

2003 C.V. THEIS AWARD

M. S. Doug Bedinger, Recipient

This award was established in 1986 to honor the charter member of AIH, C.V. Theis - the founder of modern groundwater hydrology. The award is presented annually, on the recommendation of the AIH Awards Committee, for a major contribution to the field of groundwater hydrology. The first C.V. Theis Award was presented to Rodger J. M. DeWiest at the AIH Conference on Application of Recent Advances in Hydrosociences in San Francisco on March 26, 1987.

Citation: Written by Joseph DLugosz, presented by P. Patrick Leahy

M. S. Doug Bedinger graduated with honors from Texas Technological College, (Texas Tech University) in 1955 with a B. S. degree in petroleum geology. Doug has held certification as a professional hydrogeologist by the American Institute of Hydrology and registration as a Professional Geologist by the State of Arkansas. He has held memberships in a number of organizations over the years:

- American Institute of Hydrology
- American Society for Testing and Materials
- Fellow of Geological Society of America
- American Geophysical Union
- International Association of Hydrologists
- Association of Ground Water Scientists and Engineers
- Colorado Ground Water Association

Doug began his career with the U. S. Geological Survey in Washington D. C. in 1955. After a year of stirring the pot the USGS relocated him to Little Rock, Arkansas. Doug liked Arkansas, and he stayed from 1956 to 1974, where he conducted studies of the effects of navigation locks and dams on ground water, and analyzed the thermal flow system of Hot Springs, Arkansas. Success has its rewards, so Doug was transferred to God's country in Denver, Colorado, where he served in the Colorado District, and the office of the Regional Hydrologist in Denver.

Doug has held supervisory and administrative positions during his career, but has steadfastly maintained a direct participation in technical studies. In addition to project leadership, he served as Chief of Hydrologic Studies in the Arkansas and Colorado Districts, Assistant District Chief in Arkansas, and Ground-Water discipline specialist for the Central Region. He was active in carrying out many "backyard" projects during his career which were encouraged by the Chief Hydrologist of the Water Resources Division, Luna Leopold. As an example, being an avid "spelunker" in his earlier years, he discovered and named a troglobitic crayfish and he made computer models of cavern development in carbonate rocks.

The scope of Doug's interest is broad and interdisciplinary as indicated by a sampling of the subjects of his 125 publications: He was one of the earlier hydrogeologists to write digital programs

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for analysis of groundwater flow. He was the first to devise methods for determining relation between depth to ground water and evapotranspiration, and to implement the relations in analog and digital models of the Arkansas River Valley. He conducted studies of the relation between tree species and the frequency and duration of flooding in the Arkansas-White-Mississippi floodplain; he formulated a method for calculating ground-water fluctuations produced by changes in stream stage; prepared a map of the location and extent of Pleistocene lakes in the western U. S.; he devised a set of guidelines for mapping the deep regional ground-water potential of the Basin and Range Province based on the relation between geologic structure, surface hydrologic features and topography; he prepared a compilation of recharge rates in arid regions of the world.

He has organized training sessions and presented lectures at the WRD National Training Center on hydrologic properties, analog and digital modeling, and aquifer test analysis. He presented many technical papers at Symposia of the GSA, AGU, Midwest Ground Water Conference, Rocky Mountain Ground Water Conference, Devils Hole Ground water Conference, and at International meetings of UNESCO and IAEA and other international conferences in Lublin (Poland), Paris, Sydney, and Copenhagen.

From 1980 to 1985 he was in charge of the Survey's Task I project that was charged with evaluation of the Basin and Range Province for favorable hydrogeologic environments for disposal of high-level radioactive waste. He led the interdisciplinary study, and organized and headed the committee to review potential sites. The review committee was made up of representatives appointed by the governors of the seven states. The project was completed on schedule, and produced more than 80 published reports and numerous papers published in technical journals. In 1985, near the completion of this program Doug received the U. S. Department of Interior Meritorious Service Award and the U. S. Geological Survey Scroll of Honor.

From 1985 until retirement from the USGS Doug studied the problems of low-level radioactive waste disposal. He chaired an international committee of UNESCO on disposal of low-level radioactive waste, and prepared the technical report of the committee. The findings were published by UNESCO. He organized and chaired a U. S. working - group to review problems of low-level radioactive waste disposal. Papers presented and prepared at the conference by the participants were published as a U.S. Geological Survey Circular.

From 1988 until 1993, Doug was a member of the professional staff of the Environmental Research Center of the University of Nevada Las Vegas. He provided technical assistance and consultation on hydrogeologic problems to EPA offices across the country. He prepared a course of lectures for training EPA employees in contaminate hydrogeology, with special emphasis on application to site characterization. The training sessions were a key part of the newly implemented Superfund Technical Support Center at Las Vegas, NV.

