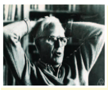
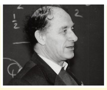
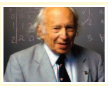
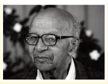
ICM 2010
HYDERABAD • INDIA

REFLEXIONS

The daily newsletter of ICM 2010

August 23, 2010

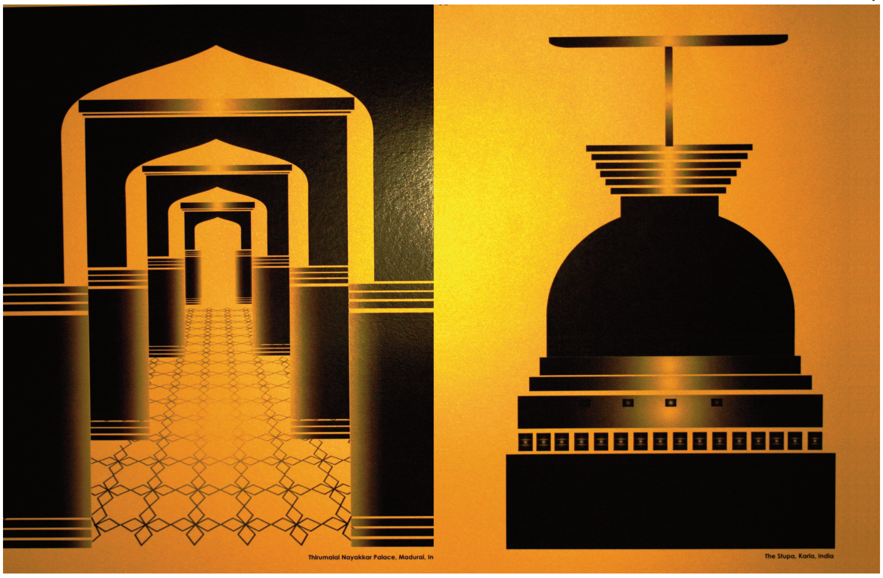






In Remembrance... 2, 3, 4

Traditions of Counting and Measurement

Photo: Rahul V Pisharody



Geometric forms in Indian architecture — Concept: Koumudi Patil

Oral societies have invested tremendous effort and ingenuity in devising mnemonic techniques to memorise, preserve and transmit to future generations their rich bodies of knowledge. Shlokas, mantras and sutras rendered through elaborate rhythmic patterns were all means to ensure that the rich knowledge of such societies was made memorable for posterity. Moreover, verse and rhyme, which help in memorising long pieces of complicated information, have been woven creatively with the empirical observations and philosophical moorings of oral civilizations (Rampal, 1992). Voluminous bodies of early scientific texts exist in purely oral form, composed and recited through the use of complex techniques. However, such poems, narratives, riddles, games and songs exist not in the repertoire of classical oral literature, meant for the limited consumption of the 'learned' elite, but more in the folklore of ordinary people. We found that older generations living in villages savour and enjoy this rich repertoire of folklore received through their ancient traditions of orality.

We noted that a large repertoire of poetic riddles, puzzles and stories about numbers exist in the folklore of different regions of the country, which are often non-trivial to solve, even with written algorithms. However, people enjoy enumerating these and try to give answers more through familiarity, using often intuitive and empirical strategies of finding solutions.

For instance, in one oral riddle a sparrow from a flock flying overhead calls out to one sitting on a tree and says: "We are not yet a hundred strong. We, a similar flock like us, one half of that, a half of that again, and you together will make one hundred". In order to calculate how many were flying in the flock, we would require an equation of the kind: $n + n + n/2 + n/4 + 1 = 100$ which yields the answer as $n = 36$. However, it would be more interesting to see how people attempt to solve this orally. Similarly, there is another popular riddle that is used as part of an oral story, but which is not as simple to solve:

If counted in pairs, one will remain,
If counted in threes, two will remain,
If counted in fours, three will remain,
If counted in fives, four will remain,
If counted in sevens, nothing remains.
(One hundred and nineteen)

A poetic riddle, based on a rhythmic play of words and sounds, meant to tease and challenge the minds of learners, is indeed a potent tool used by traditional oral societies to develop their faculties of creative thinking and imagination. Even today numerous such gems, amazing in their philosophical, lyrical or mathematical content, can still be found being recited by the older members of rural societies. Unfortunately, children today, especially those who are schooled, no longer know these riddles or poems, and are systematically losing their folk knowledge.

