M. Turhan Taner

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At the recent EAGE Paris Conference, M.Turhan Taner added the Erasmus Award to the tributes he has received for his exemplary roles as teacher, scholar, and practitioner. Probably no other geophysicist has contributed more to the seismic method—coding efficient algorithms in deconvolution, statics, multiple attenuation, velocity analysis, velocity inversion time imaging, depth migration, seismic attributes, reservoir characterization, and more. But it may well be that "Tury" has earned the affection and respect of his colleagues more for his integrity, insight, generosity, and consideration of others than for a lifetime of achievements.

Taner's humaneness surfaced early on, as gleaned from *Some Thoughts and Memories*, a mosaic of his youth—from Tury's earliest awareness of a balcony over a candy shop in his native Akhisar, Turkey, through personal gems such as falling in love, at age four, with a much older woman whom he rapturously called *Guzel Hanim* (Beautiful Lady), playing soccer with a ball of crunched up newspaper wrapped in string, or the flavor of dew-covered grapes in his family's vineyard—embedded in thoughts of infinity, metaphysics, and history. All this is told in the unassuming tone Taner uses to explain complex science or the delights of a Brunello di Montalcino wine. Science, arts, friendship, work, leisure—all is One for Tury Taner.

"It was May in Paris," remembers Simon Spitz (CGG Americas). "Tury and I went for dinner in one of those 19th century brasseries. The brasserie was my idea and I felt apprehensive, because what Tury doesn't know about food in Paris is not worth knowing. He gave an approving glance to the crowd and we sat at a small table. As usual, the conversation jumped from scientific arguments to common friends, to our profession … and finally to a subject dear to Tury, the Ottoman Empire. 'Have you ever heard of Nasreddin Hodja?' Tury asked. 'He was a wise fool and quite a famous character in Turkish folklore. I wish people here knew something about him.' And over the Armagnac he proceeded to enlighten me.

"Several months later I settled down to listen to one of Tury's papers at the SEG Annual Meeting. The lights dimmed and Tury began: 'Thank you, Mr. Chairman. I wonder if some of the eminent geophysicists present here have ever heard of a person called Nasreddin Hodja. Let me tell you one of his stories …'"

The liberal dissemination of everything he has learned and discovered is one of the expressions of Taner's generosity. Be it Turkish folklore or seismic attributes, he is enthusiastic about the multiplier effect of spreading knowledge. Perhaps that is why he considered a career in academia in 1957, when he got his first job teaching at Duke University School of Engineering. Although he soon redirected toward industry, Taner has in fact continuously taught and mentored in many ways: as a Distinguished Lecturer of both AAPG (1975) and SEG (spring 1992); as adjunct professor at Rice University (since 1988); visiting lecturer at his alma mater, Technical University of Istanbul; member of the Technical University of Delft, Delfi Consortium advisory board; or chatting freely with the many who seek his advice. "Blessed are those who discover things and make them understandable," reads an anonymous paraphrase of the Sermon on the Mount that is axiomatic to Taner.

"Baki kalan kubbede hos bir seda imis … *it's a line of a Turkish poem that for some reason I remember, meaning: … a gentle little echo in the eternal dome. Our life is just a little echo; if you can leave a couple more reverberations behind of what knowledge we have gained, that is a very satisfactory condition."*

—TURY TANER, *May 2004*

His eagerness to discuss the exciting world of science is redoubled among those who perceive it to be out of their reach. "When I lecture in Turkey, I try to convey the hope that with enough courage and enthusiasm anything is possible. In countries where you still must look outside to find the latest technology, the best books, and the advantages that more affluent economies can deliver, it is easy to get an inferior feeling. I want to give them hope and also some pointers in areas of research. Because if you know what you don't know, then you will seek the answers."

(As a foreign student at the University of Minnesota, Taner dealt with his own insecurities. In one particular instance, Professor Weiss replied with a hearty belly laugh to Taner's polite request for guidance regarding the topic of his thesis. Coming from a country "where professors are half way to the gods," Tury automatically assumed he had committed a grand *faux pas* and uneasily waited to hear its nature. Barely recovered, Weiss explained, "Taner, you sounded like the guy who having finished a correspondence course on how to become an inventor, wrote a letter to the Patent Office requesting a list of things that had yet to be invented.")

