

Paul Erdos, the World's Most Beloved Mathematical Genius "Leaves"

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One of the most remarkable minds of our time, Paul Erdos, "the Albert Einstein of twentieth century mathematics," died on September 20, 1996, in Warsaw. Or to use Erdos' own language he "left" at the age of 83. He may have died, but he left his legacy, and the legend goes on forever.

First Encounter

I was 14 years old and solving some math problems. My father knew I was a budding genius and wanted to share the glory with others. We heard about another young genius, Paul Erdos, 17 years old, and my father called Erdos' father and they decided that Erdos should visit me. (An aside: It was not the custom in Hungary to call men by their first name. We always called each other by family name.)

My father had one of the top shoe shops in Budapest and I was sitting at the back of the shop. Erdos knocked at the door and entered. "Give me a four digit number," he said. "2,532," I replied.

"The square of it is 6,411,024. Sorry, I am getting old and cannot tell you the cube," said he. (During his entire life, even in youth, he referred to his old age, his old bones.)

"How many proofs of the Pythagorean Theorem do you know?" "One," I said. "I know 37. Did you know that the points of a straight line do not form a denumerable set?" He proceeded to show me Cantor's proof of using the diagonal. "I must run," and he left.

Kathy, the sales woman in the store, asked me who the weirdo was. I was embarrassed and asked why. "I have never met anyone who knocked at the door of a store before entering."

An aside: when he said must run, the statement was literally true, because he never walked but cantered a weird gait. People turned around to stare at him on the sidewalk, and I was always embarrassed to walk or skate with him. Both of us were avid skaters. I, because that was the way I met girls, he because he liked skating. I was always embarrassed because the girls asked who was the gorilla I was skating with.

Starting at our first encounter, Erdos has been a steady inspiration to me to do math. When later I hesitated whether to stay a mathematician or go to the Technical University and become an engineer: "I'll hide, and when you enter the

gate of the Technical University, I will shoot you," said Erdos. This settled the issue.

The Golden Age of Hungarian Mathematics

Around the turn of the century a group of male aliens invaded the earth, a world to be considered for colonization. Due to the well known beauty of Hungarian women, the aliens established their base at Budapest. After a year or so they decided that the Earth was not worth colonizing, and left. But later an unusual group of very talented people were born. Erdos was born in 1913.

Paul Erdos' life was unprecedented. He was completely dedicated to mathematics and mathematicians, and he published about 1,500 articles, most of them jointly. Both his mother and father were math teachers. A friend posed to Erdos : "What is 100 less 250?" He replied instantly: "150 below zero." The less than four-year-old math genius had already discovered negative numbers.

There is a way to sequence mathematicians. The highest level mathematician has an Erdos number One. It means you wrote a joint paper with Erdos. If you never wrote a paper with Erdos, but wrote a paper jointly with an with an Erdos number One mathematician, then your Erdos number is Two. And so on, Three, Four, and Five. It is reported that every real mathematician has an Erdos number less than or equal to Five. Albert Einstein's Erdos number was Two; My Erdos number is One. Here is the story.

I was doing research, in 1936, in Budapest, on a classical graph theorem, the Koenigsberg theorem of Euler, and managed to extend the theorem to infinite graphs. I had only the necessary but not the sufficient condition. I used to meet with Erdos practically daily and made the fatal error of telling Erdos on the phone about my discovery. I say fatal because he called me back in 20 minutes and told me the proof of sufficient condition. "Damn it," I thought, "now I have to write a joint paper with him." Little did I know the fame Erdos number One would bring me.

While still at the University, Erdos claimed he proved the Chebyshev theorem, that there is a prime number between any number and its double, between A and $2x_A$. But nobody could understand his proof, and mathematicians disclaimed his claim. Laszlo Kalmar of the University of Szeged, at the urging of Erdos' father, offered to take a day off and try to read Erdos' mind. By 3:00 PM Kalmar was convinced. He himself wrote the paper for Erdos, and Erdos' fame was established.