We also conducted studies of how people perform oral arithmetic while transacting different objects as part of their daily life activities. In different studies of street mathematics it has been observed that people who depend on oral arithmetic make very few errors and have efficient ways to prevent straying far from the correct results. Detailed studies, comparing the strategies used by the same children first while selling their wares in street markets and later using written mathematics, were conducted for almost a decade in Brazil under a research program of the Universidade Federal de Pernambuco, Recife. (Nunes et al, 1993). Some of our own investigations (Rampal et al, 1998, 2000) were greatly influenced by the approach of the Brazilian studies. We shall, however, not elaborate on our work on street mathematics here, but shall focus more on techniques related to measurement and estimation.

In addition to market transactions, counting and sorting is done by people participating in specific production processes, through which they also acquire the ability to make very accurate estimations. Estimations form the basis of all measurements, and there is normally a consensus as to which type of unit it to be used for measuring what and when. Even though people use a variety of units for different situations, they may not know how to convert from one type to another. This may be true of us too, who may not easily estimate heights of persons in the metric system, though for cloth or distances we might have been using standard metric units.

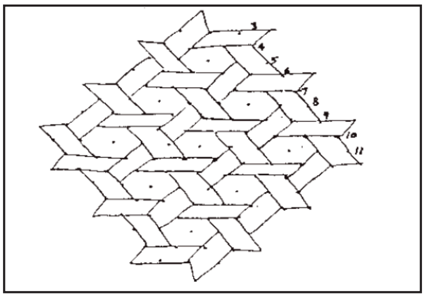
A beautiful old poem in Tamil illustrates an amazingly wide range of length measures from the atomic to an astronomical scale, through the use of rich life-world imagery. Though the English translation cannot.....

Continued on Page 2

...continued from page 1
possibly match the sense of rhyme and sounds of the original, it is still worth giving an extract here.

8 atoms = 1 speck in the sun's ray
8 specks in the sun's ray = 1 speck of cotton dust
8 cotton specks = 1 hair point tip
8 hair tips = 1 small sand particle
8 sand particles = 1 small mustard seed
8 small mustard seeds = 1 sesame seed
8 sesame seeds = 1 paddy seed
8 paddy seeds = 1 finger width
12 finger widths = 1 span
2 spans = 1 cubit
12 cubits = 1 stick (kol)
500 'kols' = 1 'kooppidu dooram' (calling distance)
4 'kooppidu doorams' = 1 'kaadam' (about 1.2 kms)
and so on…..

The measure 'kooppidu dooram' or 'calling distance' is known to have been used as a traditional measure in many early metrological systems. This suggests that folk and empirical knowledge acknowledged that sound travels only a finite distance and that different frequencies attenuate at different distances. In fact, the Saharan nomads developed an elaborate system of distance measurement, where the carrying distance of the human voice was distinguished from that for various



The art of 'kolam' decoration in South India

other animals, to give rise to different comparative units.

Historically, the earliest stage in the development of metrological concepts is 'anthropomorphic', in which most measures actually correspond to parts of the human body. Thus throughout the world there have been measures such as the foot (say, to mark distances while sowing potatoes), the pace, or the elbow or 'ell' (to measure cloth, etc.). Moreover, as has been pointed out in the context of old Slavonic measures, the peasant fisherman would refer to his net as being '30 fathoms long and 20 ells wide', thus choosing different convenient measures for the length and the width.

Similarly, the Saharan nomads, for whom the distances between one water hole and another was often a matter of life and death, have developed a rich system of measures for long distances. Thus, they reckon distances in terms of a stick's throw or a bowshot, or the carrying distance of voice (either human or animal). Distance is also measured as what can be seen from the ground level, by a person standing or from a camel's back. There are various units for 'walking distances', as that covered by humans walking from sunrise to sunset, which is further differentiated into a man's walking distance without a load to carry, or with a laden ass, etc.