Taner became the living example of what he wants students in Turkey and elsewhere to reach for.

Like his father, Mehmet Izzet, before him, Taner has an engineer's mind. He earned a degree in structural engineering in 1950, following which he served in the Turkish armed forces. Then came the life-defining decision to pursue a doctorate in civil engineering abroad. He applied to American instead of nearby European universities simply for the love of jazz. "I thought that if I came to the United States, maybe I would get into the music scene. I wrote to CalTech, MIT, and the University of Minnesota. UM accepted me just before MIT did, so I ended up in St. Paul. As I had hoped, I was fortunate enough to meet Dizzy Gillespie and

other great musical talents … and I quickly gave up the idea that I had any future in music. But every step of the way, however unplanned, seems to have led to a good place."

Taner's innate love of music—popular, classic, jazz—led to radio and public performances in Istanbul that primed the shy youngster, if not for the glittery audiences he once imagined, for the scientific forums he so often addresses. His attraction to American music was also indirectly responsible for meeting Fulton Koehler, his applied mathematics professor at UM, a pivotal figure who "got me into mathematics and applied math and a realization of physical things." Their association would be of enormous consequence to the science and business of geophysics.

After testing the academic waters at Duke, in North Carolina, Taner returned to Minnesota to join Ellerbe & Co. Architects and Engineers. His job was to develop engineering applications on the Bendix G-15 computer, designing earthquake-resistant high-rises, bridges, and highways. Foreseeing a multitude of computer applications beyond structural engineering, Taner contacted Koehler with the proposition that they form a scientific computation service company.

In the summer of 1959, Scientific Computers Inc. was established in St. Paul. Taner remembers the parting words of his boss at the architectural firm: "You keep your customers rich; that's the only way you can get rich." SCI grew, opening offices in New York City, Kansas City, and in the summer of 1962, Houston. This was another one of those steps leading to "a good place."

Top left and counterclockwise: Taner and Fulton Koehler circa 1975. The Seiscom team, standing from left: Scott Kelso, president; Jim Mitchell, former president of Delta Exploration; and Taner; (seated) Fulton Koehler; John Bapp; and Nigel Anstey, senior VP, Europe. Taner and RSI president Richard Cooper.

"It was Jim McGregor, of Robert Ray Geophysical Company (who later became instrumental in developing hardware that connected analog tape read/write to Control Data 1604 computers directly—I developed the NMO application and CDP stacking programs for it), who suggested that perhaps there might be some digital applications in geophysics and that I should go see Burton McCollum, the inventor of many early geophysical exploration techniques. When I met the legendary Dr. McCollum, he asked, 'What do you know about geophysics, young man?'—he was about 75 then and I was 35. 'Nothing, Sir,' I answered. 'Good,' he said, 'we know where we start.' I told him I represented a company that had computers, digital processing, and so forth, and that we may be able to help him solve some problems. One of them, Dr. McCollum explained, was that he had a seven half-cycle sine wave hidden in noise and wondered whether it could be found. I talked to Dr. Koehler about it and he said, 'Yes, we will find a match filter and we'll filter the sine and cosine and sum their squares and it'll come out a peak.' We tested and I went to Dr. McCollum, who looked at it and said 'Good! Where's your contract?'

"Well, in those days, if we had $1000 job we would open a bottle of champagne; that contract was $10 000 a month for research leading to finding signal in noise. That was my introduction to geophysics."

Turhan Taner, the clean slate in matters geophysical, was poised to transform the field.

Unlike SCI, other computer companies failed to see a future in commercial seismic data processing. Only Houston-based Computer Laboratories, headed by A. Scott Kelso, agreed to join forces with the new branch of SCI—just in case there was something to their vision about geophysics. The joint operation was later sold to Control Data Corporation, from whom they had been renting computer time. Kelso, Koehler, and especially Taner grew restless at Control Data; six months into it, one good day Koehler rhetorically asked, "Why don't we solve Stocke's equation and get busy doing some geophysics?" They couldn't wait.

Taner remembers with a smile, "Well, we haven't solved Stocke's problem yet—ignorance is bliss—but at least that made me think about forming a new company to see what we could do. I enjoy doing new things."

