

## Editorial\*

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*B Sury, Chief Editor*

“*Nihil constat nisi mutatio*” as your Latin-speaking neighbor might say, roughly meaning that change is the only constant. Our journal has completed 25 years of publication. As with any journal, the Editorial Board changes once in a while, but this time we have a board, half of whose members are new. It is an occasion to place on record our gratitude to all past editorial boards for their sterling support for this unique journal that carries scholarly articles on diverse topics in science and mathematics in every issue. It is heartening that the editors who are academicians of high standing and are eternally busy with their research activities, have also seen it fit to spend valuable time towards the betterment of *Resonance*. I am confident that the new members of the editorial board will not only continue to bestow *Resonance* with their time and wisdom, but will also bring in fresh points of view; it is my pleasure to welcome them.



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The last one year—despite having been one of struggle for many—has had its own compensations in some quarters. Many academicians have become increasingly used to virtual meetings so much so that they are attending more conferences and writing more research papers than in previous years as travel time is saved. Each year, *Resonance* has its annual meeting of the Editorial Board on the premises of the Indian Academy of Sciences where the editors develop social bonds, and this year they are forced to forego this opportunity. Nevertheless, the show must go on.

This issue of *Resonance* features Stephen Hawking whose name seems to be a household word in our country if one were to go by social conversations—the erudite in society seem to have browsed through his popular science book *A Brief History of Time*. However, the layperson is drawn to Hawking principally due to his

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extraordinary worldly struggles, whereas, the real importance of a scientist is divined from her scientific contributions. The current issue carries an article—republished from *Current Science*—by Rajesh Gopakumar and Spenta Wadia on Hawking’s scientific work. The collaborative work of Hawking with Roger Penrose—one of the Nobel Laureates of 2020—has also been detailed. This breakthrough work from 1970 showed, under very general conditions, that singularities are unavoidable (in either the past or in the future) in solutions of Einstein equations. An Indian connection is that this work used a then decade-old work on the Raychaudhuri equation crucially. We quote from the article, a very interesting aspect of some of Hawking’s work: “When these ideas were put forward, de Sitter space-time was more of a historical toy example of a cosmological space-time. It is rather remarkable that 40 years later, de Sitter space-time is central to modern cosmology.” They also mention the sensation his 2001 visit to India caused in the media where several people accompanied him for a “walk” on Marine Drive. The work of Amal Kumar Raychaudhuri alluded to above is described in remarkably elementary terms in an article by Joseph Samuel. As Samuel mentions, Raychaudhuri’s paper was one of the finest scientific papers to have ever come out of India, and was the seed of many profound developments in the theory of general relativity.

In an intriguing article by T Ramakrishna Rao, we learn how body size can crucially affect the functioning of living organisms. Kleiber’s rule shows that metabolic rates of organisms are directly related to the body mass (the former is a constant times the three-fourths of power of the latter). The author discusses the metabolic theory of ecology that is an expansion of Kleiber’s rule to include two additional influencers of metabolism - temperature and resource availability. The metabolic theory posits that many physiological rates, life-history traits, and ecological processes follow quarter-power scaling laws. The author speculates, as an ecologist, on the different physical, ecological, and physiological constraints that might be counteracting the evolution of foot-long mosquitoes and mouse-sized hippopotamuses.



The so-called ‘black hole information paradox’ arose from a combination of general relativity and quantum mechanics. Hawking shocked the scientific community in 1974 when he announced that quantum effects near the horizon of a black hole cause the radius of the event horizon to continuously decrease and eventually disappear. This would mean that quantum information could be lost completely in a black hole. Raghu Mahajan takes us through a fascinating journey of this puzzle in the article ‘Recent Progress on the Black Hole Information Paradox: Computation of the Page Curve’ and acquaints us with recent research on the problem. The ‘Page curve’ in the title refers to a tent-shaped curve, named after Don Page, who argued that the entropy of Hawking radiation should follow the curve (known now as the Page curve).

Book reviews are carried rather rarely and this issue contains a review of Deanna Kuhn’s book, *Building our Best Future: Thinking Critically About Ourselves and Our World* by Jeena Anne K. The book highlights how argumentation skills can be developed in a classroom environment. Rajarshi Ghosh writes about the life and work of Priyadarajan Rây in the chemical sciences. His teacher, the legendary P C Rây has remarked that Priyadarajan Rây is an acknowledged authority on complexes and valency as also on microchemistry. It was P C Rây’s practice to submit his own papers for Priyadarajan’s criticism and judgment before they were contributed to Chemical Societies. P C Rây mentions that even his presidential addresses at the annual meetings of the Indian Chemical Society of 1926 and 1929 were based mainly on the ideas and suggestions of Priyadarajan Rây. P C Rây refers to Priyadarajan as “A more silent and unobtrusive worker is seldom to be met with.” Priyadarajan Rây’s remarkable, significant contributions in inorganic chemistry include the design and synthesis of new ligands and their coordination compounds, determination of stability of different unusual oxidation states of metals, the structure of the coordination complexes, their stability, optical activity, reaction mechanism, etc., and also designing several methods for the detection and estimation of different metal ions in macro and micro amounts.



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The history of and the mathematics behind Brownian motion is described beautifully by B V Rao.

Finally, I point out for specific mention, the series of wonderful, educational, and inspirational articles Raghavendra Gadagkar has been writing over the last two or more years. Before every issue appears, many readers like me look forward to his next serving. Sadly, the present one appearing in this issue is the last on the menu for now. Through this series, Gadagkar makes an incisive point for all of scientific society to take note of—that low cost, and highly impactful research on the study of animal behavior is possible and, is important to pursue. We are all aware of his scholarly work for more than four decades, on the ecology, evolution and animal behavior of wasps, bees, ants, etc. But, we need to note the additional very important idea he puts forward that low cost research experiments on animal behavior are very much possible and are also an urgent necessity. One of his strongest motivations for writing this series is, as he says, “make the practice of science more inclusive and democratic, and empower large numbers of people to become knowledge producers rather than merely remain knowledge consumers. The people I especially have in mind are, less-endowed sections of society, including, but not restricted to, underdeveloped countries, marginalized institutions, and individuals, students, the general public, amateurs, and all those with little or no access to large research grants and sophisticated laboratory facilities, for whatever reason.”

I am delighted that we got permission from Gonville & Caius College, Cambridge to use the image of the Stephen Hawking memorial stone, which appears on the front cover here. Also, the classical seminal paper of Hawking on particle creation by black holes from 1975 has been reproduced here. Spenta Wadia has written a lucid preface introducing this article to the non-experts.

Once again, I welcome the new members to the EB and place on record the tremendous contributions of all past editors.

