The Environmental Protection Authority originally recovered 65,000 litres of oil, but the clean-up was halted as oil continued to seep into the tunnels at a rate of 2,000 L per week.

After the prison was closed in late 1991, an investigation found the oil had leaked from nearby underground pipelines carrying fuel to the port. The subsequent clean-up by Dames and Moore Pty Ltd used bioremediation to remove both free product and oily residues coating the tunnel walls. Special health and safety measures were required to work 20 metres underground in partly submerged tunnels containing diesel vapour, with no natural ventilation or light.

GROUNDWATER AND LANDUSE PLANNING INAUGURAL CONFERENCE
Fremantle, 15 -18 September.

An international conference on groundwater and landuse planning focussing on urban development was held in Fremantle 15 -18 September. The conference concentrated on the protection of the Gnangara and Jandakot Mounds, and presentations came from a wide variety of speakers, including interested landholders and environmental representatives. The international flavour was provided by keynote speakers Stephen Foster presenting problems from urban areas around the world, and Lee Koppelman giving an account of issues on Long Island, together with other presentations from Indonesia, France, Thailand and New Zealand. Janine Gibert presented some results of recent research on stygofauna in groundwater. A half day tour took delegates to see a variety of land uses impacting on groundwater, and the memorable conference dinner was held in Fremantle Prison, above the remediated tunnels.

The conference, held as a recommendation of the Parliamentary Select Committee into Metropolitan Development and Groundwater Supplies, was opened by the Minister for Environment, and closed by the Minister for Planning, keeping groundwater protection firmly on the political agenda. The conference reinforced the need for wide public involvement when developing policies relating to land management in areas where groundwater quality must be protected.

GENERAL NEWS

UNSW GROUNDWATER CENTRE
1997 Postgraduate Program: MAppSc, MEngSc and Grad Dip

You will all be aware of changes to tertiary education announced in the last federal budget. HECS for engineering based undergraduate and postgraduate programs is set to increase at the beginning of 1997 to $4,700 per year. Changes to funding for the coursework Masters program were also announced, with preliminary reductions to HECS funded places in the 1997 program and major place reductions planned for 1998.

As a result of these changes it has been decided to charge fees for the Masters programs in Applied Science and Civil Engineering at UNSW. A full 12 month program will incur a fee of $7,050 with individual subjects (12 credits) costing $705 each. The fee for the Graduate Diploma will be $5,640. These fees include the HECS liability of the student and can be claimed on tax returns as the cost of self education. After tax concessions these fees are less than deferred HECS and not much more than upfront HECS.

Students currently enrolled at UNSW in the Masters programs will not be charged the new fees but they will be liable for the increased HECS charges announced by the Federal Government.

A brief description of the 1997 Program is provided below.

GROUNDWATER INVESTIGATIONS & MANAGEMENT

Objectives
The course is designed for engineering and science graduates who intend pursuing a career in groundwater studies, either in the public or private sectors. The course is co-ordinated by the UNSW Groundwater Centre and has had more than 40 successful graduates in the past five years. Facilities developed by the Groundwater Centre, such as the East Lakes Experimental Site and the David Phillips Pumping Test Field Laboratory in the Botany Sands aquifer are used in the teaching programme.

The course is based upon a mixture of theoretical analysis and practical application and makes extensive use of PC laboratories. The course is suited to professionals who wish to work either in the development of groundwater resources or the investigation and treatment of contaminated groundwater.

Core Area - Course Content
- Hydrogeology and the investigation of groundwater resources
- Hydrological processes, the hydrological cycle, rainfall, run-off and evaporation; experimental catchment studies
- Hydrogeochemistry; field and laboratory procedures, chemical modelling and isotope studies
- Groundwater studies in a variety of different geological environments
- Investigation techniques at contaminated sites; Groundwater remediation methods

Elective Area - Course Content
Elective subjects may be chosen from the range of subjects offered within Civil Engineering. Subjects may also be taken in other faculties with the consent of the course coordinator. Recommended subject areas include:
- Environmental and engineering geophysics. Geophysical techniques used in groundwater studies and contaminated site investigation are covered.
- Remote location water supply and sanitation. The supply of water and the treatment of water in remote locations is important, whether in a rural setting in Africa or an outback farm. Appropriate technology is required in all locations.
- Urban hydrology and storm water. Studies of urban impacts on groundwater are becoming increasingly important.