In December 1964, the trio founded Seismic Computing Corporation—Seiscom in the vernacular. By mid-1965 they had developed a deconvolution program that competed with GSI's. Still, the team was braced to endure lean times until they developed more seismic data processing techniques. The turning point was the discovery of what many consider to be Taner's crowning contribution to geophysics—velocity spectra. Taner remembers it like this:

"Milo Backus and Bill Schneider gave a paper on the dynamic correlation analysis, that was sort of a velocity analysis using residual moveout. One Friday afternoon, Ray Sanders of Amoco came by Seiscom and we were talking about this technology. GSI was doing thousands of correlations to find the residual moveout. At that time we at Seiscom were studying some MIT papers. One of them, I believe by Wiggins, was one of those that when you see it, the first reaction is, 'why didn't I think of it before?' And I thought, well gee, if we sum the traces and square it we will get cross products in the meantime too, and that led to the ρ (rho) function. Later that function became the semblance, which is the main part of the velocity spectrum. So I thought that instead of doing all those correlations, we could do the scanning with a hyperbolic scan and then compute this ρ function.

"After Ray Sanders left, I stayed at the office and by Sunday afternoon I had the first velocity spectrum. I called Ray saying he'd better come by again before going to the office Monday morning. He did, and he saw that the velocity spectra [well log velocities] matched beautifully. Ray was smoking two cigarettes at the same time, repeating 'I'll be damned, I'll be damned …'. I knew it was something new, but I didn't know the value of it."

After Taner delivered his now classic paper on velocity spectra, there were patents issued on the method—not by the inventor but by oil companies seeking to protect themselves. Taner never took issue. "I'm not for patents; the knowledge is there. The lucky person who discovers uni-

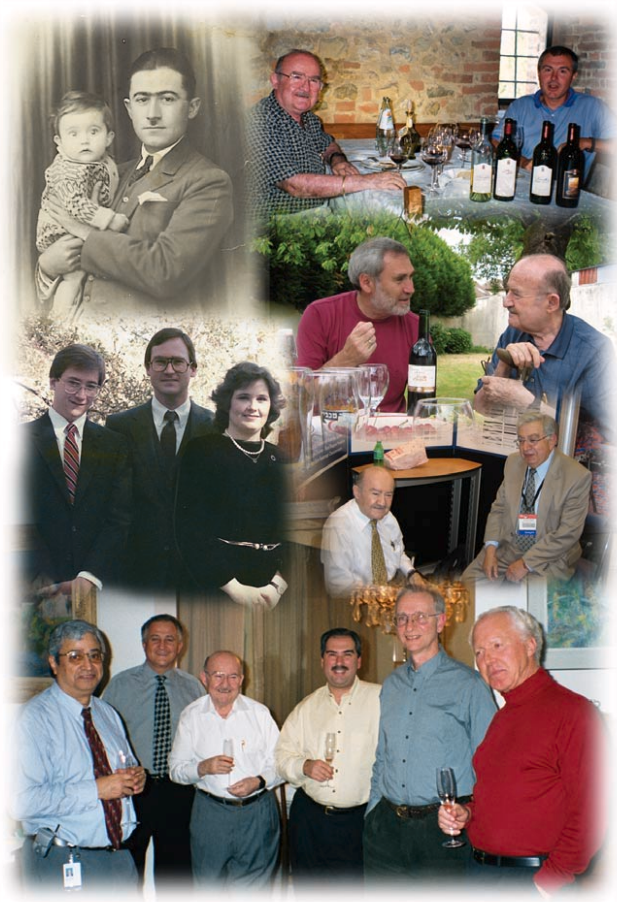
versal physical laws should share the wisdom. We are all just seeking the solution to different problems. And the solution has to be scientific and correct. I agree with myself all day long, but that doesn't mean I'm correct. With Fulton Koehler, for example, when we discussed something, he would always take the other side, and we would discuss the problem until we had gleaned it down to its essence. The same way Richard Uden, VP of R&D at Rock Solid Images, and I do. You only get a perspective by looking from different points of view, and for that you need to discuss matters with your colleagues. Disclosure also keeps you sharper; you can't sit back and let them catch up with you—you have to work harder to stay ahead."

