Editorial

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"He has changed the very way we think about many branches of mathematics. Many of his ideas, revolutionary when introduced, now seem so natural as to have been inevitable. Indeed, there is a whole generation of mathematicians for whom these ideas are part of the mathematical landscape, a generation who cannot imagine that his ideas were ever absent. In contemplating his magnificent achievement, one is struck by the simplicity of the fundamental concepts which underlie it, and by the profound unity of thought which brought it into being. It is difficult to imagine that they all sprang from a single mind." Alexander Grothendieck's influence on mathematics has been described thus by some of the foremost contemporary mathematicians.

An algebraic equation like $x^2 + y^2 = 1$ may represent totally different geometric objects depending on where we are looking for solutions. A unified understanding comes from the idea of Grothendieck who thought of an entity in the background called schemes and the spaces of solutions as its manifestations. M S Narasimhan's article contains a description of Grothendieck's mathematics and a glimpse into his personality as well. Like Euclid's *Elements*, the monumental works *EGA* and the *SGA* (mentioned in Narasimhan's write-up) are said to be unsurpassed to this day in clarity, technical mastery and conceptual perfection.

The profundity of Grothendieck's mathematical perception makes it difficult even for most mathematicians to appreciate his ideas immediately. Kapil Paranjape provides a mathematical glossary of terms occurring in Narasimhan's write-up.

A precise description in *Resonance* of Grothendieck's work would be a Herculean (if not futile) task, and so, Kapil briefly enunciates the concept of space as envisaged by Grothendieck.

Angered by military funding, Grothendieck resigned from the IHÉS in protest and criticised his colleagues as lacking ethics. He refused to go to Moscow to receive his Fields Medal in 1966 and declined the Crafoord Prize in 1988. Grothendieck's withdrawal from mathematics, and his diatribe on contemporary mathematicians, find resonance in a more recent instance involving the Russian topologist Grigori Perelman.

Perelman refused to receive the 2006 Fields medal saying, "I'm not interested in money or fame; I don't want to be on display like an animal in a zoo. The Prize was completely irrelevant for me. Everybody understood that if the proof is correct, then no other recognition is needed." He also refused the million dollar Clay Millennium Prize awarded to him for solving the Poincaré conjecture saying that he considered the award unfair and that his contribution to solving the Poincaré conjecture was no greater than that of Richard Hamilton, the mathematician who pioneered Ricci flow with the aim of attacking the conjecture.

Grothendieck had a genius for the *mot juste*. He thought the naming of an object as an important part of its discovery. The origin of the mathematical word 'crystal' invented by him is explained in his famous letter to Tate as follows.

"A crystal possesses two characteristic properties: rigidity and the ability to grow in an appropriate neighbourhood. There are crystals of all kinds of substances: sodium, sulphur, modules, rings, relative schemes, etc." The reader is encouraged to look for the bases of Grothendieck's reasons for choosing the names '*étale*', 'topos', 'schemes', 'stacks' and '*Dessins d'enfants*'. Incidentally, the mathematical phrase 'perverse sheaves' in popular usage today, he found particularly distasteful.

Grothendieck's way of thinking in generalities not depending on examples sometimes led to amusing incidents. During a mathematical discussion, someone wanted to consider a particular prime for illustration. Grothendieck is said to have asked, "You

mean, an actual prime number? All right, take 57." From then on, 57 has come to be known as the Grothendieck prime.

Grothendieck is presumably in mathematical valhalla now, but in the decades to come, if the saga of the growth and decline of algebraic geometry is penned, the Grothendieck line of algebraic geometry would be at the zenith.

In an article on the role of microbes and gut-epithelium, it is argued that healthy interaction between the microbes and intestinal epithelium is essential for the normal development of the gut-immune system and overall health of an organism. Another interesting article explains the principles behind phase change material based technology used to store thermal energy and its various applications to daily life. There is an informative book review of a book titled *The Artist and The Mathematician – the story of Nicolas Bourbaki, the Genius Mathematician who Never Existed*. The first Presidential address of the Association of Mathematics Teachers of India in 1993 by K R Parthasarathy on Brownian Motion is a classic by now, and it is reproduced here for the benefit of students and teachers interested in this ubiquitous subject. Finally, in a very interesting write-up, a mathematician tries to explain the logic behind a 22-shruti model for the system of notes in Hindustani classical music.