- Catchment and water quality management. An understanding of groundwater impacts on surface water quality, salinity and the part played by groundwater in total catchment management are of increasing importance. Students who undertake a research project select two electives. The degree may also be awarded to students who undertake ten subjects.

Elective Area - Project
A 36 credit project may be undertaken in the general area of groundwater studies. Recent projects have included the following:
Dryland salinity studies on the Liverpool Plains and at Yass
Gas chromatograph studies of the weathering of oil spills
Electrical imaging studies at landfill sites
Remote sensing using SPOT and MSS data
Heavy metal transport through sandy aquifers
Groundwater modelling of coastal aquifers

The UNSW Groundwater Centre currently has 11 PhD students enrolled. Many of the current projects are arranged in areas in which the Centre has current research interests.

UNIVERSITY OF NEW SOUTH WALES

UNSW Water Research Laboratory - AWACS

Much of the commercial work undertaken by the UNSW Groundwater Centre has up until recently been undertaken through Australian Water and Coastal Studies Pty Ltd (AWACS). AWACS is a joint venture company of the Department of Public Works and Services and Unisearch Ltd of the University of New South Wales (UNSW). The company was established in 1987 to market the services of the Department's Manly Hydraulic Laboratory (MHL) and the University's Water Research Laboratory (WRL).

After nine years operation, the parties of the venture have decided that the company has accomplished its aim of strengthening the commercial viability of the two laboratories and raising their profiles both nationally and internationally. As a result the Directors of AWACS have determined that the company move to a non-trading position over the coming months. With the winding down, all commercial work taken on by the UNSW Groundwater Centre will now be undertaken directly by Unisearch Ltd through the UNSW Water Research Laboratory.

In the last year the main focus of the Water Research Laboratory groundwater consulting business has been on coastal dune studies, particularly using multi-level piezometers to assess the impact of effluent disposal on coastal aquifer quality. A total of six operating or proposed dune exfiltration sites have been investigated.

Another area of activity has been the use of state of the art soil coring techniques to recover LNAPL and DNAPL contaminated sediment samples from loosely consolidated sands. The UNSW Groundwater Centre is currently developing methods for measuring the vertical head gradient within a bore installed with the multi-level piezometers. This technology will be also soon be made available commercially through Unisearch Ltd Water Research Laboratory.

Something Slightly Different

GLACIAL BURST FLOOD IN ICELAND

November 6, 1996
The expected glacial burst flood in Skeidara Iceland started at 800 Icelandic time last morning (Nov. 5 1996). A part of the Skeidararjoekull glacier broke up sending a flood wave several meters high down Skeidararsandur sweeping down 3 brigdes and 30 km of road. The flood reached its peak 2230 the same night at an estimated maximum discharge of 45.000 cubic meters in second. The flood is bringing down enormous quantities of sediments and icebergs that are fragments from the glacier.

Hydrologists expect the flood to decline today.

The water comes from the Grimsvoetn caldera inside Vatnajoekull and travels 63 kilometers under the glacier before it reaches Skeidara. The basaltic caldera has been filled with water unusually fast, due to a volcanic eruption that started on September 29 inside the glacier.

The total damage is expected to exceed US$30.000.000, mainly in broken roads and bridges that will take about 2 years to repair. This flood event has put transportation in the area 30 years back according to Iceland's Prime Minister David Oddsson.

November 7, 1996
The glacial burst flood wave has passed. The total discharge is estimated 3200 million tons of water an 100 million tons of sediments. The subsidance of the over 200 meters thick ice cover of the lake in the Grimsvoetn caldera has not been estimated but may be as large as 170 meters. Its elevation was 1510 m.a.s.l. before the flood.

This flood ends a 60 years period of moderate glacial bursts from Grimsvoetn. These floods have lasted about 27 days with peak discharge 2000 - 9000 cumecs. In 1922, 1934 and 1938 floods similar to this one were observed, but te present flood has a higher flood peak and lasted a shorter time, the duration of the flood peak (triangular shape) is only one and a half day even though the base length of the hydrograph will be somewhat more.

