ground water

Historical Note/ David Deming, History Editor

# Shlomo P. Neuman: A Brief Autobiography

by Shlomo P. Neuman

## Prologue

I thank *Ground Water* and its editor for the privilege of sharing some highlights of my personal and professional lives with colleagues. The story of my childhood, which is a key to understanding who I am, might otherwise have never been told: I owe it to our younger colleagues, my children, and my grandchildren. I urge the reader to explore further the historical events and circumstances that I describe by turning to readily accessible sources starting, most conveniently, with Wikipedia on the Internet.

## Lost Childhood in Europe

I was born and named Peter on October 26, 1938, to Klara and Alexander Neumann in Žilina, an industrial town in northwestern Slovakia. Between the two world wars, Žilina and much of Slovakia were part of a thriving democracy under the Czechoslovak republic. By a stroke of bad fortune (or lack of spine and foresight), Czechoslovakia was handed over to Nazi Germany in the infamous Munich Agreement signed a month earlier (on September 29) between Hitler, Mussolini, and the prime ministers of England and France, Chamberlain and Daladier. Considering that Chamberlain was hailed at home as the deliverer of (in his own words) *peace for our time*, it took a giant of Winston Churchill's caliber to denounce this shameful act in the House of Commons as ''a total and unmitigated defeat . . . an awful milestone in our history, when the whole equilibrium of Europe has been deranged, and . . . the terrible words have . . . been pronounced against the Western democracies: 'Thou art weighed in the balance and found wanting'" (http://www.churchill-society-london.org.uk/Munich.html, accessed October 11, 2007). I find it disheartening that Churchill's admonition rings as true and relevant today as it did 70 years ago.

On October 5, 1938, the executive committee of the nationalist Slovak People's Party met in Žilina and, on behest of Hitler with the acquiescence of all Slovak political parties except the Social Democrats, decided to form an ''autonomous'' Slovak government under Monsignor Jozef Tiso. Their decision led to the formal establishment on March 14, 1939, of a Slovak Republic beholden to Nazi Germany with Tiso as president; a fascinating description of the previous events is given by Shirer (1960). Thus, it happened that I was born into a nascent fascist state that, like other Nazi-allied or dominated governments with the shining exceptions of Denmark and Finland (Dawidowicz 1975), would soon take active part in Germany's murderous designs against their Jewish citizens.

Before reaching my first birthday, the Slovak government had enacted (on September 4, 1939) discriminatory laws requiring Jewish businesses and medical clinics to exhibit signs identifying them as Jewish and doctors' prescriptions to bear the Star of David (e.g., Dawidowicz 1975; Gordon 2003). Prior to reaching my second birthday, a law was enacted (on April 25, 1940) requiring all Jews to itemize their property and assets in preparation for their confiscation and transfer to ''Aryan'' hands. In 2006, a Slovak government document came to my attention that had been filled by hand, signed and dated September 14, 1940, by my late father (pictured with me in Figure 1). The document is stamped November 16, 1940, by the Žilina district archives. It includes a detailed warning to Jews of their asset reporting duties and a complete financial statement detailing (to the Slovak equivalent of a penny) the worth of my father's photography business, debts owed to the business by various clients and their names, value of my father's insurance policy, family debts and savings, and annual taxes paid by us from 1938 to 1940.

As of June 24, 1941, when I was 2.5 years old, Jews were prohibited from living, walking, or strolling on main streets; entering public parks; or leaving their homes after dark; our family had to relocate twice from the center to the outskirts of town. On September 9, the Jewish Codex was enacted prohibiting Jews from owning real estate or luxury goods, excluding them from public employment and the professions, banning their participation in sport or cultural events, excluding them from secondary schools and universities, banning them from marrying non-Jews, annulling debts owed to Jews, and requiring all Jews (including children of my age) to wear a large yellow Star of David in public.