Scholars have argued that traditional measures were not only more functional but were also technically sound for comparative purposes. For instance, for land measurement the hectare normally does not provide a directly 'addable' measure, owing to the unequal quality of soils. The value of land depends upon many other parameters. Thus mechanically adding hectares is not technically correct, since every hectare is not 'equal' to another. The traditional measures, based on qualitative factors, such as the labour-time needed to till the land, or the amount of seed required for sowing a given crop, presented a more realistic value of a given piece of land. Interestingly, such forms of measurement are widely prevalent in India even today, and coexist with the new standard systems.

Anita Rampal
Professor, Department of Education, Universty of Delhi

Extracted from `*Counting on Everyday Mathematics*' in Cross-cultural Perspectives in Human Development: Theory, Research and Practice. (2003)

OBITUARIES

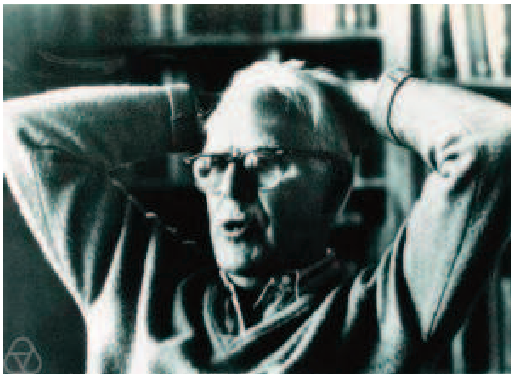
I play all the time and am fortunate enough to get paid for it

Gardner was not a mathematician in the strict sense of the term. He was a graduate in philosophy, and was a free-lance writer. He had an uncanny ability to develop mathematical puzzles, and this made him an iconic figure in the field of mathematics. He is well known for his column Mathematical Games in Scientific American, which he contributed from 1956 to 1981. Through his puzzles, he popularised diverse mathematical concepts, such as flexagons, soma cubes, Penrose tiling and fractals among even non-mathematicians.

Gardner was born in Tulsa, Oklahoma, and lived for most of his life in New York. After schooling in Tulsa, he studied in the University of Chicago. As a child he had a love for magic and tricks and this remained with him throughout his life. After serving in the US Navy during World War II, he went back to study in the University of Chicago, but was unable to complete his graduate studies. He worked as a journalist, writing for periodicals such as Esquire, The Tulsa Tribune and the Humpty-Dumpty Magazine for Little Children, for which he used to contribute cut-and-fold games.

He became an expert in this, and he wrote a piece on flexagons for Scientific American in 1956. He was immediately invited to contribute a regular column for the journal – this was how Mathematical Games began. The column not only inspired budding mathematicians, but also impressed many great intellectuals of the day – Roger Penrose, John. H. Conway, M. C. Escher and Stephen Jay Gould to name a few.

Apart from recreational mathematics, Gardner was an author of fiction, poetry and literary criticism. He was also actively involved in 'exposing' pseudoscience – he was strongly opposed to ideas such as creationism (though he was a theist), belief in the existence of flying saucers and the practice of astrology. He was a founding member of the Committee for Scienific Investigation of Claims of the Paranormal, and authored the column, Notes of a Fringe-watcher, for the organization's periodical, Skeptical Inquirer. Gardner has authored more than seventy books, and numerous articles.



Martin Gardner
(October 21, 1914 – May 22, 2010)

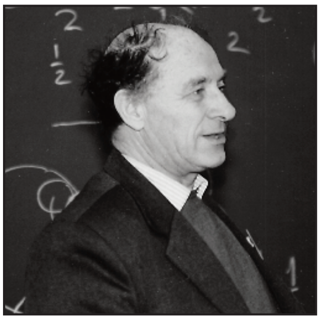
Some of his famous books are Fads and Fallacies in the Name of Science, Science: good, bad and bogus, Order and Surprise and The Flight of Peter Fromm, which is a semi-autobiographical novel. Of his works on literary criticism, the most celebrated is The Annotated Alice, in which he has explained the puns, riddles, encoded messages, mathematical puzzles and so on in Lewis Carrol's Alice's Adventures in Wonderland and Through the Looking Glass.