Damages are much less than expected. The main bridge, Skeidara bridge (1080 meters) lost 5 spans but 17 are standing to everybody's surprise as this bridge was designed to withstand 9000 cumecs discharge only. Gigja bridge is totally gone and Saeluhusavatn bridge damaged, probably beyond repair; 17 km of roads and 6 km of levees are gone. Total damage is now estimated US$ 11 million.

This concludes my reporting of this flood event to the hydrology list. More information can be found on http://www.norvol.hi.is/index.html and in the news media. Scientific accounts are in Bjoernsson, Helgi: Hydrology of Ice Caps in Volcanic Regions, Societas Scientarium Islandica 1988 (ISSN 0376-2599), 140 pages, 21 maps.

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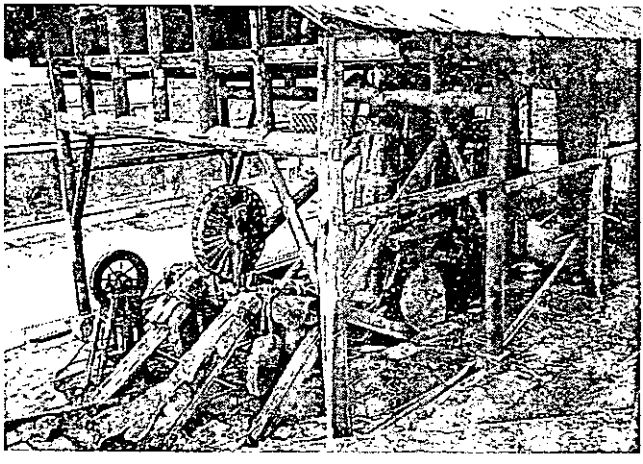
THE GREAT WELL OF CHINA

by Bob Fahey



One of the milestones in the early evolution of drilling technology is the Shenhai brine and gas well at Zigong in Sichuan province, China.

It was drilled over 160 years ago by the cable tool method to extract brine for making salt. It was also the first drill hole in the world to exceed a depth of one kilometre. In contrast, when the well was constructed in 1835, the deepest drillhole outside China was only 370 metres.

After having invented the cable tool drilling technique in Sichuan in the middle of the 11th century, the Chinese attach considerable historical and cultural importance to the Shenhai Well. It was declared a cultural relic in 1988.

The salt industry has played a pivotal role in the economical and social history of China. For over 2000 years, salt taxes provided successive ruling dynasties with a high proportion of their revenue.

Most of this salt was produced from sea water, but in the landlocked province of Sichuan, salt was produced from local saline groundwater.

Recent historical research (see "The Great Well of China", Scientific American, June 1993) has put to rest the folklore belief that cable tool drilling in China dates back several thousands of years.

The historical evidence indicates that Sichuanese salt producers invented the technique around 1050 AD – a result of the gradual depletion of shallow brine deposits easily accessed by hand dug wells, and the need to tap into deeper richer brine deposits.

The Shenhai Well is located on the outskirts of Zigong, a small city off the beaten track in Sichuan and not often visited by Westerners. I was in Chengdu in 1993 with a couple of spare days and decided to make the journey by train. Initially by diesel/electric train, to Neijiang 150 km SE of Chengdu, then by steam train on the 50 km branch line to Zigong. The steam train was huge and powerful and I felt a tinge of sadness knowing that wonderful old machines like this would quickly disappear as the country modernises.

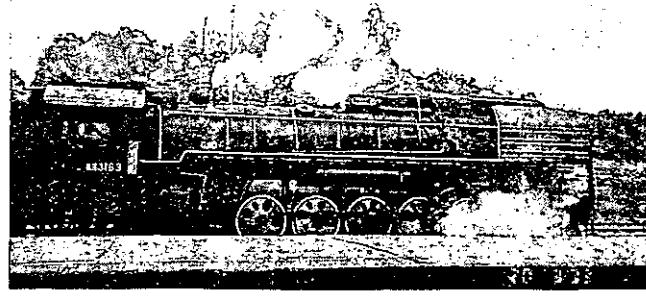
At the wellsite I was amazed to find the 18 metre-high, all-wood/bamboo rig essentially intact and well preserved. Adjoining the rig was a stove building where salt was still being produced.

The well produced both the brine and the natural gas used to boil it – as it has done for 160 years!

At its peak, the Shenhai Well produced 8,500 cubic metres of natural gas per day with which 14 tons of salt could be made. The drillhole was extended from its 1835 depth of 1001.42 metres to 1346 metres in 1966, in an effort to prolong the life of the well. At the time of my visit the brine was almost depleted.