As Chairman of the Hydrologic Properties Section of the American Society for Testing and Materials, Doug led the preparation of standards for pumping tests and other field methods to determine hydraulic properties of aquifers and confining beds. This ASTM section developed a comprehensive plan for aquifer test standards development, and developed more than 20 standards on aquifer test methods. Doug's work is part of a compendium of ASTM standards published in "Environmental Site Characterization", sponsored by committee D-18 Soil and Rock. He was a founder of the ASTM section on on-site septic systems, organized the first ASTM conference on on-site septic systems and was an editor of the volume of papers from the conference. He prepared the

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first ASTM standards on on-site septic systems. He authored standards for the ASTM section of ground-water modeling. He served on the ASTM Terminology Committee. He received the Frank W. Reinhart Award for outstanding contributions to the American Society for Testing and Materials in 1996. In 1999 he was presented the second A. Ivan Johnson Outstanding Achievement Award for outstanding and significant contributions to ASTM. A. Ivan Johnson himself received the first A. Ivan Johnson Award in 1998.

Since 1988 Doug has been in private consultant. As a private consultant he worked on ground-water supply and other hydrogeologic problems in the Great Basin of California, Nevada, and Utah, the Hot Springs region of Arkansas and the Olympic Peninsula of Washington. Currently Doug is working on a contract to the National Park Service in California and Nevada on ground-water issues related to Death Valley National Park. Work has included a study of the fluctuations in the stage of Devils Hole, an appraisal of ground-water flow to Death Valley from desert basins in southeastern California, and preparation of a regional ground-water potential map for the Death Valley flow system. As a technical consultant to the National Park Service, Doug is engaged in oversight of the of the U. S. Geological Survey program that is modeling the Death Valley regional ground-water flow system.

Some day Doug will look back on his many accomplishments, and only regret that there wasn't more time. However, he should be very proud of his career since he maximized the use of his time, and dedicated his life to the hydrologic profession. This is why M. S. Bedinger is being honored as the 2003 recipient of the C. V. Theis Award.

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I am deeply honored and pleased to receive the C. V. Theis Award from the American Institute of Hydrology. I want to thank the C. V. Theis Award Committee and the Board of Directors for making this award possible.

I have admired C. V. Theis since my introduction to him and his work when I joined the USGS Ground Water Branch in 1955. Theis's paper on the relation between the lowering of the piezometric surface and the rate and duration of discharge of a well was revolutionary in the sense of breaking barriers to the understanding of transient-state ground-water flow. The community of ground-water scientists did not immediately embrace the theory or capitalize on the great potential of understanding and quantitative techniques that were tapped by this seminal work. C. V. has been quoted as saying he spent the first years of his career encouraging hydrologists to use his method; then he spent decades warning them of the limitations.

Twenty years after publication the Theis method was the standard for analysis of well hydraulics. The Theis theory opened the door or a host of transient methods. By 1955, the theory of images, multiple well problems, leaky aquifer theory, line source and line sink methods, flowing well tests, slug tests, cyclic head fluctuations, had been introduced by leaders in the field of ground-water hydrology, John Ferris, Stan Lohman, Herb Skibitzke, Bob Stallman and others, as well as by Theis himself. They transformed the Theis theory into practical usable methodology.

In 1955 there were no electronic calculators; slide rules were the pocket calculators of the day. The first model I used to help solve a practical problem was not even a resistor-capacitor network but

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a conducting paper analog model. The first finite difference calculations I made were not with a computer, but by hand, calculating recharge rates using finite-difference methods presented by Bob Stallman.

I am currently preparing two talks, for the GSA convention this year in Seattle. One is a perspective on the significant contributions to hydrogeology of the Great Basin during the past 100 years. The other is a report on the recent work I have done in estimating the quantity of ground-water flow to Death Valley from desert basin of southeastern California. Preparation of this paper has given me cause to reflect on the evolution of hydrologic knowledge of the Great Basin. Preparation of this acceptance speech has given me cause to reflect on advances in the state of hydrologic science and on my hydrologic education as it developed over the past fifty years.

The past fifty years has been an exciting time to have been in the field of ground-water hydrology. I am just as enthusiastic about my present work as when I was assigned my first areal ground-water appraisal in the Mississippi River delta of Arkansas. There were no academic programs in ground-water hydrology at the time of my formal academic education. My text books on ground water were the reports of Oscar Meinzer. Fortunately, the Survey's training program was ongoing from the day I started and throughout my career. A. Ivan Johnson, who founded the Water Resources Division National Training Center was one of my first teachers. I have maintained professional contact and personal friendship with Ivan Johnson since 1956. Ivan is one of the principal reasons that I am still working in hydrology. Near the time I retired from the USGS, Ivan enlisted me to join and work on standards with the American Society for Testing and Materials. After several years work on ASTM committees, I was honored to be the recipient of the first A. Ivan Johnson Award for developing ASTM standards. Knowing that Ivan Johnson was an earlier recipient of the C. V. Theis award makes the award all that more meaningful.