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**Figure 1. 1940 in Žilina with my late father.**

Between March 25 and October 10, 1942, the Slovaks deported around 58,000 Jews to the death camp of Auschwitz on Polish soil and other centers of mass execution. My parents and I were extremely fortunate to have succeeded, prior to being rounded up, in crossing the border illegally into Hungary where attitudes to Jews were, at the time, more lax. I remember distinctly riding on my father's shoulders as we crossed on foot a path heavily guarded with searchlights and barking dogs, of which I became mortally afraid well into my adolescent years. In Budapest, I was held indoors for 2 weeks until my Hungarian became passable enough to ensure that I would not reveal our identity by talking Slovak. With the aid of relatives, we managed to avoid discovery till early 1944 at which time German troops were approaching Hungary to eventually seal the fate of its Jews. Once again, with extraordinary luck, we managed to sneak back into Slovakia and, pretending to be Hungarian Christians, lived the year out in a small village (Čeklís) near Bratislava under an assumed name (Modos). While my parents commuted to town daily for work, I chased pigs marked for slaughter with village urchins and attempted to solve my first ground water puzzle: How did the water get into the well in our yard, and why would our ornate hand-operated pump exhaust so much of my energy?

Deportations of Jews from Slovakia resumed on September 30, 1944, as the Soviet Army reached the Slovak border, inspiring the Slovak National Uprising in which my uncle, a lieutenant with the partisans, lost his life fighting. As a result, the Germans occupied Slovakia and deportations continued till March 31, 1945, at which time the Soviets completed their conquest of Slovakia. Our Jewish identity was revealed by an informer on Christmas day of 1944, and we were promptly jailed by the Slovak secret police (whose menacing leather trenchcoats would forever remain engraved in my memory as the embodiment of evil). My father was separated from us and, except for a brief moment at the transition camp of Sered where he volunteered to deliver coal to our barracks, we never saw or heard from him again. My mother and I were packed with many other women and children into locked freight cars and transported under extremely difficult conditions by rail to Terezín (Terezienstadt), a concentration camp north of Prague that had previously served as a way station to Auschwitz. Luck was with us again: By the time we arrived, transports to Auschwitz had been halted under the pressure of advancing Soviet and Czech troops that, in May 1945, liberated Terezín. The camp is today a museum, which I strongly urge my readers to visit. (Gavrilo Princip, who assassinated Franz Ferdinand, Archduke of Austria and his wife, thereby triggering World War I, was imprisoned there until his death from tuberculosis in 1918.)

During the course of the war, German and Slovak authorities deported about 70,000 Jews from Slovakia, of whom about 65,000 were murdered or died in concentration camps; according to Klein-Pejšová (2006), the total number of Slovak Jews who perished during the Holocaust was 105,000, or 77% of their prewar population. With the active or tacit support of many others across Europe, the Germans succeeded in carrying out the systematic murder of 6 million Jewish children, women, men, and the elderly (http://www.yadvashem.org/, accessed October 11, 2007). Of 3500 Jews living in Žilina and its surroundings at the start of the war, 2668 are known to have perished, including almost the entire Neumann clan (my father, his three sisters, their families including several of my young cousins, my grandmother, and many others) and my maternal grandmother (Gordon 2003). Only 214 returned from concentration camps, most widowed and orphaned; that my mother and I were among them is to me nothing less than a miracle (among 15,000 children that have passed through Terezín, fewer than 100, of whom I was one, survived; e.g., Weil 1978). In 1947, my mother remarried, we adopted a Slovak sounding family name (Lesný), and soon she gave birth to a boy named after my stepfather's baby son, who, like his mother, failed to return.

The war and postwar attitudes I have encountered in and out of school have made it clear to me that Slovakia and Europe could never again be called home. To my everlasting horror, similar attitudes have resurfaced across Europe in recent years. Through a miraculous convergence of circumstances, we were able in 1949 to restart our lives in the newly established State of Israel, just weeks before the gates of postwar Czechoslovakia were slammed shut by its new communist masters. Having thus emerged from darkness to light at age 10, I felt reborn, adopted my Hebrew name Shlomo (Salomon, after my paternal grandfather), relegated my given European name to second place initial, and later in college, returned to a shortened version of my original family name.

