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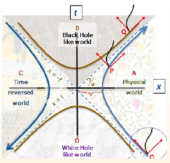
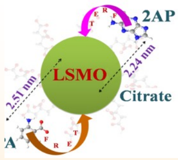
Page 03 

Page 04 

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Newsletter

Volume: 02
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Period: Jan - April 2010
Published on: 29.10.2010

S N Bose National Centre for Basic Sciences

Editorial

We are happy to bring out the last issue of the second volume of our Centre's Newsletter. The publication of this issue has been long overdue. We would not put too many excuses for this delay. However, we would like to point out that the contribution from people in the Centre had been somewhat sluggish that partly made this delay. We are trying to make contributions to the Newsletter more interesting and rewarding by declaring awards in different categories of contribution. We sincerely hope that it will stimulate people to contribute to the Newsletter more spontaneously. We request to all in the Centre to spend just few minutes to make the Newsletter richer and richer in the coming days.

Dr. Tanusri Saha-Dasgupta elected fellow of Indian Academy of Sciences

Dr. Tanusri Saha-Dasgupta has been elected a fellow of the Indian Academy of Sciences, Bangalore. Dr. Saha-Dasgupta received her PhD in 1995. Her field of research involves computational materials science and condensed matter physics, particularly electronic structure calculations. Dr. Saha-Dasgupta was recipient of Swarnajayanti Fellowship in 2005-2006 and was appointed as head of Max-Planck-India partner

20th S N Bose Memorial Lecture by Prof. Masashi Hayakawa

Prof. Masashi Hayakawa of the University of Electro-Communications, Chofu, Tokyo Japan, delivered the 20th S N Bose Memorial Lecture of our Centre on 16th March 2010 at the Rabindra Okakura Bhawan Auditorium Salt Lake, Kolkata. Prof. Hayakawa's work include: magnetospheric/ ionospheric radio emission, atmospheric electricity, seismo-electromagnetics, direct and inverse problems of wave propagation, modern methods of signal processing seismogenic radio emission. Title of his talk was "Is prediction of earthquakes possible by means of electromagnetic effects?". Earthquakes (EQ) cause disasters of all kinds. For the 1995 Kobe earthquake, the monetary loss was estimated at ten billion US dollars. The loss of lives and the misery caused cannot be estimated. There is virtually no escape time once the quake has started and this underlines the importance of short time EQ predictions. It was concluded around 1997, that the conventional mechanical measurement (seismic observation of crustal movements) is unable to make short-term EQ prediction. Prof. Hayakawa's, group explored an alternative method for short-term, EQ prediction. They studied higher-order (microscopic) effects of the lithosphere which could provide the precursory effect of an EQ signature. This type of microscopic effects would result in electromagnetic signals due to generation of currents in and around the EQ hypocenter. Prof. Hayakawa, also discussed various advantages of this electromagnetic technique for short term EQ prediction.

Inside

Bose Fest 2010

The annual in-house meeting of the S.N. Bose Centre (Bose Fest) was held with usual enthusiasm during 27th -28th January 2010. The Bose Fest is an annual meeting to highlight different research activities in the Centre in a given year. The scientific talks were delivered by the senior research students, post doctorate fellows and visiting scientists. There was poster presentation from other academic members of the Centre. The organizers of the Bose Fest declared best oral presentation and best poster awards to the students as a token for encouraging the students to pursue better scientific research. The recipients of the awards are: Mr. Sourav Bhattacharya (oral), Ms. Hena Das (oral), Ms. Raka Dasgupta (oral), Mr. Santosh Roy (oral), Ms. Swastika Chatterjee (poster), Mr. Amartya Sarkar (poster), Mr. Rudranil Basu (poster), Ms. Indrakshi Roy Chowdhury (poster).