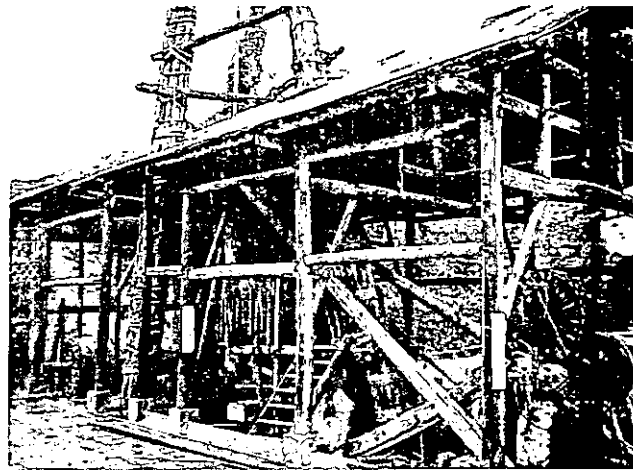
The upper diameter of the drill hole is 114 mm with wooden casing to 64 metres. The hole then reduces to 106.7 mm at 125 metres and continues at this diameter to TD. There are two layers of natural gas – the first at 802.6 metres, and the second at 922.07 metres.

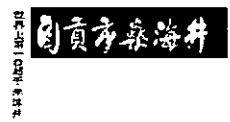
The rig's 18.3 metre high wooden derrick consists of four columns, each with many lengths of timber and bamboo bundled together and closely bound.



Around the rig is a big wooden capstan for feeding the bamboo cable into the hole, and a large variety of iron-tipped bamboo rods – the drill bits! The lift and drop chopping action of the drill bit was introduced by way of a long, pivoted, wooden walking beam. As the hole got deeper the walking beam was kept correctly balanced by adding rock weights to one end, and the lift and drop motion was created by several drill crew continually jumping on and off the other end. After the hole was drilled a short distance, the bit was withdrawn, and a bamboo bailer was lowered to remove slurry from the hole. The capstan was set up for both man power and cattle power operation.

Interestingly, this drilling technique is fundamentally the same as that used on today's cable tool rigs. These rigs, also called "mud punchers" are still commonly used for water boring in rural Australia.





Right: This ca-1ch Chinese script reads: 'Shenhai Well – Zigong' (horizontal line) and 'The first drillhole in the world to exceed 1000 m' (vertical line).

The article "The Great Well of China", is reproduced with permission from Australasian Drilling, the journal of the Australian Drilling Industry Association Ltd (issue September/October, 1996, pages 24-25). Thanks to the author Bob Fahey, and Graeme Wakeling, Executive Director.

SOFTWARE

GROUNDWATER FOR WINDOWS

The Water Research Laboratory has been testing and using the United Nations developed package Groundwater for Windows (GWW). This package contains a relational database which is set up to input all lithological, geophysical, water level, hydrogeochemical and bore construction data. It has the capacity to produce borelogs, geological cross-sections, Piper diagrams, hydrographs and contours of piezometric head.

The program comes with an extensive manual and the UNSW Groundwater Centre is happy to provide IAH members with a copy of the disks and an unbound copy of the manual. A charge of $50.00 will be levied to cover the cost of disks, photocopying and mailing.

Enquires can be directed to either Dr Ian Acworth or Mr Chris Daniels
UNSW Water Research Laboratory
(02) 9949 4488 (ph), fax (02) 9949 4188
i.acworth@unsw.edu.au (email).

HYDROLOGY, GEOLOGY & OTHER ENVIRONMENTAL SOFTWARE WEB SITE

We have just enhanced our web site to include html descriptions, requirements, and prices of our over 100 hydrology, geology and other environmental software products. A "BY CATEGORY" feature, i.e. Bioremediation, Transport Models (Unsaturated), Solid Waste, Exposure Assessment, GeoChemical Models, GeoTechnical Models, etc., has been added to make it easier to find software which is of interest rather than having to browse the entire list.