I don't think Erdos himself actually wrote many papers. His handwriting was abominable -- readable, but childlike, as shown in Exhibit 1.

Here is the story to the Exhibit. One day, Erdos got reckless and told Laura, my wife, that he will prove to her the Pythagorean “scandal,” that the square root of 2 is irrational. (According to legend, the disciple of Pythagoras, who revealed the secret to laymen, was put to death.) He started with an almost blank sheet and started the proof (Exhibit 1). “Laura, if you do not understand a step, let me know, so I will clarify the proof,” he said. Let us assume that the square root of 2 is rational, that is it equals a/b , where a and b are whole numbers. “OK?,” Laura agreed. Then he went down, step-by-step and reached a contradiction. “See, the assumption is wrong, the square root of 2 cannot be rational.”

But Laura did not like the proof. Erdos got annoyed. “I asked you to tell me at every step if you don’t understand something. You said nothing.”

“Why didn’t you tell me at the beginning that this is all wrong?” said Laura. Erdos flipped his top.

I recalled that when Albert Einstein gave one of his last talks, at the end they unscrewed the black board and sent it to the Smithsonian. So I asked Erdos to certify the document, so I could keep it for history. He signed his name and p g o m a. d, signifying Poor Great Old Man Archeological Discovery. At age 70 he started to use LD for Legally Dead, and at 75 CD for Count Dead, for reasons unknown to me.

The Language of Erdos

During the Horthy dictatorship in Hungary there were spies lurking everywhere. So Erdos developed his own private language, which later became accepted by the universal club of mathematicians. The US was always Uncle Sam, so the USSR became Uncle Joe, after Joe Stalin. He was very fond of children and many years later Erdos told a tale to my daughter, Bobbi. “Sam and Joe went up the hill to fetch a pail of water.” But Bobbi said “Not so, Erdos, it was Jack and Jill.”

In the Erdos dialect, communists were on the “long wave length”, because that is the wave length of the color red. In Hungary, wives referred to their husbands as “My boss.” Erdos inverted the term, and wives were “bosses” in the international community of mathematicians. Husbands were “slaves.” Giving a math lecture was “preaching”.

Children were epsilons, because small quantities in math are often designated by the Greek letter epsilon. When you make a general estimate of a quantity you use the word ordo. One of the worst bridge players in Manchester was the mathematician Mahler. So when somebody performed very poorly, Erdos said he performed “ordo Mahler, OM”.

God was referred to as the SF (Supreme Fascist). Any alcoholic beverage was “poison,” “Give me an epsilon of poison,” he used to say, meaning a small amount. Classical music was “noise”. He could not live without it. He was particularly fond of the baroque, like Bach, Vivaldi, Boccherini.

When in the middle school in Hungary, we all solved problems for the Matematikai es Fizikai Lapok (MFL), the journal posing all sorts of mathematical problems. In addition to problems, every issue presented the “model” solutions to problems posed in earlier issues. This solution was written either by the editor, Andor Farago, or the student who found the “model” solution. We all waiting eagerly for the appearance of MFL and to see our names printed as students who correctly solved the problem. Or for the honor of having the “model” solution. Erdos referred to the 1933-34 volume as the Vazsonyi volume because I had a record of 15 “model” solutions.

The late Tibor Gallai, a mathematician, told me that Erdos extended the model of MFL to include all mathematicians and all fields of mathematics. He became the world’s greatest problem solver and problem poser. Farago was replaced by the SF (God) who had the “Big Book” with the “model” solutions to all conceivable mathematical problems. The greatest compliment Erdos could pay to a mathematician was, “Your proof is straight from the Big Book.”

According to Erdos a mathematician who stopped doing math was dead: he died a most ignominious death. I was a victim of World War II so Erdos forgave me. “Those were difficult times,” he said. But in 1960 I proved a very difficult theorem in geometry and Erdos told Laura, “Strange, Vazsonyi is dead, but never lost the touch. Yesterday he found a proof straight from the Big Book.”

