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American Institute of Hydrology

2002 C.V. Theis Award

The American Institute of Hydrology (AIH) established this award in 1986 to honor the charter member of AIH, C.V. Theis - the founder of modern ground-water hydrology. The award is presented annually, on the recommendation of the AIH Awards Committee, for a major contribution to the field of ground-water hydrology. The first C.V. Theis Award was presented to Roger J.M. DeWiest at the AIH Conference on Application of Recent Advances in Hydrosciences in San Francisco on March 26, 1987.

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

Dr. Everett is the 13th recipient of a Ph.D. in hydrology in America. Upon completing his Ph.D. at the University of Arizona. Dr. Everett was invited to join the faculty in the new Department of Hydrology and Water Resources. Shortly thereafter, the General Electric Company's Think Tank in Santa Barbara invited Dr. Everett to manage their Water Resources Program. Upon the formation of the United States Environmental Protection Agency in 1970, Dr. Everett received a multi million dollar sole source award to develop a National Groundwater Monitoring Strategy. This strategy was published in his book entitled *Groundwater Monitoring*. The United States Environmental Protection Agency has endorsed the book *Groundwater Monitoring* as "establishing the state-of-the-art used by industry today". The book is also recommended by the World Health Organization "for all developing countries".

Dr. Lorne G. Everett is the sixth Chancellor of Lakehead University in Thunder Bay, Ontario, Canada. In the British system, Chancellor's are high honor positions and function primarily at convocation ceremonies. MacLain's evaluation of Canadian universities in 2001 rated Lakehead University as the highest ranking university in Canada for "value added to students". Dr Everett is recognized internationally as one of the foremost hazardous waste clean up scientists in the world. In January 2002 Dr Everett was appointed to the US Department of Energy Executive Committee for the Long Term Stewardship- Science and Technology Program. The Russian Academy of Natural Sciences elected him in 1995 to full foreign membership. His original contributions to science have been recognized at the highest levels.

Lorne's career has focused on conducting research on vadose zone characterization, monitoring and remediation. He is credited with the notion that the US regulatory policy on groundwater monitoring is illogical. He has throughout his career stated that groundwater regulation should not begin at the water table but should be source oriented and established within the vadose zone. He has made the case that early alert monitoring has significant prevention and remediation value in America and throughout the world. Lorne's ideas are now championed by DOE, EPA and American industry. For his contributions, the DOE invited Dr Everett to participate on the Executive Committee for the National Vadose Zone S&T Roadmap which will chart Multi-Agency Vadose Zone research for the next 25 years. Because of his monitoring ideas EPA and DOE in 2001 requested that Dr Everett co-edit a new "State of the Art" monograph on Long Term Prediction and Verification of Containment

and Treatment Barrier Performance. This new monograph is anticipated to be the fundamental document used in DOE 's Long Term Closure program and in EPA's, RCRA subtitle C and D, landfill cap program.

Lorne is an AIH registered hydrologist and hydrogeologist. He has participated on the AIH Board of Registration, presented papers at numerous AIH symposia and co-chaired the Remediation Session of the First USA/USSR Hydrology Conference in Leningrad in June of 1990. Since that time Lorne has been a co-editor of the first Groundwater Map of the World supported by UNESCO and he is the English Editor of the new monograph entitled Groundwater Resources of the World and their Use to be published by UNESCO in the fall of 2002.

Dr. Everett is the Chief Scientist and Senior Vice-president for Stone & Webster Consultants, Inc. Previous positions include Chief Research Hydrologist for ARCADIS Geraghty and Miller, and Chief Scientist for Metcalf and Eddy Inc. Dr Everett is very active as a senior scientist in Canada, participating for example as scientific advisor to Biolargo Inc. in Alberta and on the Board of Directors of Global H2O, Inc. in British Columbia.

When the Groundwater Monitoring and Remediation Journal was proposed by the American Association of Groundwater Scientists and Engineers, Dr. Everett was asked to write the initial paper in the charter issue (1981) of the journal. In the charter issue the National Groundwater Association described Dr. Everett's paper as "written by one of the pioneers in groundwater monitoring". Subsequently, the United States Environmental Protection Agency, on a sole source basis, awarded a multi million-dollar contract to Dr. Everett to develop the Groundwater Monitoring Handbook for Coal and Oil Shell Development. Since that time, Dr. Everett has written twelve books, two of which have been directly commissioned by the American Academy of Environmental Engineers. Dr. Everett has been credited with writing the "classic books on monitoring used throughout the world". His book entitled: Handbook of Vadose Zone Monitoring and Remediation has been designated a best seller.