Seiscom took two important steps in 1968: It merged with Delta Exploration Company, which became a wholly owned subsidiary (and part of its name four years later); and it hired Norman Neidell, a Cambridge PhD who had worked with Gulf. Neidell was a natural researcher who according to his boss had "fifteen million things he wanted to tackle!" Neidell, in turn, found that "Tury was and is full of wisdom and always willing—eager I should say—to address any scientific problem, no matter how formidable."

With Taner as senior VP, director of research, and chairman of the board, Seiscom Delta scored numerous technical achievements. In 1973 Taner became chairman emeritus to concentrate on his role as principal researcher because, as he readily admits, "Being an engineer, I'm a team man. I don't want to manage, I want to work with people."

Beginning in 1977, Seiscom Delta made great inroads in the international market collecting and processing geophysical data, quadrupling its net income in only three years, and becoming the world's largest company of its kind, with annual revenues of $200 million. That's when Taner decided that financial success, which he had amply attained, was not enough. He and Koehler left Seiscom Delta and in June 1980 formed Seismic Research Corporation. Their long-time association had and would continue to produce radical results in seismic velocity computation (most obviously the classic GEOPHYSICS paper, "Velocity spectra—digital computer derivation and application of velocity functions"), special band-pass filters, reflection and refraction statics computation methods, high-resolution wave equation migration and velocity analysis for time and depth migration, seismic attributes, plane wave processing and imaging systems, and practical multichannel deconvolution.

Concurrent with his work at SRC, Taner was setting aside 20% of his time for consulting; or so he thought. "I accepted all of the offers and ended up 120% booked. Those were the good old days. Then the 1984-85 crunch hit and the first casualties were the consultants. The United States was in a sad position, so I went to London, where during my time with Seiscom I had established good connections, seeking additional work. Italy's Agip was the first one to ask me for an extensive proposal—including investigation of all processing modules and designing a seismic processing flow for stratigraphic and lithological interpretations objectives. As a second stage of the work, it also included development of new seismic attributes."



Top left and counterclockwise: A seven-month old Tury and his father, 19 November 1927. Taner's sons John and Jeff and daughter Jane. A get-together at Tury's. From left: Luis Canales (Western Geophysical), Rick Chimblo (ex-Aramco), Taner, his son-in-law Chris Harris and Jim Schuelke (both ExxonMobil), and Guus Berkhout (Delft University). With Nafi Toksoz at the SEG booth. Enjoying a Bordeaux with Evgeny Landa in Pau and a Brunello di Montalcino with Alfredo Mazzotti (University of Milano) at Castello Banfi. Advises the connoisseur, "Don't save the good wine for a special occasion. Every moment that we are alive is a cause for celebration; so-called special occasions sometimes pass without our noticing until we realize how special they were years later."

Taner's application of Hilbert transform to generate seismic attributes equals the velocity spectrum in significance to the industry. "Attributes are his attribute," says Tad Ulrych (University of British Columbia); Fred Aminzadeh (DGB-USA) introduced Taner at the 2002 Houston Geophysical Society Spring Workshop on Attributes, as *the Legend Attribute*; and without doubt, today's buzz about attributes is due largely to Taner's continued interest which began in the 1970s.

"Nigel Anstey did the original work on reflection strength and average frequency computation; he invented the attributes," punctuates Taner. "The fact is that before the 1990s, attributes were considered a management tool; you drew pretty pictures to impress them and so forth. But I never saw it that way and wanted to do more."

Taner talked to Agip about the possibility of using attributes for reservoir characterization and they offered financial support. Pleased with the initial results, Agip agreed with Taner's suggestion that the project be expanded into The Attribute Consortium, which was supported by some 25 companies until 2003. It has evolved into the LFP (Lithology and Fluid Prediction), backed by about 15 companies. Since the beginning of the consortium in 1992, Taner has developed a number of physical, geometrical and hybrid attributes, and several supervised and unsupervised neural network modules for reservoir characterization. One of the important joint developments with Sven Treitel was a robust computation method for Q (quality factor) computation and compensation. He also introduced the harmonic attributes using the Gabor-Morlet joint time frequency decomposition. The geophysical industry has benefited from all these developments.

In 1998 SRC joined with Petrosoft and Discovery Bay to create Rock Solid Images, a unique company combining

geophysical, rock physics, and computer technologies for seismic reservoir characterization. Which brings us to the present.