His special language was contagious. So when Mahler wanted to use a derogatory term, he said “He is OM,” (meaning ordo Mahler) without having the faintest idea that he was referring to himself. When later he was told what OM meant, he just laughed it off.

He often played with the English language by pronouncing words using Hungarian phonetics. The sounds for a, e, i, o, u, are always pronounced (roughly) as the vowels in father, bet, tip, coin, and rule. I was astounded once visiting Erdos to find that all the mathematicians: Americans, English, Japanese, or what not, used this very weird sounding language.

Working Habits

Erdos never had an office, or a desk, but his mind worked on math all the time. You are eating lunch with him, and suddenly he jumps up, runs toward the wall. Is he going to smash his head? No! He miraculously stops within one inch of the wall. (Unfortunately, once, for a short time, he developed some trouble with his body control and did run into the wall.)

Using computer lingo, the mind of the mathematician works in the background, while in the foreground he/she is communicating with the world. An uncle of mine thought I was plain lazy. I sat frozen for hours, doing nothing. But suddenly, he said, I took a little piece of paper and made some notes. Then he realized I was “working”.

Erdos worked all the time. Often there were outward signs. Like once when we were frolicking on the sand in Laguna Beach. I'll always remember the image of Erdos sitting on a rock, holding an umbrella against the sun, in the left hand, and reading a math journal in the right hand.

When he had a grant at the Institute of Advanced Study in Princeton (the home of Albert Einstein) he was criticized because he never “worked”. He was either talking to other mathematicians or playing GO, his favorite game, yet he published more (joint) papers than the rest of the grantees together.

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During World War II, an article appeared in the New York Times: “The three most intelligent spies ever arrested by the FBI.” Those days there was hysteria about the Japanese invasion, and the seashore was off limits. Erdos, Kakutani and a Britisher were taking time off from the Institute of Advanced Study, Princeton, and were walking on the seashore in New Jersey. Naturally they ignored all warning signs. Neighbors got concerned about the suspicious characters and called the FBI. One character was “a Hungarian of strange appearance.” The second was “a registered foreign agent of the Imperial Japanese Government.” (Kakutani was a professor of math in Tokyo, a government agency.) They asked Erdos why he did not obey the signs. “You see,” he said, “I could not read any of the signs because I was sinking about masemathical seorems.” They were hauled into town, the FBI called the Institute, and were enlightened about the life style of mathematicians. They were released with apologies, but it was too late for the New York Times.

During World War II, in August 1941, an article appeared in a New York City tabloid: “The three most intelligent spies ever arrested by the FBI.” Those days there was hysteria about the Japanese invasion, and the seashore was off limits. Erdos, Kakutani and Arthur Stone were taking time off from the Institute of Advanced Study, Princeton, and were walking on the seashore in New Jersey. Naturally they ignored all warning signs. Neighbors got concerned about the suspicious characters and called the FBI. One character was “a Hungarian of strange appearance.” The second was “a registered foreign agent of the Imperial Japanese Government.” (Kakutani was a professor of math in Tokyo, a government agency.) They asked Erdos why he did not obey the signs. “You see,” he said, “I could not read any of the signs because I was sinking about masemathical seorems.” They were hauled into town, the FBI called the Institute, and were enlightened about the life style of mathematicians. They were released with apologies, but it was too late for the release in the New York newspaper.

Some time ago, while in Germany, he ran up a hill, and had a mild heart attack, which he did not even notice. Having returned to Budapest, as he felt unwell, he was examined and the problem was discovered. One of the doctors, Erzsi Forgo (the wife of Feri Forgo, a management scientist) told me he was the most aggravating patient they ever had. He would accept no advice. All that interested him was mathematics. He would take no time off to take care of his health. Later, when cataracts severely curtailed his vision, and he could not return to Ping-Pong, his favorite game, he still refused to have the cataracts removed: no time for that. Neither did he take time for rest: "There will be plenty of chance for that when I leave".