I have been very fortunate to have had a succession of challenging assignments, to have had supervisors who were supportive, and to have worked with colleagues who were extremely talented and a pleasure to work with. In telling you about some of my past and current projects, I would like to take this opportunity to credit a few of the many colleagues that were very important in my career. I would not be here today were it not for the help and assistance given me by the many able and talented people I have worked with for these past 50 years.

One of my projects in the Arkansas District from 1956 to 1974 was the Arkansas River navigation project. The objective was to project the effect of navigation locks and dams on the ground water in the alluvial aquifer. During this period I worked closely with a classmate of mine from Texas Tech. Joseph E. Reed is the perfect embodiment of the quiet and unassuming individual. He has a brilliant mind and an innate insight into the mathematical application of quantitative ground-water hydrology. Joe was not only a technical collaborator, but also my teacher in quantitative ground-water hydrology. The first ground-water model Joe and I made was a conducting paper electric analog paper model. We progressed to resistance -capacitance analog models for most the models we used to project the effect of the dams on ground water in the Arkansas River Valley. In the late 1960's and early 1970's we coded finite-difference computer models for analysis of ground-water problems. Our code was used in the analysis of the effects of proposed dams on the Red River in Louisiana.

Joe Reed and I again teamed up on the study of the Hot Springs of Hot Springs National Park, Arkansas. Joe wrote the code for a combined ground-water and heat-flow model that was used to help understand the hot springs flow system.

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After a time as ground-water discipline specialist of the Central Region, I was assigned to chief of the Task I, a study of favorable geohydrologic environments for disposal of high-level radioactive waste in the Basin and Range Province. Ken Sargent was my Geologic Division counterpart on the Task I study. Ken led a group of geologists in mapping distribution of potential repository rocks and evaluation of geologic environments of the Province. Ken Sargent was everything a co-leader should and could have been in interdisciplinary collaboration and technical leadership. He became a close personal friend. Joe Reed joined the project and modeled deep flow and time of travel along flow paths in the geologic sections that the geologists had constructed. During this time Joe and I collaborated on a practical guide for analysis of aquifer tests for the Environmental Protection Agency. Our cooperator was Joe D'Lugosz who was in charge of the ground water group of EPA in Las Vegas.

Upon retirement from the USGS, I joined the staff of the Environmental Research Center (now the Harry Reid Center for Environmental Studies) of the University of Nevada Las Vegas. There, again I worked with the EPA group headed by Joe D'Lugosz, an active AIH member. It was during this time that I was selected to lead one of several sections of the American Society for Testing and Materials. A group of experienced and dedicated hydrogeologists had been recruited by A. Ivan Johnson to write standards for hydrologic testing. My group, writing standards for field aquifer tests included John McLean, Charles Appel, Ed Gutentag, and Joe Ritchie. Other groups prepared standards for ground-water modeling, collection and testing of saturated and vadose zone samples, and data acquisition and storage. The other groups included Joe Downey, Charles Morgan, John Moore, Jim Rumbaugh, and Lorne Everett, all members of AIH.

Scientific organizations such as ASTM and the American Institute of Hydrology serve an important function in the advancement of scientific knowledge. I valued my membership and certification by the AIH and the many colleagues of mine who are members of AIH. I was pleased to serve as chairman of the technical program committee for the 1990 Annual Symposium of American Institute of Hydrology in Las Vegas.

I now live on the Olympic Peninsula of Washington. My wife and I have a small farm where we raise llamas and grow chestnuts. I would spend more time there, but great projects keep coming along. For the past few years I have been working on ground-water problems for the National Park Service at Death Valley in California and Nevada. My National Park Service cooperator is Dan McGlothlin, who I am pleased is here tonight. In the studies at Death Valley, I have as a partner Jim Harrill. Jim has intimate knowledge of the Great Basin from almost 40 years of study of ground water in Nevada. He is a gifted quantitative applications specialist; possesses a quick and perceptive grasp of hydrologic problems and insight to analysis of problems.

The National Park Service is a stakeholder in the U. S. Geological Survey modeling project of the Death Valley regional ground-water flow system. Jim Harrill and I represent the technical interests of the National Park Service in an oversight capacity of this USGS modeling effort. We have mapped the regional ground-water potential in the Great Basin to determine the natural ground-water boundaries of the Death Valley flow system and have calculated the lateral boundary flows to the domain of the USGS ground-water model. Our contributions to the modeling project that are now in the draft of the final USGS report of the project.

One of my persistent recommendations to the National Park Service was the need to study the ground-water contributions to Death Valley from the west side. Ground-water models of Death Valley historically have been concerned primarily with problems of the flow system in Nevada. The

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inflow to Death Valley from the California desert basins west of Death Valley had not been included in previous models. The Park Service authorized Jim Harrill and me to make this appraisal. The inflows to Death Valley from our appraisal are included in the new USGS model of the Death Valley flow system.

I gratefully accept this award from my peers of the American Institute of Hydrology. It allows me to cherish the hope is that I have truly contributed to knowledge of the science and have returned to my colleagues some part of the wealth that they bestowed upon me.