बोस कोलोक्वियम

सौजन्यः सुष्मिता दासगुप्ता

दिनांक 23 अप्रैल 2010 को शाम चार बजे केन्द्र के व्यास्थान कक्ष-2 में **'बोस कोलोक्वियम'** का आयोजन किया गया। जिसमें प्रोफेसर राज नाथ भट्ट, विभागाध्यक्ष, भाषाविज्ञान विभाग, कला संकाय, काशी हिन्दु विश्वविद्यालय ने **'स्वनिम विज्ञानः हिन्दी-आर्य भाषा समूह के संदर्भ में'** पर एक सारगर्भित व्यास्थान प्रस्तुत किया। प्रोफेसर भट्ट ने अपने व्यास्थान में बताया कि स्वनिम विज्ञान की आधारभूत इकाई स्वनिम है। मिलते-जुलते स्वनों (ध्वनियों) को, जो व्यवहार की दृष्टि से किसी भाषा में एक ही इकाई बनाएँ, **स्वनिम** कहा जाता है। उन्होंने भारतीय आर्यभाषा के अन्तर्गत आने वाली भाषाओं, जैसे हिन्दी , बंगला, असमिया, उड़िया, गुजराती, सिन्धी, पहाड़ी, डोगरी, पंजाबी, कश्मीरी, नेपाली, कोंकणी तथा सिंहल आदि भाषा के संदर्भ में बताया कि इन भाषाओं के स्वनिमों में सूक्ष्म अंतर के कारण तथा उनके उच्चारण में थोड़ा बहुत अंतर होने के कारण एक भाषा का शब्द दूसरी भाषा में अन्य अर्थ देता है। इस व्यास्थान में केन्द्र के शैक्षिक एवं प्रशासनिक सदस्यों के अतिरिक्त निदेशक महोदय की उपस्थिति ने कार्यक्रम को और भी अधिक प्रभावशाली बना दिया।

केन्द्र के कुछ सदस्यों ने विषय से संबंधित विभिन्न प्रश्नों को प्रोफेसर भट्ट से पूछ कर अपनी शंकाएँ दूर की तथा कार्यक्रम को गतिशीलता प्रदान कर उसे सफलता की ओर अग्रसित किया। इस प्रकार इस वर्ष हिन्दी में आयोजित **बोस कोलोक्वियम** सफल रहा।

Bose Colloquia

- Prof. Sankar Pal, ISI, Kolkata; *Machine Intelligence, Rough-Fuzzy Granules and Data Mining: Concepts, Features and Applications* (08.01.10)
- Prof Sugata Marjit, Director,Centre for Social Sciences, *Game theoretic approach to the problem of displaced persons* (12.02.10)
- Prof. Biswarup Mukhopadhyaya, HRI, Allahabad; *The Large Hadron Collider and New Physics: Some Reflections on the Invisible and the Visible* (05.03.10)
- Prof. Raj Nath Bhat, BHU, Varanasi; *Swanimvijnan: Hind Arya Bhasha Samoh ke Sandarbh Mein* (23.04.10)

Distinguished Lectures

- Prof. Tapan Chatterji, Science Division, Institut Laue-Langevin, France, (12.01.10 – 14.01.10)
- Prof. S M Yusuf, Solid State Physics Division, Bhabha Atomic Research Centre, Mumbai (12.01.10 – 14.01.10)

EVLP Visitors

- Prof. Joydeep Dutta, Centre of Exellence in Nanotechnology, Asian Institute of Technology, Thailand; 01.01.10 - 10.01.10
- Dr. Alex Matzkin, CNRS, Grenoble, F – 38402, France; 15.02.10
- Prof. J Maharana, Institute of Physics, Bhubaneswar; 07.03.10 - 09.03.10
- Dr. Abhijit Chakraborty, Department of Physics, University of Burdwan, Golapbag, Burdwan; 16.03.10 - 17.03.10
- Prof. Ken J W Lynn, Ionospheric Systems Research Head, 38, Goodchap St. Noosaville QLD 4566, Australia; 19.03.10 - 26.03.10
- Prof. N D Hari Dass, PPISR, Bangalore; 29.03.10 - 31.03.10
- Dr. Narayan Adhikari, Central Department of Physics, Trivhuvan University, Kirtipur, Kathmandu, Nepal; 19.04.10 - 26.04.10
- Mr. Gopi Kafle, Central Department of Physics, Tribhuvan University, Kirtipur, Kathmandu, Nepal; 19.04.10 - 26.04.10
- Mr. Souvik Ghosh, University of North Bengal Rajarammohunpur Dist Darjeeling, West Bengal; 19.04.10 - 30.04.10