Incidentally, his Ping-Pong style was terrible. On the other hand Paul Turan's style, his life-time math collaborator has a terrific style. But Erdos' reflexes were so fast that he returned all balls. Finally Turan got tired, made a mistake and Erdos won.

In spite of his total devotion, to math he always found time to visit friends. We were in London at my hotel and Erdos said, "We must go and see so-and-so. We got into a cab and went to the other end of London. Upon arrival he opened with his standard gambit: "What are you doing?" meaning what math problem was he working on. His friend told him. After five minutes or so Erdos said, "We must go," and we did.

Also he always found time to talk and play with children. He never failed to stop when he encountered a mother with a baby, or young child, and ask the bewildered mother, "How old is the epsilon?" (the child).

His reflexes were extraordinarily fast. A frequent open gambit was to show a child that he could hold a quarter and catch it when falling. "Can you do it?"

The Lilies of the Field

Consider the lilies of the field, how they grow; they toil not, neither do they spin. And yet I say unto you, That even Solomon in all his glory was not arrayed like one of these.

MATTHEW VI, 28-29, C.75

Many years later, but before he had worldwide recognition as a genius, I received a letter from Erdos' mother. "What is to become of my son?" I replied, explaining that the ordinary rules of life do not apply to a genius. "What is he going to do for money?" she asked. "He will manage somehow. Anyway, he has unlimited credit with his friends," I replied.

Erdos never had a job, a home, a girl friend, a family, earthly possessions, checking account, credit card, automobile. He traveled continuously, and had all his possessions in two suitcases. But he had friends, thousands of them. We loved him, we would gladly do anything for him, and we took care of him.

He was helpless from the beginning. He had two sisters who died young from scarlet fever and this had a traumatic effect on his mother. She protected her only son neurotically, beyond any reason. Particularly from women. (Esther Szekeres and Josephine Bruning form a separate story.) There were legends going around about the measures she took. His parents did not send him to public school; they protected him from lurking dangers; they attended to his education themselves.

He was the youngest Hungarian Ph.D. in math, (I was the second) and after he got his Ph.D., he received a grant of 50 pounds from Prof. Mordell of Manchester, England. This was the first time he left his mother. Mrs. Mordell was dismayed to find that Erdos asked her to cut the meat and make toast and butter it for him, since he did not know how. As time went on, he learned a few fundamentals, but relied on friends to do the simplest tasks. One day I was having breakfast with him and he could not open the little container with cream. So I opened it for him. Next day he did not even try. - He just handed it over for me to open.

When Erdos arrived for a visit, Laura, as all wives, welcomed him, and did all the sewing, mending, laundering, ironing, necessary to ordinary human beings. "Laura, I have a missing button in the front of my pants. Please sew it back," he said. "Aren't you going to take it off?" Laura asked. He was astounded. "You don't want me to go around without my pants?." "Okay," says Laura. But hold out your pants so the needle will not go into your stomach." Of course, the red silk underwear appeared. Because of his sensitive skin, all his underwear and shirts were silk.

"Laura, please cut these pills in two," he says. Laura used a pill cutter to Erdos' absolute amazement.

"Here is your jacket fresh from the cleaner's," Laura said. "How much do I owe you?" asked Erdos. "You don't owe me anything, Erdos", she replied. With that he starts to leave, but returns saying "Yes, Laura I do owe you something, I owe you thanks." He expected, but also appreciated all this attention to trivial matters.

Erdos was an early riser, and even though he had been told where to find milk, bread, cereal, the toaster, in case he got hungry, he waited for Laura. She gave him his toast, choice of cereal with brown sugar, raisins, nuts, and jam, and an egg, however he wished, and sat down with him.