Taner is senior VP and chief geophysicist of Rock Solid Images. His corner office is not showy: A massive desk and slanting towers of paper, journals, and books dwarf the occupant. Jeffrey Taner, the company IT manager, kindly cleared a path and a seat to make his father more accessible to this writer. Taner is content just being a member of his top-notch team. The only bow extended to him—more for being in his seventies than one of the best known exploration geophysicists of our time—is flexible hours. Taner leaves the office at leisure and, in his nearly vintage Mercedes convertible, minnows his way through Houston traffic faster than one would think possible.

At his high-rise apartment he is greeted by Sammy's eager chirps demanding freedom from a large cage set by a panoramic window. Taner obliges. It isn't long before he, cockatiel perched on his shoulder, is at the home workstation. Sammy's contribution to science is singing a little *Carmen* or "Strangers in the Night" while his human companion thinks. But even the energetic bird flies back to his cage and is head-under-wing long before Taner turns in, usually in the small hours. "It's a good thing they don't ask me to punch the clock early at the office," he confides impishly.

Taner's friends—and they are legion—ponder the phenomenon. "Tury continues to amaze and surprise with his intellectual brilliance," extols Panos Kelamis (Saudi Aramco). "He has provided the geophysical industry with solutions that are in production and use in every processing shop. Like a fine Tuscan wine, he is getting better with age."

Sven Treitel (TriDekon), a scientist of Taner's approximate vintage, durability, and fame, marvels no less at the fact that "Tury's scientific creativity has flourished unabated for over five decades. His acute mind shares space with heart-warming human kindness. Not often does one find both these human attributes coexisting under the same roof. So what's his secret?" (One suspects that Treitel can answer his own question, since they are coauthoring several articles covering Backus type of deconvolution and robust method of Q estimation.)

Vision is another one of Taner's attributes. "Tury was doing common image gather flattening before the term CIG was introduced," asserts Evgeny Landa (Opera, Pau University). "Tury wrote his convolution multiple prediction before the Delfi consortium was created. Tury used the high-resolution Radon transform before the academic world realized its potential and started to investigate convergence and amplitude preservation properties. He is always pointing the way ahead. And hundreds of scientists have written hundreds, maybe thousands, of papers trying to explain to the world the mathematically correct way to use Tury's algorithms. And in many cases—due to their enthusiasm, let's hope—they even forgot to give him credit!"

Taner dismisses the to-do: "As long as you can think clearly and draw from years of experience, you can produce. To me work is a hobby, like painting." But because Taner doesn't accept demarcations, a hobby can become just as absorbing, like when he delved into the Impressionists and copied no less than 20 van Goghs "to find his style." The joy of discovery may be, if not the "secret," at least the fuel to Taner's perpetual quest. "Being able to accomplish something is a tremendous joy. Until then your mind is completely given to that problem; it dominates your thoughts night and day, and when you finally find the answer, it's a big relief."

Fame, fortune, scientific accomplishments, and the respect of all—yes all—his colleagues and friends—is this success? According to Taner, "I suppose that if you reach a stage toward your ideals, even if it isn't fully what you were hoping for, that's accomplishment. When I come to the end of my knowledge about something and it feels like I know everything there is to know, that's the time I look at the problem again. It may feel like there is nothing more to do, but the truth is there is no end to knowledge. When you see the end, the nature is that there is much more beyond that. So we can credit ourselves for reaching stages, but the ideal goal is only in our minds."

Receiving the Maurice Ewing Gold Medal from SEG president Marion Bone; Bob Graebner in the background (top). At the EAGE awards ceremony in Paris, Landa, Mecheraoui, Taner, and Kelamis.