Gardner has also authored annotations of Chesterton's The Innocence of Father Brown, Coleridge's The Rime of the Ancient Mariner, Joyce's Ulysses, Moore's The Night Before Christmas and Baum's The Wonderful Wizard of Oz. He opened the eyes of the general public to the beauty and fascination of the mathematics.

OBITUARIES

Mathematics is the part of physics where experiments are cheap.

Vladimir Igorevich Arnold, who was the most cited Russian scientist and one of the three mathematicians who propounded the KAM theorem of Classical Mechanics, died on June 3, 2010 in Paris due to peritonitis. He passed away just a few days before his 73rd birthday.



V.I.Arnold
(June 12, 1937 – June 3, 2010)

Arnold was born in the port city of Odessa, Ukraine. In an interview, Arnold has talked about how the Russian tradition of engaging children with mathematical problems, and the excitement of solving a problem posed by one of his teachers in school, attracted him to mathematics at a very young age (Lui. S. H., Notices of the AMS, 1997, 44(4), 432-438). Arnold was a student of the famous Soviet mathematician, Andrey Nikolaevich Kolmogorov. He obtained his Ph.D from the Moscow State University in 1961. Arnold served as a Professor in Steklov Mathematical Institute, Moscow, Ceremade, Universite de Paris, France, and later in Moscow State University.

When Arnold was nineteen years old and was a student of Kolmogorov, he solved Hilbert's thirteenth problem, one of the 23 problems listed by David Hilbert in 1900. He proved that a solution does exist for general seventh degree equations, where the three variables, a, b and c can be expressed using a finite number of two-variable functions.

In the 1950s, Kolmogorov, Arnold and Moser proposed the KAM theorem of classical mechanics that deals with persistence, under perturbation, of quasi-periodical motions in Hamiltonian dynamical systems. He also proposed the famous Arnold Conjecture on the number of fixed points of Hamiltonian symplectomorphisms. Before this, he had demonstrated the chaotic map of a two-torus onto itself, using the picture of a cat.This came to be known as Arnold's Cat Map. Arnold also solved what has come to be known as the 'Folding Rouble problem' or the 'Margulis Napkin Problem'. Arnold concluded that folding rectangular surfaces, like folding a piece of paper in origami, increases the perimeter of the surface. However, if a square piece of paper is folded, the perimeter does not increase. He is also known for his work on symplectic geometry and topology.

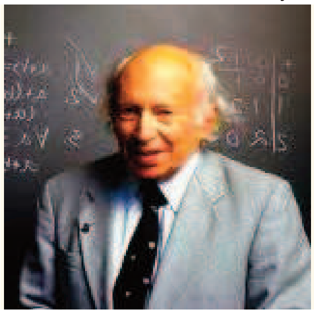
Arnold has also made fundamental contributions to other areas of mathematics such as dynamical systems, singularity theory, stability theory, topology, algebraic geometry, magnetohydrodynamics and partial differential equations. Besides mathematics, Arnold had an interest in the works of Alexander Pushkin – he has described himself as an 'amateur Pushkinist'. In the 1990s, Arnold published a short paper titled About the epigraph to Eugene Onegin in the Proceedings of the Russian Academy of Sciences.

V. I. Arnold is also the author of a number of books on mathematics such as Catastrophe Theory, Topological Methods in Hydrodynamics, Mathematical Methods of Classical Mechanics, Ordinary Differential Equation as well as a brain-twister called Arnold's Problems. He was known for his geometric approach to traditional mathematical topics, and his disapproval of introduction of high levels of abstraction in mathematics.

Arnold was nominated for the Fields Medal in 1974, but unfortunately did not receive it due to various reasons. He is however the recipient of a number of other prestigious awards, such as the Lenin Prize (1965), Crafoord Prize (1982), Harvey Prize (1994), Wolf Prize in Mathematics (2001), and the State Prize of the Russian Federation (2007).

Mathematical achievement is not only about aptitude. It is about appetite.

Israel Moiseevich Gelfand, a legendary figure in the history of modern mathematics, passed away on October, 5, 2009 in New Jersey, a few weeks after his 96th birthday. He is survived by his wife, Tatiana, two sons, one daughter, grandchildren and great-grandchildren. One of his sons, Sergei.I.Gelfand, is also a famous mathematician.