When he visited me the last time in Santa Rosa, CA, he asked me to take him to a travel agent, to purchase a ticket to London, and pay for it. "Graham vissza fogja neked fizetni," (Graham will pay you back), "Vazsonyi," he said. I did get the check within three days.

Ron Graham, Director of Mathematical Research, AT&T and Bell, the mathematician (and master of the trampoline) who wrote 26 joint papers with Erdos, took care of all administrative matters for Erdos. Graham has an "Erdos room" in his house, where all matters pertaining to Erdos are stored.

Some years after World War II, in 1964, his mother joined him, and from then on she resumed her attitude of protection.

They came to see us at Manhattan Beach, CA and we decided to take a walk on the esplanade by the seashore. We were several hundreds of feet away from the waves, and perhaps 50 feet above. She was concerned that Erdos would be washed away by the waves.

That same visit he got lost on the straight line path on the esplanade, (totally incomprehensible to me), but knocked on the door and a good Samaritan lady who allowed him to call me on the phone. "Go to the esplanade, and I will wave to you," I said. And so he found his way home, to the great relief of his mother.

We rented a fine suite for them in Westwood but his mother was totally dissatisfied with the place. "It is too dusty," she said. Erdos asked the desk to put a cot for him in the bedroom, and her objections evaporated.

The fact was they were inseparable. No mother has been loved more by a son than Erdos' mother. She died during one of his lecture tours in Calgary, Canada at the age of 93. "They misdiagnosed her; she should have lived longer," Erdos said. "Strange," Erdos said, "I was always concerned when flying on a plane. But after my mother died, I lost my fear." "You look depressed," a friend remarked once. "Well, you know my mother died," said Erdos. "But that was five years ago," the friend observed. "I still miss her," Erdos responded.

Outward Appearances

He regarded all appearance as "trivial". The word in math refers to obvious theorems. Erdos extended the meaning of the word to all useless, nasty beings or things. When Laura asked Erdos what was the bundle in the corner, he said that those were just trivial things, his other pair of pants.

I was walking with him on a winter day in Philadelphia. The lining of his overcoat was sweeping the snow on the sidewalk. "Erdos, you should pay more

attention to your apparel.” He looked back and said: “Vazsonyi, your powers of observation are remarkable.”

“What is this hole in your lapel?” I asked. “I don’t get it,” he replied, “I bought this jacket and there was a tag on the lapel. I did not need it, so I cut it out.”

He always wore sandals, because no shoes would ever fit his weirdly shaped feet. Well, not always, only after he left Budapest. Prior to that he wore shoes tailor-made by my father’s shop. They made wooden lasts of both feet, over which they shaped his shoes.

A Visit by Erdos

Being visited by Erdos was always a trial. Three days prior to his arrival the phone starts to ring. I get out of bed at midnight. A voice with heavy accent says: “I am calling from Berlin. I want to talk to Erdos.” “He is not here yet.” “Where is he?” “I don’t know.” “Why don’t you?” Click.

When Erdos arrived you had no life of your own. Of course, he did not drive, and you willingly became his private chauffeur. Once in Rochester he demanded I to take him to the University at 10:00 AM. I told him I could not do so because I would be “preaching” from 9:00 to 11:00. “No problem.” Delete: **He called the Arthur Stone, Head of the Math department and said: “This is Erdos, please pick me up at 10:00 AM at Vazsonyi’s”. And he did.**

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He called Arthur Stone, Head of the Math department, one of the “The three most intelligent spies ever arrested by the FBI,” and said: “This is Erdos, please pick me up at 10:00 AM at Vazsonyi’s”. And Stone did.

Professor Szego of Stanford fame gave a party and Mrs. Szego came to me practically in tears. “Erdos dropped in three weeks ago and he is still staying with us. I am at the end of my wits.” “No problem,” I said, “tell him to get out.” “I could not do that. We love him, and could not insult him.” “Do what I say. He will not be insulted at all.” An hour later he came to me and asked me to take him to a motel, where he would stay. I played dumb and asked him what happened. “Oh, Mrs. Szego asked me to move out because I stayed long enough,” he said nonchalantly, totally undisturbed.