TPSC Visitors

- Dr. P. Basu, Centre for High Energy Physics, Indian Institute of Science, Bangalore; *Some aspects of twisted quantization; Effects on Quantum Statistics, Super conductivity and Quantum entanglement* (17.03.2010)

JNC Research Conference on Physics of New Materials

Anjan Barman

The JNC research conference is an annual event that focuses on certain advanced areas and brings together the practitioners in that field to share ideas on the state of the art. The conference *Physics of New Materials* was jointly organized by S. N. Bose National Centre for Basic Science Kolkata (Prof. A. K. Raychaudhuri and Dr. A. Barman) and Jawaharlal Nehru Centre for Advanced Scientific Research (Prof. U. Waghmare), and

was held at the Fortune Park Panchwati, Howrah during Jan 16 to 18, 2010. The conference was attended by more than 70 researchers of various levels from national and international eminent scientists to Ph.D. students. This includes six international scientists from USA, UK, Japan and France and more than 30 students. The inaugural lecture was delivered by Prof. C. N. R. Rao. The conference had state of the art discussions in selected modern areas of physics of materials including (a) Graphene; (b) Molecular Materials; (c) Oxide Heterostructures and Functional Materials including Multiferroics; (d) Spintronics and Related Issues; (e) Quantum Dots and Nanowires, and separate sessions were dedicated for each of these topics. In addition, there were four tutorial talks at the beginning of the conference on Science of Thin Film Growth; Use of Neutron Scattering in Condensed Matter Sciences; Molecular Materials and Experiments at High Magnetic Field and at Low Temperatures. The conference ended with the concluding remarks by Prof. C. N. R. Rao, Prof. A. K. Raychaudhury, Prof. A. K. Sood and vote of thanks by Prof. U. Waghmare and Dr. A. Barman. In the end the conference proved to be highly interactive, which triggered many important discussions and potential collaborations and was particularly beneficial for students and junior scientists.

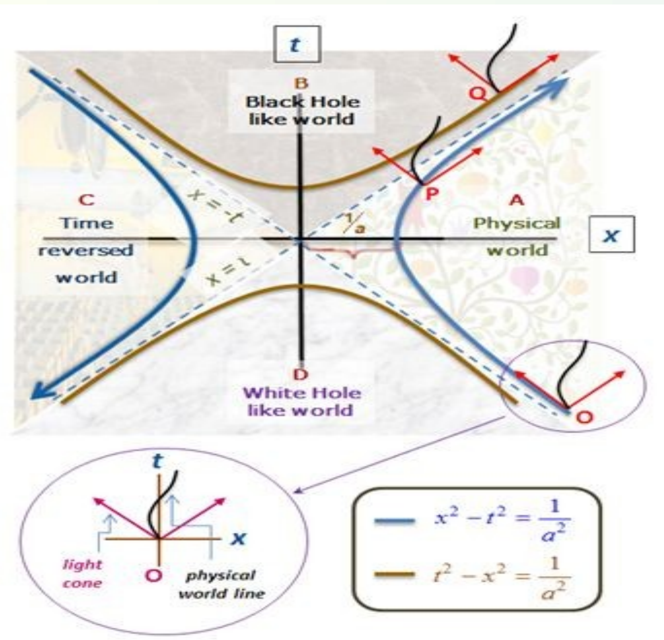
Scientific Essay

Black holes demystified

Rabin Banerjee

Black holes are perfect black bodies supposed to exist in nature. They are the end result of a star's collapse under its own gravitational pull. Perhaps the most dramatic property of black holes is their all absorbing nature. To visualise this, note that black holes are separated from the ordinary world by a region called the horizon. Anything from the outer world can cross the horizon to enter the black hole. But nothing, not even light, is allowed to escape by crossing the horizon from inside to outside thereby leading to the coinage `black holes'.