I.M. Gelfand
(Sep 2, 1913 – Oct 5, 2009)

Gelfand was born near Odessa in Ukraine, to a Jewish couple. His Jewish identity caused him a great deal of trouble throughout his stay in Russia. When he was a schoolboy, he suffered from appendicitis, and all through the course of his treatment that lasted 12 days, he 'entertained' himself by working out problems in calculus. Unfortunately, due to certain political circumstances, he was disallowed from attending school when he was in the ninth grade.

When he was about 16 years old, Gelfand went to Moscow University, and did odd jobs there. But since he was interested in mathematics, he attended seminars in the University. Though Gelfand did not complete formal schooling or have an undergraduate degree, he was directly accepted for graduate studies in the University of Moscow when he was 19 years old. He was a student of Andrey Nikolaevich Kolmogorov, a famous Soviet mathematician. He obtained a Doctorate in 1935, and a higher doctorate in 1940.

Gelfand began his career in the Steklov Institute, Moscow. But he was stripped of his position due to his Jewish identity. Similarly, in the Moscow University, where he worked later, he was demoted from full Professorship since he was a Jew. The Soviet Academy of Sciences too did not grant him full membership until 1984. In 1989, Gelfand left for the United States of America, where he worked for a year at Harvard and Massachusetts Institute of Tehnology (MIT) and later at Rutgers. Gelfand became a member of the National Academy of Sciences, USA, and the Royal Society, Britain, in 1994.

Gelfand, unlike his colleagues, preferred not to specialize in any particular branch of mathematics. Instead, he contributed greatly to a variety of areas including functional analysis, representation theory, geometry, integrable systems, Banach algebra, infinite-dimensional representations of Lie groups. His work on representation theory was not only important for mathematicians, but was also highly useful for advances in the field of quantum mechanics. His work on integral geometry is used to obtain three dimensional images from MRI and CAT scans.

Gelfand's significant contributions include Gelfand-Naimark theorem, Gelfand-Pettis integral, soliton theory, the philosophy of cusp forms, Gelfand–Fuks cohomology, Gelfand–Kirillov dimension, combinatorial definition of the Pontryagin class, generalised hypergeometric series, Gelfand - Tsetlin patterns, representation theory of classical groups and so on.

Gelfand was also a great educator. His weekly seminar at the Moscow University, and in Rutgers, were free for all who were interested – from school children to professional mathematicians. He also started a Mathematics Correspondence School in the 1960s for students who lived in villages or smaller cities, and had little or no access to good literature in mathematics.

Gelfand has won several prizes – Wolf Prize in Mathematics (1978), Kyoto Prize (1989) and Macarthur Fellowship (1994), the Order of Lenin (thrice.

OBITUARIES

The quest for Beauty (in mathematical proofs) illustrates magnificently the Unity of Mathematics and, by consequence, its transcendental Truth.

Paul Malliavin was a famous French mathematician, known for the so-called Malliavin calculus and Malliavin's absolute continuity lemma passed away on June 3, 2010. He was 84.

Paul Malliavin
(Sep11, 1925 - June 3, 2010)

Malliavin was born in Neuilly-sur-Seine, France. In his youth, he came under the influence of the Swedish mathematician Arne Beurling, with whom he proposed the Beurling-Malliavin theorem.

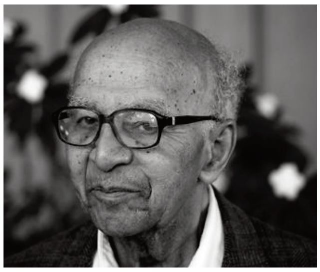
Malliavin obtained his Ph.D in 1954. He has taught and worked in a number of prestigious institutions including Stanford University, University of Chicago and Massachusetts Institute of Technology. He was Emeritus Professor at the Pierre and Marie Curie University. Malliavin was elected as a Member of the Swedish Academy of Sciences. He also served as the Editor of Journal of Functional Analysis and the Bulletin of Mathematical Sciences. He has authored a number of books on stochastic analysis.

