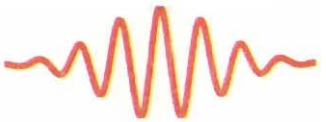


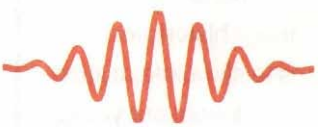
In this context it is difficult to avoid the temptation to recall a few other memorable lectures in the history of mathematics and science, each of which had profound consequences for later developments. One was the October 1872 lecture of Felix Klein at the University of Erlangen, titled "Comparative review of recent research in geometry", in which the characterization of each kind of geometry by its group of symmetries was established. This

Konrad Lorenz —
father to ethology and mother to ducks, geese, jackdaws, salamanders, fish and many more!

Konrad Zacharia Lorenz was born in 1903 as the son of a distinguished orthopaedic surgeon in Vienna. Like Darwin (and perhaps like so many of today's kids), he studied medicine in deference to the wishes of his father and like Darwin, his real love lay elsewhere - in this case, in the study of animal behaviour. But "study" is not how it began. Lorenz spent most of his life in the company of his favourite pets - ducks, geese, jackdaws, salamanders, fish and many more. Very early in childhood, when the scientific study of animal behaviour, or of anything else for that matter, was far from his mind, Lorenz and his childhood friend and future wife Gretel, took care of their pet ducklings by pretending to be mother ducks by living with them "a complete duck's life" and becoming "most thoroughly familiar with the whole repertoire of all the things a duck can say or do", without knowing that "this was to be called an 'ethogram' many years later".

It is now a matter of history that the science of the study of animal behaviour christened, *ethology*, was largely developed by Konrad Lorenz along with Niko Tinbergen and Karl von Frisch for which they won the Nobel prize in 1973. Lorenz is best known for his discovery of *imprinting* the phenomenon by which young animals, especially birds, learn to recognize their mothers. Lorenz's discovery of course came from the fact that his ducklings and goslings became imprinted on him as he had replaced their mother early enough. Today imprinting is well understood as a form of learning possible only in early life and of enormous adaptive value.Young animals are not born with a mental image of their mothers but are born with an innate capacity to follow their mother or any moving object (including Lorenz) and take it to be their mother. In some species such "knowledge" gained during childhood, of what members of their species are supposed to look and sound like, is also used by the adult birds to correctly court conspecifics rather than some wrong species. This Lorenz discovered to his great delight when his hand reared jackdaws began to court him! Along with Niko Tinbergen, Lorenz laid the foundations of ethology particularly in relation to the organization of instinctive behaviour. Together they demonstrated the presence of motor programs, fixed action patterns and innate releasing mechanisms, phenomena that are still poorly

circle of ideas is often referred to as the "Erlangen Programme". Then in 1900 comes the famous Paris lecture by David Hilbert at the second International Congress of Mathematicians, titled "Mathematical Problems" and whose aim was no less than to list a set of problems (twenty three in all) which would engage the attention of mathematicians for the coming century. Sometime after the development of special relativity by Einstein in 1905, we



understood from a neurophysiological perspective.

Lorenz was a personality hard to ignore. His biographer Alec Nisbett describes him as "colourful, almost flamboyant; assertive in the manner of his speech and controversial in much that he says, but deeply interesting as an individual and as a man in relation to his concept of science." Lorenz's method of and motivation for doing science deserve our attention especially in today's fast-track, high-tech, publish or perish culture. Lorenz laments that "it is fashionable in science nowadays to experiment rather than to observe, to quantify rather than to describe ... descriptive science, based on plain unbiased observation is the very fundament of human knowledge ... I contend that not even a person endowed with the almost superhuman patience of a yogi could look at animals long enough to perceive the laws underlying their behaviour patterns. Only a person who looks with a gaze spellbound by that inexplicable pleasure we amateurs, we dilettante enjoy, is in a position [to do so]." For all his dislike of experiments, Lorenz admits "Niko [Tinbergen] and I were the perfect team. I am an ... amateur and prefer observing to experimenting ... Niko Tinbergen is the past master of the unobtrusive experiment ... We published in joint authorship, a paper that has become a classic."

But coming back to his motivation for doing science (notice that he calls himself an amateur), Lorenz's favourite quotation is that "Man is only then completely human when he is at play". He recalls his early childhood by saying that "As a very little boy, I loved owls and was quite determined to become an owl. In this choice of profession I was swayed by the consideration that an owl was not put to bed as early as I was". On retirement at the age of seventy one, Lorenz said " If you ask me what I have done throughout my life in the field of research and teaching, then I must honestly say: I have always done the things which at the moment I considered the greatest fun." I wonder if modern science, even ethology, any longer affords us the luxury of doing what we consider the greatest fun and yet make fundamental discoveries. Perhaps not, but the explanation that most of us find satisfying for this state of affairs is that our science is far too advanced to permit the kind of amateur play that Lorenz's infant ethology did. Indeed we often go so far as to believe that all branches of science are far too advanced to permit any place for Lorenz today. I hope that young readers of *Resonance* are *not* convinced!

Raghavendra Gadagkar

The purpose in recalling some of these historic lectures is to stimulate at least a few of our young readers to look for and go through the original texts; and also to convey a sense of wonder that profound and daring thoughts could be presented over an hour or so, which would then guide progress for years to come - a staggering realisation indeed.

have the September 1908 address by Herman Minkowski at Cologne on "Space and Time", containing the memorable line "Henceforth space by itself, and time by itself, are doomed to fade away into mere shadows, and only a kind of union of the two will preserve an independent reality."

Skipping a couple of decades (and some other lectures), we remember next Niels Bohr's address, in September 1927 at the Alexandro Volta centenary meeting in Como, titled "The quantum postulate and the recent developments of atomic theory." It was here that he first presented his *complementarity principle*, as a general philosophical guide to the interpretation of quantum mechanics. It turned out though that not many in the audience could comprehend his ideas, and they had to be further elaborated later on. Then in August 1932 Bohr spoke to a gathering of physicians at Copenhagen on "Light and Life" — an attempt to apply the complementary principle to the understanding of life. Though his expectations have subsequently not been realised, this lecture deeply influenced one young listener — Max Delbruch — and induced him to turn from theoretical physics to biology, with well-known consequences.

The purpose in recalling some of these historic lectures is to stimulate at least a few of our young readers to look for and go through the original texts; and also to convey a sense of wonder that profound and daring thoughts could be presented over an hour or so, which would then guide progress for years to come — a staggering realisation indeed. Borrowing from Bernard Shaw: "The reasonable man adapts himself to the circumstances surrounding him. The unreasonable man adapts the circumstances to himself. All progress depends on the unreasonable man." So is it in science and mathematics, as in other endeavours.

To explain all nature is too difficult a task for any one man or even for any one age. 'Tis much better to do a little with certainty, and leave the rest for others that come after you, than to explain all things.

But the years of searching in the dark for a truth that one feels, but cannot express; the intense desire and the alternations of confidence and misgiving, until one breaks through to clarity and understanding, are only known to those who have themselves experienced it. *Albert Einstein (1933)*