## Rebuilding My Life in Israel

While my parents and baby brother settled in the beautiful coastal resort town of Nahariya in northern Israel, I opted to join other newly arrived immigrant children in the aptly named communal farm (kibbutz) of Gan Shmuel (Garden of Samuel) in the country's center. We lived a carefree life in the school dormitories of the

kibbutz, attending classes in the mornings and helping with farm and service work in the afternoons and during school holidays. Shortly after the conclusion of the Manhattan Project (Rhodes 1986), I developed an interest in physics and mathematics kindled by books describing the people, physics, and secrets behind this extraordinary enterprise. That scientists in Nazi Germany tried but failed, while scientists forced out of Germany and other European countries, with the help of others, succeeded to develop an atom bomb remains for me to this day an immense source of relief and satisfaction. The stated purpose of our kibbutz education was to turn us into educated farmers, not professionals or scientists. I therefore graduated without a high school diploma, obtaining one by correspondence at age 22, following a prolonged period of military service. This made it possible for me to pursue a BSc degree in geology, with a minor in physics, at the Hebrew University of Jerusalem. The cost of my studies was covered by a scholarship and a small monthly stipend from the German government in ''compensation'' for my lost educational opportunities as a child. I supplemented this income by playing Israeli folk dances on the accordion.

Having found geology (as then taught) in my junior year to be overly descriptive, I started searching for a more quantitative earth science discipline that would satisfy my early passion for physics and math. This was a time at which Israel exerted major efforts toward the development of its limited water resources. A National Water Carrier was being constructed to convey water of slightly elevated salinity from Lake Kinneret (the Lake of Galilee) in the north to agricultural and population centers in the central and southern parts of the country. As Israel has meager supplies of surface water, it helped pioneer the concept of integrated ground water and surface water management by using its coastal aquifer not only as a source of ground water but also as a seasonal storage and mixing reservoir of artificially recharged Kinneret water. There was a need for highly trained hydrologists and water resources engineers, a career path I decided to pursue in the United States.

I was fortunate to receive a warm letter of acceptance from Paul Witherspoon coupled with a generous research assistantship offer which, together with a scholarship, enabled me to pursue an MS degree in civil and geological engineering at the University of California in Berkeley (not the least among my reasons for selecting Berkeley was the aura surrounding the contributions of its faculty to the experimental and theoretical exploration of the atom and to the Manhattan Project). To cover the cost of my cross-Atlantic voyage, I spent the latter half of 1963 translating geologic texts from Russian (close to Slovak and hence relatively easy for me to understand) to English, which, at the time, paid rather well. I also received a onetime ''compensation'' of about $1000 from the German government for the hardship I had endured as a child during the Holocaust. (I will let the reader weigh the cost-benefit ratio of this largesse.) In late December 1963, our ship pulled into New York Harbor to find the city beautifully lit and decorated for Christmas. After spending five exhilarating days exploring this exciting metropolis on foot and by subway, I left for Berkeley to commence my studies in January 1964.

## The Heady Days of Berkeley

My years at Berkeley were the fulfillment of a dream. The university ranked first in the nation in overall quality, and the Department of Civil Engineering was recognized to be the best. Paul Witherspoon was starting to develop what would soon become one of the world's leading educational and research programs in quantitative ground water hydrology. His group initially consisted of Al Freeze (future coauthor of the popular Freeze and Cherry *Ground Water* text), Iraj Javandel, and me (Figure 2). Al was the first among us to complete his doctorate and to launch one of the most illustrious ground water careers of the 1970s and 1980s. Taking engineering and mathematics classes at Berkeley was a veritable intellectual challenge. Taking classes and working with Paul was an experience of a lifetime. Our most unusual, relaxed, and productive class was one in which the four of us explored jointly and individually the mathematics behind key chapters in Muskat's 1937 text on flow through porous media, learning with and from each other.

Having spent his early research career as an experimentalist, Paul had assigned to me as an MS project the development of a laboratory heat flow analogue for drawdown in a low-permeability caprock in response to water withdrawal through a well from an underlying aquifer. His purpose was to verify experimentally numerical studies that he had done with one of the earliest finite-difference simulators of porous media flow. Paul's simulations suggested that the ratio between drawdowns in the caprock and the aquifer would yield information about the hydraulic diffusivity of the caprock, needed to determine whether or not aquifers in some urban areas of the United States could serve safely and economically as reservoirs for the artificial injection and storage of natural gas.