Paul Malliavin has contributed to a number of areas of mathematics – approximation theory, calculation of probabilities, Gaussian infinite dimensional geometry, probability calculus, stochastic variation calculus and harmonic functions to name a few. He is known for his demonstration of the impossibility of spectral synthesis on non-compact Abelian groups, and development of Malliavin calculus that provides a mechanism for calculation of derivatives of random variables. Malliavin calculus also has applications in financial mathematics. Malliavin's absolute continuity lemma, another area named after him, is important for the regularity theorems in Malliavin calculus. It allows a finite Borel measure to be absolutely continuous with Lebesgue measure. Along with Levy and Ito, Malliavin demonstrated the relationship between probability theory and other areas of mathematics.

Paul Malliavin was honoured with a number of prizes. These include the Servant Award (1972), and Prix Gaston Julia of the Academy of Sciences (1974).

Basically, I'm not interested in doing research and I never have been. I'm interested in understanding, which is quite a different thing. And often to understand something you have to work it out yourself because no one else has done it.

David Blackwell, a celebrated statistician and mathematician, the first African American Professor to be tenured in the University of California and the first black scientist to be admitted to the National Academy of Sciences, USA, passed away on July 8, 2010. He was 91.



David Blackwell
(April 24, 1919 - July 8, 2010)

David Blackwell was born in Illinois. His father was a railroad worker and David attended public schools in the USA. He graduated from the University of Illinois, and obtained his Ph.D from the same University in 1941. In his early years, he was subjected to racial discrimination in the various universities that he came in contact with. He overcame these difficulties, and ultimately taught at the University of California, Berkeley. He has been awarded honorary Doctorates from as many as twelve Universities, including Harvard, Yale, University of Illinois, Carnegie-Mellon, Michigan State University, University of Warwick and Amherst College.

Blackwell is well known for his contributions to game theory. The Rao-Blackwell theorem that has been named after him shows how crude guesses can be turned into good estimates. He worked out the mathematics of bluffing and calculated the optimal moment for an advancing duelist to open fire. He is also known for his application of game theory to military situations.

Blackwell was also known as an excellent teacher. He has authored a number of books on statistics. His book, Basic Statistics (1969), was one of the first text books on Bayesian statistics.

Blackwell won several awards including the John von Neumann Theory Prize, R. A. Fisher Lectureship and the Berkeley Citation.

All obituaries were written by V.T Yadugiri

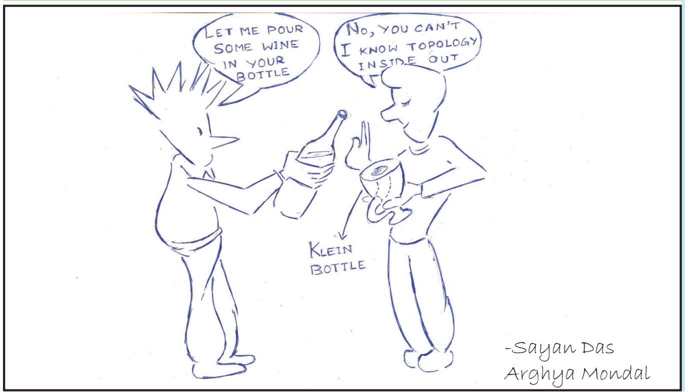
"Arnold, once a student of Kolmogorov, is the most brilliant representative of the romantic trend in the mathematics of the twentieth century, a successor of the synthetic traditions of Diophantus, Newton, Gauss, Chebychev, Lobachevsky, and Poincaré."

- S. Kutateladze

"Mathematics is a way of thinking in everyday life. It is important not to separate mathematics from life. You can explain fractions even to heavy drinkers. If you ask them, 'Which is larger, 2/3 or 3/5 ?' it is likely they will not know. But if you ask, 'Which is better, two bottles of vodka for three people or three bottles of vodka for five people?' they will answer you immediately. They will say two for three, of course."

- **I.M.Gelfand**

Mathaloon



News

www1.hs-bremerhaven.de/math-up-date.net
is a search website for mathematics. The website opens a window to the entire mathematical community. There is information and links for students, teachers and also researchers.

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