Technically speaking, black holes are solutions of Einstein's general theory of relativity. Since this theory is beyond most of us, it is tempting to contemplate whether black holes can be conceived from alternative arguments. Of course a completely full proof presentation is not possible but at least it helps in imagining things that we cannot see.



Consider the space-time trajectory for a relativistic particle moving with a constant acceleration `$a$'. This is a hyperbola ($x^2 - c^2t^2 = \frac{1}{a^2}$; see (A, C) in figure). Here `c' is the velocity of light. For simplicity, set $c = 1$. At any instant the velocity of the particle is given by the slope of the hyperbola. The maximum velocity, which is attainable at infinite time, is given by the slope of the line $x = t$. This is unity or, equivalently, the velocity of light. Consequently, nothing can exceed the speed of light in special relativity.

The arrows on the trajectories in A, C indicate the motion of the accelerating particle from smaller to greater velocities. Hence A depicts the physical world since the arrow is directed towards future time. A time reversed world is pictured in C. Different values of `a' (corresponding to different accelerations) lead to different trajectories that cover the whole of A and C regions.

This is as far as special relativity takes us. However the complete space-time region has not been covered since there are two remaining quadrants B, D. Let us stretch our imagination. We assume the existence of trajectories in B, D obtained symmetrically from A, C. The obvious construction is the hyperbolae $t^2 - x^2 = \frac{1}{a^2}$.

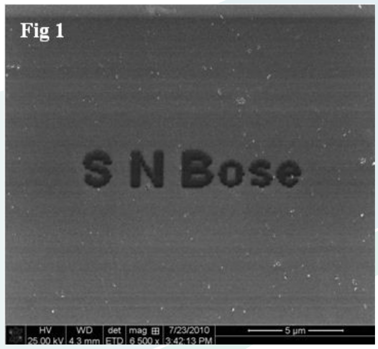
Let us now consider the effect of sending signals from our world A. As shown, nothing can propagate faster than the speed of light. Consequently, all trajectories must be confined within the asymptotes $x = \pm t$ (light cone) and directed towards the future. Take a point P and draw the light cone there. Signals propagate upwards and can enter the region B. Do the same thing at Q. Signals remain confined to B and cannot propagate towards A. Thus the region B mimics a black hole world with $x = t$ acting as the horizon.

Finally, observe that the trajectory in black holes ($t^2 - x^2 = \frac{1}{a^2}$) merely reverses the role of space and time coordinate as defined in the physical world ($x^2 - t^2 = \frac{1}{a^2}$). These basic features: (i) existence of horizon, (ii) one way flow and (iii) reversal of space-time coordinates are automatically obtained as black hole solutions of Einstein's equations.

Academic Reports

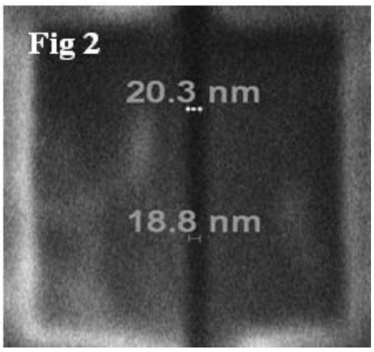
Nanolithography Facilities at the Centre