Having watched Iraj struggle with a similar project, I was determined to avoid the drudgery. I proposed to Paul that it might be equally if not more interesting and

**Figure 2. 1985 Berkeley reunion, from right to left: Al Freeze, Paul Witherspoon, Shlomo Neuman, Jane Long, and John Gale.**

productive to address the same problem mathematically. To his everlasting credit, Paul relented on condition that I complete my ''mathematical experiment,'' which was bound to fail, in 2 weeks or else I would start working on the ''real thing.'' Absent a choice, and with a good measure of luck, I came up with a surprisingly (to both of us) simple analytical solution to the problem that not only confirmed Paul's numerical results but, more importantly, enabled us to rewrite and generalize them in terms of only a few dimensionless quantities. The solution gave rise to the Neuman-Witherspoon ratio method for the evaluation of aquitard and aquiclude properties (Neuman and Witherspoon 1972).

The experience taught us that analytical solutions may have important advantages over numerical simulations: Having a dimensionless form that renders the solution general rather than site specific; revealing dimensionless groups of parameters and space-time coordinates that control system behavior that may otherwise (and in fact often do) remain unidentified; obviating the need to construct numerical grids and to compute results across the entire grid at all times of interest; and generally rendering parameter estimation easier, more stable, and computationally efficient.

Following this initial success, it was only natural for me to continue in this line of work by developing a much more general analytic solution for the hydrodynamic response of multilayered media to pumping for my PhD, published in 1968. Our excitement at having successfully compared this solution with axially symmetric finite-element simulations (a novel numerical method pioneered in part by our group) was soon dwarfed by our exhilaration at having successfully validated the theory by means of 2-month-long pumping tests spanning five geologic formations near Oxnard, California (Neuman and Witherspoon, 1972). Incredibly, the math actually worked!

Good fortune guided me to cross paths with my future wife and life companion, Yael, in summer 1964, only days after she had arrived from New York to pursue a master's degree in social welfare. That she had swept me off my feet is made evident by my having forgotten to set my alarm clock to wake me up for a final exam in soil mechanics (which could have ended in disaster, had Professor Jim Mitchell not been gracious enough to have a friend call me and to grant me extra time) and by my having allowed my grades to slip down to a solid B (which, as Paul would reveal to us years later, made him ponder whether I should be allowed to continue). Instead of studying, we watched with fascination the birth and antics of Mario Savio's Free Speech Movement, listened to Joan Baez sing *We shall overcome*, strolled with hippies on Telegraph Avenue, and marveled at the flower children occupying Peoples' Park. Our marriage in January 1965 brought about an immediate improvement in our grades and the eventual birth in 1969 of our first son Gil. It is Yael who deserves the credit for my decision to undertake doctoral studies and a lifetime career of academic pursuit. In 1970, we moved back to Israel where my wife was born and raised. Soon thereafter, my mother, who had been the anchor of our extended family throughout her life and my personal Rock of Gibraltar, was overcome at age 59 by terminal illness attributed to a wartime legacy of heavy smoking.

## Back in Israel

I spent the years 1970 to 1974 working as a research scientist in the Department of Soil Physics at the Agricultural Research Center in Bet Dagan, Israel. The department, established by the venerable Jacob Rubin, was then headed by the late Eshel Bresler. Having been granted complete freedom and sufficient funding by Eshel to pursue my own line of research, I devoted part of my time to the development of a new analytical solution for flow to a well in a compressible unconfined aquifer considering delayed gravity response (Neuman 1972). The solution offered some important advantages over the semiempirical delayed yield model of Boulton, not the least of which is its ability to deal with partially penetrating wells. I was also invited to take part in a research project headed by Dan Zaslavsky (future Water Commissioner of Israel) and Gedeon Dagan (future winner of the Stockholm Water Prize) at the Technion (Israel Institute of Technology) in Haifa, which allowed me to develop the first finite-element simulator of transient saturated-unsaturated flow in the two-dimensional vertical plane and in three dimensions under axial symmetry, UNSAT2 (Neuman 1973a). The code was soon applied to major projects such as the redesign of Guri Dam in Venezuela and later formed the basis for a popular Window-based code (HYDRUS-2D) developed at the U.S. Salinity Lab in Riverside, California.