For his achievements, the Russian Academy of Sciences presented him with the Kapista Gold Medal, the highest award given for original research by the Russian Academy of Sciences. The Gold Medal, presented by the head of the Russian Academy was awarded to Dr. Everett at the Beau Rivage Palace in Laussane Switzerland on October 29, 1999 before an audience flush with Nobel Laureates.

In October of 1999, the Department of the Navy presented Dr. Everett with the Medal of Excellence for his contributions as a charter member of the Navy's Science Advisory Board. The Medal came with the commendation that Dr. Everett's "unwavering commitment to technical excellence has been inspirational to all who have worked with him".

In 2001 the United States Department of Defense requested a successful FBI evaluation of Dr. Everett which will allow him to fulfill a secret clearance appointment as a TARA team reviewer in the Pentagon.

Dr. Everett is the Charter Director of the Vadose Zone Monitoring Laboratory for the University of California. In this capacity, Dr. Everett is a Research Professor Level VII. Level VII within the University of California is "reserved for scholars of great distinction".

In his laboratory, Dr. Everett is responsible for writing all fourteen of the ASTM International standards on vadose zone monitoring. For this activity, ASTM International invited Dr. Everett to be a millennium member of their Board of Directors, and awarded him the ASTM's highest award " The Award of Merit" and the honorary title of "fellow".

ASTM INTERNATIONAL VADOSE ZONE MONITORING STANDARDS

VADOSE ZONE TERMINOLOGY (FINAL)

SOIL PORE-LIQUID MONITORING (D 4696-92)

SOIL CORE MONITORING (D 4700-91)

MATRIC POTENTIAL DETERMINATION (D 3404-91)

NEUTRON MODERATION (D 5220-92/97)

SOIL GAS MONITORING (D 5314-93)

HYDRAULIC CONDUCTIVITY (D 5126-90)

DECONTAMINATION OF FIELD EQUIPMENT (D 5088-90)

FLUX DETERMINATION BY TIME DOMAIN REFLECTOMETRY (D 6565)

DETERMINING UNSATURATED AND SATURATED HYDRAULIC CONDUCTIVITY IN POROUS MEDIA BY STEADY STATE CENTRIFUGATION (D 6527)

HORIZONTAL APPLICATIONS OF NEUTRON MODERATION (D 6031)

FREQUENCY DOMAIN CAPACITANCE (Z4302Z)

FIELD SCREENING (Draft)

WATER CONTENT DETERMINATION (DRAFT)

VADOSE ZONE BOREHOLE FLOW RATE CAPACITY TEST (DRAFT)

AIR PERMEABILITY DETERMINATION (OUTLINE)
THERMALCOUPLE PSYCHROMETERS (OUTLINE)

Dr. Everett has made presentations on different occasions before the United States Congress, the National Academy of Engineering, the National Academy of Sciences, the Russian Academy of Sciences, and the World Federation of Scientists. The World Federation of

Scientists has invited him to be a permanent member of their International Pollution Panel in 1995.

Dr. Everett has published extensively, and continuously, in the area of groundwater hydrology. In addition to his twelve books he has published over 170 papers and reports, holds several patents, and has received numerous awards including the A. Ivan Johnson ASTM International Outstanding Achievement Award for hydrogeology presented by Ivan Johnson in June 1997. Dr. Everett holds numerous registrations including Certified Groundwater Professional, Registered Environmental Assessor, etc. and has received honorary Doctor of Science degrees from different universities for his accomplishments.

Dr Everett is sought after internationally to be an expert witness with over 30 successful court cases involving awards of over $2 billion dollars. He has distinguished himself, associated organizations and the individuals who have had an opportunity to work with him. It is long overdue that he be recognized as a recipient of the C.V. Theis Award.

Joseph J. DLugosz
U.S. Environmental Protection Agency
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Duluth, Minnesota

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C.V. THEIS AWARD

Response: Lorne G. Everett

As I accept this C.V. Theis Award I am emotionally drawn back to my first course in hydrology taught by the wonderful Dr. Dan Evans in the Department of Hydrology and Water Resources at the University of Arizona. The respect for Theis expressed by my mentors in the department of hydrology which in addition to Dan Evans included Drs Chester Kisiel., Gene Simpson, Martin Fogel, John Harshbarger, and others, humbles me at this time. As I review the previous recipients of the C.V. Theis Award, I feel particularly honored to be listed in their grand company.