K. Das and A. K. Raychaudhuri

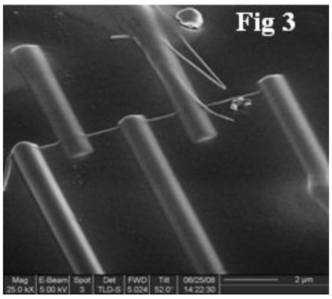


One of the important challenges in the area of nanosciences and nanotechnology is to fabricate structures with dimensions below 100nm. Typically there are two pathways by which one can achieve sub-100nm nanofabrication. One is the bottom-up approach, which is often based on chemistry, where atoms are assembled to a size of few tens of nanometer dimensions. The other, more equipment based but more precise route is the top-down approach where one starts from a big piece (like a Si wafer) and then by using lithographic techniques transfers patterns to it then eventually fabricate that pattern. The development of lithography tools for making the chips triggered IT revolutions. In the regime of nanolands, the lithography tools are often referred to as nanolithography. The two main tools in this area are Focused Ion Beam (FIB) Lithography and electron beam (e-beam) lithography. In the first one, a beam of 30KeV Ga focused to 10nm size impinges on the materials to be "nanomachined" and creates the intended pattern. In Figure 1, we show the name of "S.N.Bose" written on a piece of Si using the FIB machine. The length of the pattern is 10μm (the size of your hair) and the width is about 3 μm. The engraved letters have a lateral width of 300nm and depth of engraving is 500nm. The pattern in Figure 2 goes down by more than an order. It has a trench of about 20nm cut into a piece of Si.

The FIB machine can also deposit metals and make objects of nanosizes. Figure 3 shows a nanoline of Platinum deposited by the machine that has a length of the 15μm and width of 100nm. The line is connected to four leads that are used to measure resistance of such a narrow line. Recently, we succeeded in combining the top down and bottom up. We were able to attach five leads of diameter 300nm to a single



Ni nanowire grown by a chemical method. The wire had a diameter of 55nm and length of few µm. By measuring the resistivity of such a single nanwowire down to 3K, we could for the first time validate the theory of electron- phonon interactions in such nano objects [1].



[1]M.Venkatakamalakar et.al Applied Physics Letters (2009)

Electron doped CrO_2 -A charge ordered ferromagnet

Priya Mahadevan

Ferromagnetic insulators are rare and usually when one finds one, an alternate mechanism is needed to describe the ferromagnetism than the conventionally used ones. Recently a compound was synthesised, $K_2Cr_8O_{16}$ which was ferromagnetic below 180K and more interestingly, a ferromagnetic insulator in the temperature range 0-95 K. What makes this compound all the more interesting is that unlike most examples of magnetic insulators, magnetism sets in first as temperature is decreased and then we have the metal-insulator transition. When we analysed the properties of this compound[1] within first principles density functional calculations we found that a charge ordering transition took place with the doped carriers occupying Cr sites that minimize their repulsive energy. This is shown schematically in the figure below where we give the network of Cr atoms, with those sites where the electrons are localized denoted by larger circles. This charge ordering generates a pathway for electrons to hop and therefore allows ferromagnetism to be favored in an insulating material. We started out by describing this compound as a rare example of a ferromagnetic insulator. However, our analysis revealed something even more rare, a charge ordered ferromagnet. This has appeared in *Phys. Rev. Lett.* [1].

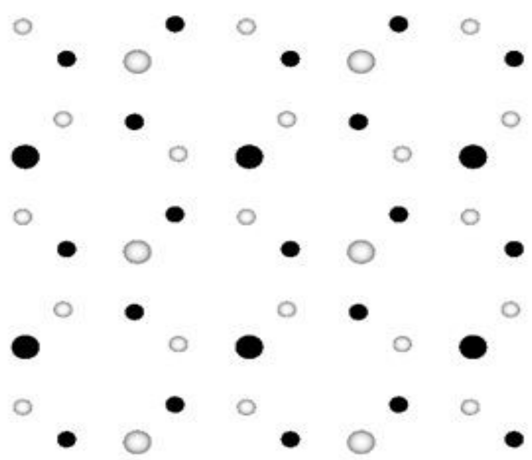


Fig: Charge ordering in $K_2Cr_8O_{16}$

[1] Priya Mahadevan, Abhinav Kumar, Debraj Choudhury, and D. D. Sarma, Phys. Rev. Lett. **104**, 256401 (2010)