"More Information" on each product is available with the Adobe Acrobat Reader along with demos and tutorials. A "Publications" section and "New Products" section have also been added. Visit us at http://www.scisoftware.com

Barbara Wehrle
Hydrology & Geology Software Scientific Software Group
P.O. Box 23041
Washington, DC 20026-3041
e-mail: info@scisoftware.com
Ph:(703) 620-9214 Fax:(703) 620-6793

HEC-1, -2, AND -6 AVAILABLE TO DOWNLOAD
US Army Coprs of Engineers

The Army Corps of Engineers has, once again, made HEC-1, HEC-2 and Hec-6 available as public domain freeware by FTP download. They have flip-flopped on this policy but it looks like the program postings are here to stay. You can download these programs, as well as their manuals in PostScript format, through The WRCS Hydrology and Hydraulics Software Shop Pages: http://www.waterengr.com.

We have also added TR-20 and SWMM version 4.3 to our list of H&H programs available for download from our site, and are excited about the posting of a demo for a new Time Series Data Manager Program: HydroTech. Check it out, the statistical capabilities and graphics are great.

Rick Van Bruggen, M.S., P.E.
Water Resources Consulting Services
rvb@waterengr.com
WRCS Hydrology & Hydraulics Software Shop:
http://www.waterengr.com

HYDROLOGY NEWSGROUP WATER ONLINE

A new site devoted to the issues of water and wastewater, Water Online. Water Online offers constantly updated product, technology, and regulatory information along with the ability to find companies, associations and organizations in the water and wastewater industry.

Consulting Engineering firms, engineers, manufacturers, and industry suppliers are encouraged to register and be included in the buyers guide database under the appropriate categories and key words.

There is also a free newsletter edited by Ian Lisk, who is widely regarded as one of the leading editors in the industry.

Please visit the site and register your information in the "New Users" Section.

Charles Kessler
kessler@wateronline.com
US Tel (215) 443-3330 US Fax: (215) 443 3336

Water Online
http://www.wateronline.com

IAH Working Group on Groundwater-related Salinisation

The Working Group has reached a milestone with the preparation of a Theme Issue of *Hydrogeology Journal* devoted to the topic of Groundwater Processes in Land and Water Salinisation.

A total of 17 papers was processed for this issue and although not all could be accepted, I am very aware that this has involved the time of more than 30 authors, and also the time and dedicated critical minds of 34 reviewers, most of whom were Australian. So a big thank you to all who helped with writing and reviewing the articles ! The wisdom distilled from all this will be presented in the Theme Issue to be published as Volume 5, No 1 of *Hydrogeology Journal* early in 1977.

Gerry Jacobson

Additional sources of groundwater related software and modelling information:

- Groundwater modelling mailing list
- EnviroMod software server
- Richard B. Winston's Home Page
- Geotechnical & Geo-environmental Software Directory
- The Hydrology and Hydraulics Software Shop

Please contact Andrew.Piggott@CCIW.Ca if you have any additions or corrections to this list.

TRAINING AND SUPPORT

Australian Research Council Funded Honours and Postgraduate Projects in MODELLING & MONITORING TRANSPORT OF WATER AND CONTAMINANTS THROUGH SOILS

Australia produces one of the highest volume of agricultural, industrial and municipal wastes per capita in the world. Increasingly the public are demanding statutory authorities investigate environmentally sound methods of land application. Recent experiments suggest that industrial and farm chemicals (such as fertilisers) and pesticides may reach groundwater in much shorter times than current models predict. These findings indicate we may be significantly under-estimating the risk of groundwater contamination. A new and innovative experimental program funded under a large ARC grant is proposed to study heterogeneous solute transport in soils.

The data will be mathematically modelled for the purposes of understanding the key physical mechanisms controlling transport and developing predictive tools for practical applications. This research will have important implications for the sustainable environmental management of soils and for improving chemical application and irrigation schedules.

A range of Honours and Postgraduate scholarships are available for 1997. (Post-doctoral candidates are also encouraged to apply). Honours students receive a tax-free stipend of around $4000. Postgraduates students will be offered an attractive, competitive, industry-based, tax-free stipend depending on qualifications. Candidates should have a good background in environmental chemistry and/or computer and mathematical modelling.
For further information please contact:

Dr Frank Stagnitti
School of Aquatic Science & Natural Resources Management
Deakin University
PO Box 423, Warrnambool, 3280. Australia.
ph. +61 (0)55 633 535 fax. +61 (0)55 633 462
email. frankst@deakin.edu.au
http://www.cm.deakin.edu.au/~frankst/

GROUNDWATER PROTECTION AND RESTORATION RESEARCH UNIT (GWPRRU)
three research vacancies

Research Assistant (preferably post-doc) for a 24 month project on groundwater modelling well and adit systems, for both yield and protection zones.