I was fortunate to have been visited for a year by Reinder Feddes of Wageningen Agricultural University in the Netherlands with whom we expanded UNSAT2 to include water uptake by plants. Inspired by the work of Emselem and de Marsily at the Paris School of Mines in Fontainebleau, I developed a new approach to model calibration, which, in addition to minimizing the difference between computed and measured heads, includes a parameter plausibility criterion to help regularize the otherwise ill-posed inverse problem and to render the parameter estimates close to prior measurements (if available) and/or reasonably smooth (Neuman 1973b). Another major project, conducted with Shmuel Dasberg, concerned field and laboratory studies of local and regional flows through peat soils in drained marshes of the Hula Valley in northern Israel to help address the potential for nutrient migration into Lake Kinneret downstream.

In October 1973, the Yom Kippur War erupted (Rabinovich 2004) and I was immediately drafted into reserve duty while my wife was in her ninth month of pregnancy. Her parents managed to catch the last plane out of New York to be at her side when my daughter Michal was born on my birthday. Despite a 48 hour leave, I did not learn until much later that my wife's life was hanging by a thread for several days following the delivery. During my 4.5-month-long service, I managed to attend a conference on finite elements in Swansea, Wales (where ironically, colleagues expressed concern about my return to a war zone while friends in Israel had

been wondering aloud who in his good mind would go to England, across which the IRA (Irish Republican Army) was busy planting bombs). I also managed to pore over reams of printed computer output regularly sent to me by Reinder to help discover why UNSAT2 was rejecting his plant uptake routine (upon my return, we found that a period had been erroneously misplaced by a comma on a punch card that now occupies a place of honor in Reinder's family album from those days). I still marvel at the moral strength and courage of Reinder and his wife Foky, who remained in Israel throughout the war with their three small children, while everyone else who could packed and left at the first sign of impending danger.

In spring 1974, I received and gladly accepted an invitation from Paul Witherspoon to take over his classes at Berkeley for 1 year. In the following spring, I was invited to visit the University of Arizona in Tucson by the late Sid Yakowitz (my coprincipal investigator on a joint research project) where the late Gene Simpson (acting head of the Hydrology and Water Resources Department) with the blessing of Stan Davis (incoming head of the department) promptly offered me a position as full professor (vacated by the untimely death of Professor Chester Kisiel).

## My University of Arizona Years to Date

I started teaching at Arizona in August 1975 and continue to do so with joy as of this writing. Despite several tempting offers from venerable institutions in Israel and the United States, we decided to stay in Tucson due to the uncommon opportunity of working at a department uniquely focused on water. My son Ariel was born here in 1979, and my wife earned a PhD in educational psychology from the University of Arizona in 1995.

Throughout my professional and academic careers, I have tried to bring as much scientific and mathematical rigor to bear on the practice, science, and teaching of subsurface hydrology as the discipline would allow. With my students and coworkers, I continue to develop analytical solutions and engineering methodologies that are widely used to evaluate the hydraulic properties of multiaquifer systems (e.g., Li and Neuman 2007), water table aquifers (e.g., Tartakovsky and Neuman 2007), and fractured rock formations (for a recent overview, see Neuman 2005). The complexity of fractured rocks and other geologic media render their hydraulic and transport properties highly variable in space, scale dependent, and difficult to ascertain. This has prompted us to develop geostatistical methods of inference and analysis that view the properties of geologic media as spatially correlated random fields, rendering subsurface flow and transport equations stochastic (Dagan and Neuman 1997). We have contributed to the analytical and numerical solution of such stochastic equations, emphasizing their conditioning on real data. Of special challenge has been the development of corresponding inverse methods to help characterize medium properties statistically on the basis of observed space-time variations in system states (Carrera and Neuman 1986).