After I left the Department of Hydrology at the University of Arizona and joined General Electric's Think Tank in Santa Barbara I encountered many other recipients of the Theis Award. My first contact with a noted hydrologist outside of the department was Dr. David Keith Todd. I never quite got over the impression that he made as a hydrologist and as a professional. Later I recalled my first contamination litigation case wherein to my delight I was on the same side as Herb Skibitzke, the 1991 Theis Award recipient. Although Herb was getting on in years, he was still full of fire in the courtroom. I know of no other hydrologist who has given more of his personal time to the science of hydrology than Ivan Johnson. I was deeply honored to receive the A. Ivan Johnson Outstanding Achievement Award in 1997 from Ivan. Over the years it has been my honor to have worked with other Theis recipients including Allen Freeze, Jim Mercer and Leonard Konikow. I see from the C.V. Theis Award list that Isaac Winograd who I took Ph.D. classes with at the U of A received the award 14 years earlier than I. I guess this proves that if you work hard enough and stay alive that perhaps one can try to catch up with these truly royal members of the hydrology family.

I wish to extend a special thanks to Dr. Richard Tinlin, Dr. Gray Wilson and Dr. Ken Schmidt who early in my career identified major gaps in our understanding of vadose zone hydrology and it was their work that allowed me to focus on monitoring strategies in contaminant transport. I also wish to thank Les McMillion, Larry Eccles, John Koutsandreas and in particular Joe D'Lugosz from EPA who believed in my ideas related to early alert monitoring in the vadose zone.

Recently, I have been spending time with our research team, Subsurface Laser Applications Inc., (SLAI) which was formed with the object of creating a laser based drilling system, to be used for characterizing and monitoring contamination plumes and applying remedial procedures. By laser-based, it is meant that the hole is created by moving soil out of the way or penetrating through resistive material primarily by the use of infrared laser energy. The use of high-power lasers to make holes in the earth has been seriously studied only in the last 10 years. The fundamental research performed thus far has indicated that lasers have great potential for creating holes of various diameters through any lithology rapidly and cleanly. Laboratory tests in this regard have been done on both hard and loose material by members of our team since 1995. Calculations done in the 1960's indicated that the energy requirements for penetrating rock would be much higher than what is considered routine in the drilling industry, indicating high drilling costs. The 2001 tests done by our team show conclusively that, even before optimizing the system, energy requirements are similar or lower than mechanical systems. The difference seems to be related to mistaken assumptions of the mechanisms of earth removal when using an energy beam.

C.V. THEIS AWARD

Over 100 years ago, rotary drilling surpassed cable tools as the state-of-the-art in drilling methods. Our new laboratory applications of laser drilling techniques have indicated the potential to penetrate hard rock at 100 times faster than conventional boring technologies. Reports by the Gas Technology Institute have indicated that 50% of drilling time is spent on making hole, 25% on tripping, and 25% on casing and cementing. A conclusion is that major reductions in drilling costs can be achieved by faster drilling techniques and reductions in requirements for drill string removal, bit replacement, and setting casing. SLAI is working on techniques to create casing in unconsolidated sediments, spall rock with specific removal technologies, and to develop down hole and side-wall laser analytical technologies. Clearly, the ability to create micro bore holes in soil, micro groundwater monitoring wells and micro interrogation holes in barriers has huge breakthrough potential. The accuracy of laser drilled holes guided by laser surveying technologies allows the ability to triangulate and to develop exact understanding of rock material and contamination at specific depths.

The drilling industry, whether oil and gas or environmental, is known for its small profit margins, and it is understood that new technology will have to compete in cost savings, if not on a cost per foot basis, then on costs to some other objective, in order to be accepted. SLAI is dedicated to developing a system that follows industry guidelines in the area of environmental characterization, monitoring and remediation. The next phase of our research will focus on determining the design parameters for a working prototype. Laser parameters, such as total power, wavelength and pulse parameters need to be optimized, and decisions about the energy delivery system need to be finalized.