Two PhD studentships, both on biodegradation of organic pollutants in groundwater:

1. sponsored by the EA and linked to a major new EPSRC/EA funded project on natural attenuation of phenolics in groundwater, being conducted jointly with BGS and IFE
2. sponsored by Shell Research in support of the our new Professor of Environmental Microbiology Bob Watkinson on Redox controls on natural attenuation.

See http://www.brad.ac.uk/acad/civeng/jobsdnl.htm for details,
or contact
David Lerner
email address: d.n.lerner@bradford.ac.uk
Professor of Environmental Management
Groundwater Protection and Restoration Research Unit
Dept of Civil and Environmental Engineering,
University of Bradford, Bradford BD7 1DP, UK
Tel + 44 (0)1274 385470 Fax + 44 (0)1274 383888
http://www.brad.ac.uk/acad/civeng/emtpg.html

UPCOMING CONFERENCES

WATER IN THE BALANCE
16-21 March, 1997
Melbourne, Australia

This will be the 17th Australian Waste Water Association (AWWA) Federal Convention. The overall theme is designed to address issues such as maintainence of water quality, sustained enhancement of the environment, risks to human health and welfar, economic dcompetition for water resources, business practices, administration and ownership. The convention will appeal to all those involved in water management.

The major sponsor is Water Services Association of Australia

Enquiries to:
AWWA Convention Secretariat
PO Box 388
Artarmon, NSW, 2064, Australia
tel: (02) 413 1288 fax: (02) 413 1047
email: awwa@pegasus.peg.oz.au

3RD CONGRESS OF THE LATIN AMERICAN GROUNDWATER ASSOCIATION (ALHSUD)

The Latin American groundwater organisation ALHSUD will hold its 3rd congress at San Luis de Potos, Mexico, from the 12th to the 15th of November 1996.

Approximately eighty authors will present papers and discuss groundwater issues affecting Argentina, Bolivia, Brazil, Canada, Chile, the Czech Republic, Colombia, Italy, Peru, Spain, the UK, the USA and Venezuela. As expected, most talks will be in Spanish, but a significant number will be in English, and some in Portuguese. This was the case in ALHSUD's 1994 congress.

The 1996 Congress discussions will concentrate on 6 main themes:
1) Environmental Hydrogeology; 2) Groundwater Management and Planning; 3) Recharge Evaluation; 4) Liquid and Solid Waste Management for Groundwater Protection; 5) Flux and Solid Transport in Complex Geological Media (such as fractured rock or formations of low permeability); 6) Groundwater Monitoring Strategies and Techniques. The Congress will analyse the importance of groundwater for global development; exchange experiences in groundwater management; analyse methodologies to prevent and control groundwater contamination; propose the establishment of a common groundwater data base; and produce recommendations relevant to groundwater management on a continental scale.

Registration is inexpensive: US $200. This amount will cover the cost of the Congress proceedings and the official Congress dinner. Prior to the Congress, there will be two preliminary courses, each costing $100:
The first course, Field Hydrogeology (7-9 November), will be led by professors Antonio Cardona, Jan Hendrickx, Duncan McNeil, Frank Snelgrove and Daniel Stephens.
The second course, Volcanic Rocks Hydrogeology (10-12 November), will be led by professors Joel Carrillo, Emilio Custodio and Stephen Foster.

San Luis de Potos is situated in the center of Mexico at an altitude of 1,900 metres. The town proudly displays its colonial architecture. Many of its 16 to 18 century buildings were constructed using pink volcanic rock (rhyolite?), skilfully carved by local artisans. The city is the capital of a Mexican state of the same name, rich in gold, copper, mercury, lead, zinc, arsenic, antimony and silver. The long mining tradition began in early colonial times. The selling of opals in the streets has been an important feature of local life, the same as in some remote Australian towns.