Making manganite nanoparticles useful for biological applications

Anupam Giri, Abhinandan Makhal, Barnali Ghosh, A. K. Raychaudhuri and Samir Kumar Pal

One of the most useful applications of nanoparticles is to use them as vehicle for targeted drug delivery at the cellular level. In this respect the magnetic nanoparticles have an important role because they can be monitored and can even serve as a contrast creating agent for magnetic resonance imaging. The challenge for using magnetic nanoparticles which are most often inorganic oxides is

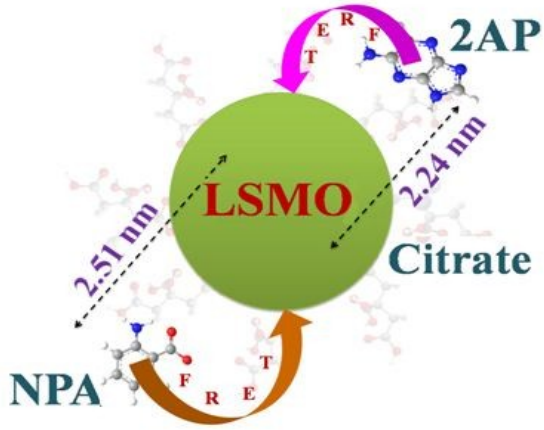


Fig: Efficient energy transfer (FRET) from fluorescent ligands to citrate functionalized manganite nanoparticles and corresponding donor-acceptor distances are shown.

their lack of solubility into water. The process of solubilization involves surface modification of the nanoparticles by some organic ligands (molecules) which make them water soluble.

Mixed-valent manganites have been recognized to be very useful magnetic materials as they have a number of esoteric properties arising from the fact that they are correlated functional oxides. However, in world of nano the manganite nanoparticles are getting another role. In recent times significant efforts have been made to use the manganite nanoparticles for the prospective application in cancer therapy involving the effect of hyperthermia. In this regard several attempts have been made to solubilize the manganite nanoparticles in aqueous solution by biocompatible macromolecules including dextran, bovine serum albumin, fatty amines, resulting in a suspension of the manganite nanoparticles in the solution. However, till date no attempt has been made to functionalize individual manganite nanoparticles with small biocompatible ligands. The individual functionalized nanoparticles are important in order to study their interaction with other biologically relevant ligand/drug molecules.

In a recent paper [1] the researchers of our centre reported the functionalization of one of the most promising manganite nanoparticles (NPs), $La_{.67}Sr_{.33}MnO_3$ (called LSMO hereafter) with biocompatible citrate ligand. The functionalization, interestingly leads to a change in the UV-Visible absorption of LSMO. The size selective solubilization of the functionalized LSMO nanoparticles with sizes around 2.6 nm, in aqueous solution has also been demonstrated from High Resolution Transmission Electron Microscope. The UV-VIS spectroscopic study on the functionalized NPs shows an intense peak at visible region as a consequence of electronic interaction of the citrate ligands with the surface atoms of the NPs. Picosecond time-resolved Förster resonance energy transfer (FRET) studies on the small ligands (like 4-Nitrophenyl anthranilate and 2-Amino purine) with the functionalized NPs, confirm the dipolar interactions of the ligands with the NPs and reveals the ligand binding sites of the NPs in the aqueous solutions. The FRET distances from the attached ligand to the host LSMO NPs also confirm the existence of the isolated functionalized NPs in the aqueous solution. Interestingly, the observed solubilization and the change in optical properties on fucntionalization arise because of the mixed valence nature of Mn.[1] "Functionalization of Manganite Nanoparticles and their interaction with biologically relevant small ligands: Picosecond Time-Resolved FRET Studies".