My group has pioneered the concept of subsurface pressure tomography and used it to image spatial variations in unsaturated fractured rock properties by propagating controlled pneumatic pressure pulses in various directions between isolated portions of vertical and inclined boreholes on scales of several decameters at a spatial resolution of 1 m (Vesselinov et al. 2001). We were successful in explaining some hydrogeologic scaling phenomena by viewing log permeability as a random fractal (for a recent review, see Neuman and Di Federico 2003).

Restricted access to the subsurface and its complexity render hydrogeologic forecasts inherently uncertain. To the limited extent that uncertainty has been considered in ground water models, it has been attributed almost exclusively to errors in parameter estimates. Yet, the complex and open nature of hydrologic systems renders them prone to multiple conceptualizations and mathematical descriptions. There is now a growing recognition among hydrologists that conceptual uncertainty is often more important than errors in data and model parameters. Our group is pursuing a maximum likelihood Bayesian model averaging approach to quantify errors in hydrologic forecasts due to the joint effects of all three factors, plus uncertainty in the scenarios under which a system might operate in the future (Neuman 2003).

My work at Arizona has benefited greatly from collaborations with the late Sid Yakowitz and Gene Simpson, and more recently with Pete Wierenga, on a host of fascinating theoretical and experimental field projects championed in part by U.S. NRC project managers John Randall, Tom Nicholson, and Ralph Cady. My work on spatial variability, stochastic modeling, and scaling has benefited greatly from close collaborations with Vittorio Di Federico of Bologna and Alberto Guadagnini and Monica Riva of Milan, Italy. I have been exceedingly fortunate to attract many unbelievably brilliant and wonderful young people to Arizona who have helped produce much of the science our group has become known for. Many among the 32 doctoral students who have completed (one just ''nearly'' so) their dissertations to date, in the order listed, are undoubtedly known to the readers of *Ground Water*: Dan Stephens, Abdalla Bin Sariti, Larry Winter (supervised jointly with Chuck Newman), Paul Hsieh, Jesus Carrera, Eilon Adar, Elizabeth Jacobson, Javier Samper, Steve Silliman, Ralph Cady, You-Kuan Zhang, Gordon Wittmeyer, Shlomo Orr, Don Zhang, Evan Paleologos, Amado Guzman, Kuo-Chin Hsu, Daniel Tartakovsky, Peter Mock (supervised jointly with Tom Maddock III), Christian Williamson, Walter Illman, Orna Amir, Velimir ''Monty'' Vesselinov, Zhiming Lu, Alexandre ''Sasha'' Tartakovsky, Wenbin Wang, Ming Ye, Abel Hernandez, Yunjung Hyun, Eric Morales-Casique, Donghai Wang, and Bwalya Malama. The majority of them occupy influential leadership positions in academia, government, and industry in the United States and across the world. I am extremely proud of their accomplishments as well as those of my many former master students. My current students are sure to follow in their footsteps.

Thanks in large part to my many talented collaborators, I won (among several other honors and distinctions)

**Figure 3. 2003 AGU Horton Medal reception (with Yael and Gil).**

the Robert E. Horton Award from the American Geophysical Union (AGU) in 1969 and the Oscar E. Meinzer Award from the Geological Society of America (GSA) in 1976; was elected Fellow of the AGU in 1984 and of the GSA in 1988; was appointed Birdsall Distinguished Lecturer by GSA in 1986, W.B. Langbein Lecturer by the AGU in 1996, and Regents' Professor by the University of Arizona in 1988; won the M. King Hubbert Award from the National Ground Water Association in 1988 and the C.V. Theis Award from the American Institute of Hydrology in 1990; was elected to the U.S. National Academy of Engineering in 1992; and was the 2003 recipient of the AGU Robert E. Horton Medal (Figure 3).