ALHSUD's Third Congress is sponsored nationally by a number of Mexican universities and organisations, and internationally by the Waterloo Centre for Groundwater Research, UNESCO and the IAH. Michael Knight will attend as a IAH representative, and it is likely he will be the only Australian at the Congress. Back in 1994, I attended ALHSUD's Second Congress, which was held in Chile. I was the only hydrogeologist from Australia then. There was nobody from Africa.

It seems as if we hydrogeologists have our eyes, ears and brains focused exclusively on the miraculous North, source of most technological developments. As a result, we tend to be blind and deaf to almost anything happening East or West of us. And so, the East-West links and work-relationships that could benefit hundreds, perhaps thousands, of groundwater professionals facing similar problems in the three main continents of the Southern Hemisphere are, at present, extremely weak or non existent. There is not enough exchange of experience between Gondwanaland hydrogeologists.

We could do something to change this situation. The rumours say that ALHSUD's next congress (their Fourth Congress) will be held, in two years, either in Brazil, Argentina or perhaps Uruguay. Since only good could come from a general reinforcement of intercontinental ties in the Southern Hemisphere, let's go there from Australia in large numbers in 1998.

Gabriel Salas
Regional Hydrogeologist (Senior Resource Officer)
Department of Land and Water Conservation
P.O. Box 717
Dubbo, NSW 2830. Telephone: 068 842560 Fax: 068 840096
email: gsalas@dlwc.nsw.gov.au

"WAI WHENUA - WATER/LAND".
24th Hydrology and Water Resources Symposium,
Auckland, New Zealand.

24-27 November 1997. Presented by New Zealand Hydrological Society and The Institution of Engineers, Australia.

My name is Bryan Bates, I am Manager, Water Resources, at the Auckland Regional Council in Auckland, New Zealand. The 18 members of my section are actively involved in various aspects of hydrology ranging from operating the data collection network, to groundwater modelling, all with the objective of managing our groundwater and surface water resources in a sustainable manner. I am also Chairman of the committee organising next years NZ Hydrological Society/Australian Institute of Engineers joint symposium.

If you are interested in this symposium please contact:
HWRS '97, The Conference Company, PO
Box 90-040, Auckland, NZ.
(Phone: 0064-9-360-1240, Fax: 0064-9-360-1242,
Email: info@tcc.co.nz).

My contact is:
Bryan Bates <bbates@ARC.GOVT.NZ

International Conference on
FUTURE GROUNDWATER RESOURCES AT RISK

Changchun, P.R. China, 12-16 July 1998
Call For Papers And Provisional Registration (First Circular)

TOPICS

1. Side Effects Related to Groundwater Development in Urban Area: Water pollution; land subsidence; aquifer depletion; rapid drawdown of groundwater level; sea water intrusion; special problems.
2. Groundwater Contamination Control and Remediation: Physical and chemical processes of groundwater contamination; modelling simulation; groundwater pollution control; physical, chemical and biochemical treatment.
3. Water Resources Development and Eco-system in Arid or Semi-arid Area: Desertification; salinization; overdeveloping of water resources; water balance; special problems in arid, semi-arid area.
4. Water Resources and Environment in Karst Area: Water supply and drainage in Karst mining area; karst water in coastal area; karst water chemistry; land collapse; special problems.
5. Groundwater Modelling and Information System: Uncertainty of parameters; stochastic model; model adoption; model application; application of GIS.
6. Groundwater Monitoring, Management and Protection: Monitoring techniques; optimization of monitoring network; data collection and processing; regulations; integrated management of water resources.

CALL FOR PAPERS

Participants intending to present a paper are requested to send a 1 to 2 page abstract in English to the Conference Secretariat. Abstract should include the full address (also phone and fax). The abstract should be received by 31 Oct. 1996. Authors will be notified of acceptance by 31 January, 1997. Accepted authors will be invited to submit their full papers by 31 May 1997, in order to pre-publish under UNESCO's series according to UNESCO's request. In addition to oral presentation, a number of poster sessions will be held.

LANGUAGE

The official conference language is English.

IMPORTANT DEADLINE

October 31 1996: receipt of abstract
January 31 1997: author notification of accepted abstracts (2nd circular)
May 31 1997: Submission of papers

REGISTRATION FEE

The registration fee will be about USD 300 (for participants from developing countries will be approximately USD 200), which will provide a copy of the proceedings, refreshments during meeting hours, social events and a half-day excursion. The registration fee will not cover the hotel expenses, meals, the accompanying persons program and a three-day post conference excursion.