[1] To appear in Nanoscale : a Royal Society of Chemistry Journal.

The Importance of the Nineteenth Century

Jayanta K Bhattacharjee

Almost everyone would agree that Darwin's theory of evolution was the biggest scientific event of the nineteenth century. The tremendous impact of Darwin's theory makes people forget that the nineteenth century witnessed a quiet but profound revolution in the world of physics and what is more a qualitatively similar revolution took place in the world of literature and art.This parallel development was not along the expected lines. Edgar Allan Poe had boldly declared that art was neither utilitarian nor moral and did not have truth as its object. Listening to the scientific jargon of the "learned astronomer" Walt Whitman became "tired and sick" and wandering out in the "mystical moist night air" looked up "in perfect silence at the stars". It is our contention that in spite of these negative sentiments,the nineteenth century was unique in ushering in,almost imperceptibly, virtually identical transformations in attitude in the arts and the sciences.

The scientific revolution of the seventeenth century, pioneered by Galileo and Newton, familiarized people with the properties of particles and waves. Particles were clearly visible. Whether they were stars and planets or grains of sand, they all followed Newton's laws of motion. The ripples on the pond and the sound coming from the vibration of the violin strings were equally familiar waves. The problem case was that of light- a case close to Newton's heart. He declared that light consisted of tiny particles and let his imagination run riot to explain all the phenomena known to him. The first two decades of the nineteenth century established that Newton was wrong and light was indeed a wave. But what kind of a wave? Certainly not the kind that we can see! In the last quarter of the century it was realized ,courtesy Maxwell, that light was an electromagnetic wave. What was vibrating were the electric and magnetic fields. Here was the big leap forward- a transition from visible to abstract, from vibrations of a particle that one could to see to the vibrations of a field which is only a concept. The nineteenth century was not done yet. Toward the very end of the century ,light emerged as a particle again and when the dust settled it was realized that fundamental particles are simply manifestations of the vibrations of a field! A subtle but revolutionary change had taken place- the visible and easily understandable world of particles had been replaced by the far more abstract and demanding world of fields.

What about the world of poetry? The imagery of the romantics gave way to the more involved and subtle imagery of the "moderns". A few lines from Baudelaire will clarify "...I think of the negress, gaunt, tubercular,/ Trudging in the mud, and looking around her/ With haggard eyes for the palms of Africa/......./Of those who have lost what can never again/ Be found,never...".Closer to home it is the difference in imagery between Rabindranath and Jibananda. A transition from what directly affects the emotions to a circuitous route to emotions via the intellect. Identical transformation occurred in the world of art. First came the impressionists making the viewer think before appreciating and then the "moderns" with a more abstract outlook. The parallels with the scientific revolution demand a closer look at the nineteenth century.

When the Smiling Faces Fade

Sunish Kumar Deb

I was loitering along the Oak Avenue
The evening dawned with the setting sun
Lining up, down the valley
The oaks stood strong
Grew high, higher
Inspired by the snowy tips
To speak to the peaks
To hear their voice
The valley loved the embrace
Of the roots
And caress of the falling leaves
Felt the fever on the lap
While the last smiling rays
Glowed on the yellowing leaves
The dimming darkness gloomed the green.
Only oaks would know the oak-like men
Who grow tall aspire to speak to the peaks
The world stands up in awe and ovation
While their smiling faces fade
And the golden leaves glow for ever.

Photography

Saikat Debnath

"Celebration called life…"

In Nature

P. S. Deo

Bird: Moubaaz

Oriental honey buzzard Locally it is called Moubaaz (Baaj pakhi), although I see no Bengali name in Salim Ali's book. One of the few raptors found in our area in winter. It migrates from Central Asia, crossing the Himalayas. It covers more than 6000 miles in a single journey. It feeds on honey and bee larvae taken off live combs. It also hunts small birds and reptiles. The bird has adapted well and can be found in semi-urban areas.