## Addendum

Our two eldest children are happily married and the youngest is pursuing an active and exciting law career. Yael and I enjoy spending time with them and with our five beautiful grandchildren as well hiking (for which Tucson is ideal), exploring our National Parks and the Canadian Rockies, and touring exotic places such as Israel, Turkey, Egypt, the Silk Road, Rio de Janeiro in Carnival season, the Amazon, the Andes, Galapagos Islands, and animal preserves of Kenya and Tanzania. We love classical music, opera, and the theater as well as folk music and dance; value art and good books as well as movies; appreciate gourmet as well as traditional and ethnic foods, never refuse a glass of fine wine or chilled vodka, occasionally dance, enjoy good company, and generally regard life to be a blessing.

## References


Carrera, J., and S.P. Neuman. 1986. Estimation of aquifer parameters under transient and steady state conditions: 1. Maximum likelihood method incorporating prior information. *Water Resources Research* 22, no. 2: 199–210.

Dagan, G., and S.P. Neuman, ed. 1997. *Subsurface Flow and Transport: A Stochastic Approach*. Cambridge, UK: Cambridge University Press.

Dawidowicz, L.S. 1975. *The War Against the Jews 1933–1945*. New York: Bantam Books.

Gordon, H. 2003. *The Rise and Decline of the Jewish Community of Žilina: Memorial Booklet*. Jerusalem, Israel: Private Edition.

Klein-Pejšová, R. 2006. *An Overview of the History of Jews in Slovakia*. http://www.slovak-jewish-heritage.org/history-of-jews-in-slovakia.php (accessed October 11, 2007). Slovak Jewish Heritage.

Li, Y., and S.P. Neuman. 2007. Flow to a well in a five-layer system with application to the Oxnard Basin. *Ground Water* 45, no. 6: 672–682.

Neuman, S.P. 2005. Trends, prospects and challenges in quantifying flow and transport through fractured rocks. Special Issue of *Hydrogeology Journal* devoted to The Future of Hydrogeology 13, no. 1: 124–147.

Neuman, S.P. 2003. Maximum likelihood Bayesian averaging of alternative conceptual-mathematical models. *Stochastic Environmental Research and Risk Assessment* 17, no. 5: 291–305.

Neuman, S.P. 1973a. Saturated-unsaturated seepage by finite elements. *Journal of the Hydraulics Division, ASCE* 99, HY 12: 2233–2250.

Neuman, S.P. 1973b. Calibration of distributed parameter ground water flow models viewed as a multiple-objective decision process under uncertainty. *Water Resources Research* 9, no. 4: 1006–1021.

Neuman, S.P. 1972. Theory of flow in unconfined aquifers considering delayed response of the water table. *Water Resources Research* 8, no. 4: 1031–1045.

Neuman, S.P., and V. Di Federico. 2003. Multifaceted nature of hydrogeologic scaling and its interpretation. *Reviews of Geophysics* 41, no. 3: 1014.

Neuman, S.P., and P.A. Witherspoon. 1972. Field determination of the hydraulic properties of leaky multiple aquifer systems. *Water Resources Research* 8, no. 5: 1284–1298.

Rabinovich, A. 2004. *The Yom Kippur War*. New York: Schocken Books.

Rhodes, R. 1986. *The Making of the Atomic Bomb*. New York: Simon & Schuster.

Shirer, W.L. 1960. *The Rise and Fall of the Third Reich: A History of Nazi Germany*. New York: Simon and Schuster.

Tartakovsky, G.D., and S.P. Neuman. 2007. Three-dimensional saturated-unsaturated flow with axial symmetry to a partially penetrating well in a compressible unconfined aquifer. *Water Resources Research* 43, W01410, doi:10.1029/2006WR005153.

Vesselinov, V.V., S.P. Neuman, and W.A. Illman. 2001. Three-dimensional numerical inversion of pneumatic cross-hole tests in unsaturated fractured tuff: 2. Equivalent parameters, high-resolution stochastic imaging and scale effects. *Water Resources Research* 37, no. 12: 3019–3042.

Weil, J. 1978. Epilogue, *... I Never Saw Another Butterfly, Children's Drawings and Poems from Terezín Concentration Camp 1942–1944*. New York: Schocken Books.