When he came to stay he told me to put on the radio to have some noise, that is classical music. Then he walked around, made phone calls, etc. but the constant music drove me nuts. So I ran down to Radio Shack and bought a headset. It was a good investment to keep my sanity.

His visits were not necessarily announced. I was sleeping early one Sunday morning in Jeanette, Pennsylvania, when I heard a terrible racket on our

door downstairs. Damn it, the newspaper boy is giving me trouble again with the Sunday paper. So I lean out the window to give him hell, and behold, it is Erdos banging on the door. "Why didn't you call me on the phone?" I asked. "Why would I do that?" he said.

One hot evening he appeared in my apartment in Cambridge, Mass., the sweat rolling down his nose. "Impossible to sleep in my attic room in the viscous heat." We had no extra bedroom so Laura made up the sofa in the living room. He liked to use Cologne, but spilled it over our coffee table, and messed it up permanently.

During his last visit I had trouble understanding him. He had a strong accent and my hearing wasn't too good. I overheard him on the phone talking to a friend. "Vazsonyi? He is alright, old and deaf." But he changed his opinion talking to Laura. "There is nothing wrong with Vazsonyi's ears, the problem is between his ears."

Hodgepodge

Caring for others, a feature not generally shared by many scientists, was essential for Erdos. He never passed a beggar without giving him/her some money. He was most generous with all, but in particular with mathematicians, and set up grants for needy mathematicians. When he "preached" he announced conjectures and offered prizes, sometimes as high as \$10,000, for the first to prove or disprove his conjectures, . There is a story that he gave a lecture in Tel Aviv and next morning there was a line forming of mathematicians claiming their winnings.

The sum total of his promised grants ran into many thousands of dollars. He was asked by a newspaper reporter, what if all the conjectures were solved at the same time. "You see," he said, "This is like a bank. What if all the depositors came in the same morning claiming their money."

Erdos had a heart of gold and frequently collected donations for good causes. One day some "vicious" friend made an offer to him. Knowing his embarrassment with naked women they offered him a \$100 donation, provided he would go with them to a burlesque show. To the amazement of all, Erdos, took up the offer. After leaving the theater they paid him and Erdos said with a grin, "See, you trivial things, I tricked you. I took off my glasses and did not see a thing."

Erdos was very interested in many things outside of math, and particularly in politics. During the China civil war he collected donations for the needy communists. Talking about communists, many years ago he wanted to go for a visit to Europe and asked for a reentry permit, because he never became an American citizen. They asked him whether he was a communist, and he said it depended on what they meant by being a communist. His reentry permit was

denied and he stayed away from Uncle Sam for many years. He also had a feud with the Hungarian communist government, because they refused visas to some Israeli citizens, who wanted to attend a math meeting in his honor. He stayed away from Hungary and the States for many years, until they mended their ways.

Obituary

“Pusztulunk, veszünk,” Erdos used to say in his phone calls, quoting the Hungarian bard. He meant that all mathematicians, all of us, are slowly leaving, one after the other. He always had a list of the ones who “left” since his last call. Now we, ourselves, must add his name to the list.

True to his life style, he spent his last day at a math conference, dined with mathematicians, in good spirits, as always. His last joke was: “A doctor a day keeps the apples away.” But no more postcards and phone calls beginning with the standard “Itt vagyok,” (“I am here,”) from him! He, the greatest of all, finally left.

Since his death on September 20, 1996, I have had many phone calls and e-mail. Probably there has never been, and perhaps never will be, a mathematical genius, nay magician, loved by so many, and missed by so many. The list of mourners would fill a volume.

Why did the SF do this to us? We will never know nor recover from the loss.