Much of my time has been spent on reshaping the DOE's Complex Wide Vadose Zone Science and Technology Roadmap into a National Vadose Zone S&T coordinated program. The foundation for our work requires increased knowledge and capabilities in three areas: 1) Understanding basic subsurface processes in the vadose zone: 2) Better data collection and monitoring capabilities: and 3) new computer models, predictive capabilities and data visualization techniques. These ideas must be woven into a multi agency approach to addressing the most important research challenges and infrastructure gaps that will protect groundwater from vadose zone contamination. Our multi agency September, 2002, meeting in Seattle hosted by the EPA and DOE will focus on integrating the research objectives of multiple agencies including DOD, DOE, DOI, NASA, SERDP, and numerous other professional and state agencies. The thrust of this program is to demonstrate the need for vadose zone research as a part of the nation's Long Term Stewardship obligations.

For the past couple of years I have been concentrating on a Science and Technology Roadmap for Long Term Stewardship at DOE's waste legacy sites._The DOE is responsible for cleaning up the environmental legacy (estimated cost $300 billion dollars) of the nation's nuclear weapons program and government-sponsored nuclear energy research. The cleanup program is one of the largest and most diverse and technically complex environmental cleanup programs in the world. In February 2002, DOE embarked on an accelerated cleanup and closure program intended to yield more secure protection of our nuclear material inventory, while reducing the cost of storage and protection at multiple sites. Due to the nature and complexity of this approach, as well as the limitations of currently available remediation technologies, much of this radioactive and chemical contamination will constitute a long-term hazard, since significant amounts of it will remain in the ground even after DOE's cleanup goals have been achieved at the 144 DOE sites. Whether contaminants are moved or

stabilized in place, the vadose (unsaturated) zone of the earth will host much of the post-cleanup contaminated material, as well as spent nuclear fuel. This approach will require an improved understanding of the processes influencing the subsurface movement of contaminants in the DOE complex in order to support necessary decisions for the short- term management and long-term stewardship of DOE sites. Breakthrough advances in environmental science and technology will be central to that understanding and would have the effect of significantly advancing schedules, and reducing costs, uncertainty and risk.

It is reported that more than one hundred DOE sites will require monitoring for an indefinite length of time, at an estimated cost of $100 million per year. More specifically, DOE anticipates that long-term stewardship will be required at various sites to ensure protection from over 75 million m3 of contaminated soil and 1.8 billion m3 of contaminated water. Risk-reduction activities will include sampling and analysis of more than 11,000 monitoring wells and maintenance of engineered barriers at hundreds of the over 3,000 existing sites contaminated with hazardous or radioactive materials.

The draft roadmap document, scheduled for completion in August 2002, will:

- Reflect a national consensus on near-term (5 year) R&D needs.
- Identify what S&T is needed. It will not identify who will do it, where to do it, or how to do it.
- Provide a strategy to plan and coordinate science and technology investments by interested agencies involved in long-term care of contaminated sites.

Over the next 50 years, DOE expects to complete clean up at all of it's sites and transition from a role of providing active remediation to one of insuring stabilization and long term stewardship. Long term stewardship refers to " all activities required to protect human health and the environment from hazards remaining after cleanup is complete. While DOE estimates that only about 123 sites will have been cleaned up and put in active or passive stewardship by the year 2006 all 144 sites will be so by 2050. Most of these sites, including the most complex ones are located in semi-arid western states with thick vadose zones. The time line driving DOE's cleanup mission, coupled with the prevalence of thick vadose zones at important sites, dictates the need for aggressive, accelerated program to understand vadose zone processes and properties, develop better tools and techniques to characterize and monitor contaminant migration and fate, and develop predictive tools to address and access long term stewardship needs."

Since the formation of EPA in 1970 I have been saying that the National approach of monitoring groundwater to prevent pollution is "Illogical". The philosophical position taken by EPA for the vast majority of the regulations is directed towards regulating contamination after it reaches the saturated zone through the use of groundwater monitoring wells. This approach clearly is flawed if one thinks in terms of long half-life radioisotopes, or in areas of significant depth to the water table, as is commonly found at many of DOE's sites. This approach is akin to monitoring a patient in a hospital to tell you when the patient is dead.

Those of you who have read my books and papers over the years know that I often refer to O.K. Meinzer's referral to the vadose zone as "no man's land". As I enter the final stages of my career I am so very proud to be involved in these vadose zone/long term stewardship

Roadmap S&T activities and break through research technologies which hopefully will allow us to travel with more understanding through the vadose zone.

Thank you once again for this high honor.

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