CONFERENCE SECRETARIAT ADDRESS:

Dr Zhao Yongsheng, Dr Sui Weiguo
FGR'98 Conference Secretariat
P.O. Box 298
Changchun University of Earth Sciences
6 Ximinzhu Street
Changchun, 130026
P.R. China
Fax: +86-431-8928327

Second International Conference on Environmental Management (ICEM2)

to be held at University of Wollongong (New South Wales, Australia)
10 - 13 February, 1998

OBJECTIVE

This Conference will aim to provide a forum for academics, researchers, engineers and scientists working in the area of environmental management and sustainable development to exchange ideas and learn about recent advances. The conference themes will embrace 21st century solutions to problems within the fields of Environmental Engineering, Geotechnology and Mining Engineering.

THEMES

21st Century Solutions to Geo-Environment-Mine Engineering Problems:

- Sustainable development
- Environmental engineering for 21st century
- Water, wastewater and stormwater systems (monitoring, design, operation and management)
- Water quality modelling and management
- Hydrology and water resources
- Waste management
- Soil-water and total catchment management
- Environmental Geo-technology
- Slope stability and landslide management
- Uncertainties, risks and decision making
- Environmental hazards legislation and policies
- Environmental economics
- Environmental problems associated with third world countries
- Seismic risk and earthquake-resistant design
- Mine environmental engineering
- Mining rehabilitation
- Computer applications

REGISTRATION FEES

Please circle appropriate amount:

		Before 1.Oct.97	After 1.Oct.97
1)	**Standard registration:** (Includes registration kit, proceedings, lunches and teas)	A$600	A$650
2)	**Full time student registration:** (As above, letter of verification required from academic supervisor)	A$200	A$250
3)	**Daily registration:** (Please circle day(s) as appropriate) Mon/Tue/Wed/Thu	A$250	A$300
4)	**Accompanying person(s):** (As per standard registration without proceedings)	A$250	A$250
5)	**Conference dinner** (/person)	A$ 60	A$ 60

James Cook (Conference Manager), ICEM2, University Union, University of Wollongong, WOLLONGONG, NSW 2522, AUSTRALIA
Phone: +(61) 42-297 833 Fax: +(61) 42-264 250 Email: j.cook@uow.edu.au

AWWA/IAWQ are inviting interested affiliated organisations to attend the BNR3 Conference being held between 30 November 1997 and 4 December 1997 at the Brisbane Convention Centre.

Recently the "1st Call for Papers" was made. Selected papers, shall be published in the conference proceedings and possibly published in the publication "Water Science and Technology". Undoubtedly many members of your organisation will not only be interested in attending, but will also be interested in presenting papers.

BNR3 will be focusing on the following themes :

- BNR Driving Forces
- Microbiology
- Modelling and Simulation - Tools for Design
- Operational Experience
- Biosolids Management
- Retrofitting
- Alternative Methods & Strategies

BNR3 Convention Secretary
GPO Box 2847
Brisbane Qld 4001 Australia

Telephone: 61 7 3211 3692
Facsimile: 61 7 3211 3698

MEMBERS MOVEMENTS and NEW ADDRESSES

CHANGE OF ADDRESS

Patty PLEASE
currently seconded from AGSO to DLWC, Parramatta until end-June 1997
email address is: pplease@dlwc.nsw.gov.au
contact phone number: 02-9895-7527.

LOST MEMBERS

If you change you address or other details, please inform the Secretary Rob Ellis, as we wish to develop an accurate and updated membership list.

NEW MEMBERS

We are pleased to welcome the following new members recently accepted into the IAH.
Congratulations.

Mark PATON	QLD	Andrew DURICK	QLD

WATER in the BALANCE

17th Australian Water and Waste water Association Federal Convention
(AWWA)
16-21 March, 1997

ENQUIRIES

All correspondence and enquiries should be addressed to:
AWWA Convention Secretariat
PO Box 388, Artarmon NSW 2064 Australia
Street address: Level 2, 44 Hampden Road, Artarmon NSW 2064

Email	AWWA@PEGASUS.PEG.OZ.AU
Telephone	+61 2 413 1288
Facsimile	+61 2 413 1047

PLEASE BE SURE YOUR FEES AND ADDRESS/CONTACTS ARE UP TO DATE