Taner is now trying to simulate human hearing perception. He presented this intriguing subject at the recent EAGE conference in a paper entitled "Listening to the waves—A proposal for reflection response detection by joint time-frequency analysis and trained neural networks." Taner explains:

"When sound gets into the spiral-shaped cochlea, it is divided into different frequencies and that goes to the brain which does the perception—recognizes voices, etc. That division of sound into different frequencies is a new technique called joint time-frequency analysis. It was developed by Gabor some time ago and Morlet rejuvenated it and developed it in octave domain to keep the wavelet shape constant. From there on it has expanded quite a bit. What it does is it takes the seismic data and it instantaneously divides it into different frequencies in time, just like the ear. So I'm taking that instantaneous spectrum and putting it into a neural network to classify it. That's why I'm listening to the waves, by simulating human hearing perception. It's a reservoir characterization sort of thing. Sven Treitel, a great scientist, is a coauthor, and in fact, it was Sven's classic paper that got me interested in deconvolution a long time ago."

Taner is also working on a robust way to calculate attenuation where the well log and seismic data don't agree. He is trying to develop a nonlinear principal-component analysis (he writes his own neural networks). With Landa he is working on the scattered imaging of fractures and folds; with Guus Berkhout (Technical University of Delft) on a new statics computation method; with Kelamis (Saudi Aramco) and Josef Paffenholz (Fairfield) on a generalized Radon transform; with Derecke Palmer (University of New South Wales) on imaging with refracted waves; and with Orhan Yilmaz (Paradigm)

on ray tracing by Huygens principle. Let's not forget that as chief geophysicist at Rock Solid Images, he is working on various attribute computations, and determinations of optimum attribute selection with neural network—in addition to various other reservoir characterization related routines. And at the upcoming SEG Annual Meeting in Denver, Taner will present his paper on hearing perception and an invited talk at the "Recent Advances and The Road Ahead" special session. It looks like Sammy the cockatiel has a lot of singing to do late into the nights to come.

Taner's monumental body of work to date has earned him Honorary Memberships from SEG (1978), Geophysical Society of Houston (1979), and EAGE (1999); Honorary Doctor of Science degree (1991) from the Technical University of Istanbul; Technological Achievement Award (1995) from Italy's ENI-Agip; and now the EAGE's Erasmus Gold Medal. He is also a member of the Turkish Chamber of Geophysical Engineers, Institute of Electronic and Electrical Engineers, Canadian Society of Exploration Geophysicists, and American Association of Petroleum Geologists.

When Taner received SEG's Maurice Ewing Gold Medal (1993), Oz Yilmaz (Anatolian Geophysical) condensed the extent of his compatriot's pioneering contributions in a dizzying one-page citation (*TLE*, February 1994), which is obligatory reading for Taner fans. Having done so and in awe, like everyone else, of Taner's "unrivalled band-width and depth-width of understanding of the seismic method," what Yilmaz most admires is "his analytic ability to dissect the problems into segments and develop a solution in meticulous detail while describing the problem and the solution without getting you overwhelmed by the details."

Once again, the educator side of Taner comes to the fore.

"Most of the time people will understand geometrical things. Mathematics is another language describing the same thing. Dr. Koeler was one of those who could understand the abstract, mathematical things. If I drew a picture, he couldn't visualize it; but if I developed an equation for it, he could understand more than I could explain to him, and then tell me about it. For that reason I try to explain things in two different ways, physical or geometrical, and with equations. This way you catch one or the other."

Taner is a proponent of balance: To be considerate of others but not miss too many chances to reward himself; to teach the teachers and also teach tunes to his pet bird; to transform an industry and deal as an equal with someone who never could; to forge warm friendships the world over, and consider Jeff, Jane, and John, his own children, his very best friends.

Under the banner that *life is too short to compromise on things*, Taner's quiet exuberance seeks to "enjoy every moment." And what better representation of Tanerian Zen that the many hours he once spent in a police station watching consecutive functionaries read each of five carbon copies of a visa application he knew he didn't need, but was made to obtain anyway, while he, far from losing patience, bemusedly thought what a great story it would make in the years to come.

Again, all is One—every experience a chance to learn and enjoy.

Geophysicists from all over the world could contribute anecdotes and encomium to a profile on Tury Taner; Tad Ulrych's is representative. "It is difficult to really do justice to that leap of Tury's imagination that envisaged how to transform, map, and understand seismic sections in a new way. Coupled with his wonderful intuitive originality is a personality that inspires. Tury defines the phrase 'a gentleman and a scholar.' He is special. We all admire Tury, envy his gifts in a gentle way, respect him deeply and cherish and love him. In fact, I can think of no one else in our community who can be dressed in these words."

What else can be said? TLE