Science Media Centre

'Need for a Science Media Centre (SMC) by Salwi makes interesting reading (*Curr. Sci.*, 1997, **73**, 721–722). In fact, this issue was published a few years back as a concluding remark in a write-up 'Popularization of science is gaining popularity' (*Curr. Sci.*, 1993, **65**, 441–442), as a follow-up of the initiative of the popular science wing of the Ministry of Science and Technology, the National Council for Science and Technology Communication. However, nothing concrete has emerged so far.

Interestingly, whatever Salwi has expected from the proposed SMC, one finds a ready-made solution in the form of ongoing multiple science communication initiatives (*Curr. Sci.*, 1996, **71**, 813). In so far as meetings with the scientists are concerned, the Indian Science Writers' Association (ISWA) has been convening such get-togethers on a regular basis for over a decade now. Excellent up-to-date publications such as Directory of R&D Institutions, R&D Statistics (both from the Department of Science & Technology, New Delhi) and Year Books of various national science academies provide instant information on nationwide scientific establishments, on-going trends in science and technology and a brief profile of scientists of repute, respectively. Information needs, especially from the research journals are being looked after by CAPS-Contents, abstracts and Photocopy Service of the Indian National Scientific Documentation Centre, New Delhi. For short-term courses/workshops in science communication, one can always look for the announcements of New Delhi-based Society for Information Science, ISWA and National Institute of Science Communication.

Ideally, these scattered science media needs need to be provided urgently under a single campus of the much-awaited SMC. It is high time that a professional society like ISWA rather than an influential individual, be identified as a nodal point for undertaking this important task.

N. C. JAIN

B-183 Suraj Mal Vihar,
Delhi 110 092, India

This refers to the article 'Need for a Science Media Centre' by Dilip M. Salwi. Indeed this is a welcome suggestion and must be paid attention to. In the era of globalization, the whole world is fast becoming a village and the dividing boundaries are collapsing with every passing day. In doing so, science is playing the lasting role. The advances made in the information technology in the form of cellular phone, pager, fax, e-mail have drastically reduced the distances between societies. Life is changing very fast and science and technology are playing a pivotal role. A major part of population is illiterate and even literate populace has a lot of biases, misconception and irrational thoughts about science. A common man has no access to any platform to know the facts of 'how and why' in science.

It is really surprising that in a country like India where 1000 million people live, the number of science journals can be counted on fingers. In print media the coverage received by science is very poor, rather negligible to say in certain periodicals. The communicators mostly have apathy for science news because most of them come from non-science backgrounds and they have no centre to approach for information. The science media centre can serve as a good platform for scientists. Communicators and media persons can assemble and have discussions. The centre will fulfil the long-felt need of science. Let us hope it will not get the fate of the much discussed and publicised 'National Science University'.

K. K. MISHRA

Homi Bhabha Centre for Science Education,
Tata Institute of Fundamental Research,
Mumbai 400 088, India

NEWS

High pressure research*

A well-attended meeting on high pressure physics and technology was held at Kalpakkam in September 1997. In his presidential address, S. B. Bhoje (Reactor Group, IGCAR) began his talk by drawing attention to how a few millibar fluctuation in atmospheric pressure can cause far-reaching effects like creating a cyclonic weather, a phenomenon experienced periodically at Kalpakkam and neighbourhood. Then he proceeded to discuss the role of shock pressures in metal bonding, formations of dish-ends, coolant tubes in heat exchangers, etc. in the mechanical engineering domain. He cautioned that one should watch out for pressure transients and their role in accident scenarios, especially in nuclear reactor systems that can affect container vessels and even the containment of the reactor itself. The equation of state of

*This is a report on the Proceedings of the Fourth National Conference on High Pressure Science & Technology (IV NCHST) held at Indira Gandhi Centre for Atomic Research, Kalpakkam, 11–13 September 1997.

alloys takes importance from the point of view of safety of such systems. Bhoje's talk also focused attention on various techniques based on hi-pressure in civil and mechanical engineering like use of water jets for cutting – one can even visualize use of such jets for cutting large-scale structures like the Kaiga reactor dome which needs to be repaired. Through these examples, Bhoje brought a freshness of approach to pressures which one comes across in many of these situations; sometimes they are static, sometimes they are transitory but by no stretch of imagination can these pressures be referred to as 'hi' pressures. Still, the applications in technology are truly impressive. In passing Bhoje also referred to the use of some of the computer codes developed for reactor safety under transient pressure excursion scenarios in relation to armament applications. The conference was inaugurated by R. Srinivasan, presently at Raman Research Institute, Bangalore. His remarks dealt with the importance of high pressure studies of properties of condensed matter systems, other than the conventional studies of transport properties like resistivity; he emphasized the need for measurements like those of specific heat or conductivity or of nuclear magnetic resonance under high pressure, because of the importance of such studies *vis-á-vis* atomic and molecular dynamics in various systems.

The papers presented in the conference can be broadly classified as (a) theoretical approaches and computations; (b) techniques and instrumentation; (c) material studies.

(a) Total energy computations of a variety of solids were dealt with in several invited talks: (i) on alkali hydrides by R. Ahuja (Uppsala University, Sweden) – The importance of these studies arises because of the interest in metallic hydrogen and also in what was referred to as 'proton hydride'. Within the local density approximation, he has employed the full-potential linear-muffin-tin-orbital (LMTO) method for these studies. The structural phase transition pressures around the NaCl → CsCl → CrB structures derived from the computations are cross checked with available data in a few cases and based on the satisfactory nature of this agreement, predictions of phase transition pressures in other cases are also made. Particularly the prediction of a phase transition at 35 GPa in RbH is noteworthy as this pressure range is now accessible in our laboratories. However, it may be noted that comparisons of theoretical results of structures by Ahuja are confined to X-ray diffraction data; high pressure data in alkali deuterides may be important to be obtained by neutron diffraction studies. (ii) Two groups of workers from Anna University, Chennai and others had contributed a large number of papers dealing with band structure calculations of a variety of compounds using LMTO method under slightly different approximations. Essentially these studies aimed at investigating phase stability of the compounds by computing the total energies of different structures for various values of cell volumes. Having located the phase transition pressures from one structure to another to correspond to minimum total energy, further parameters like lattice constants, bulk modulus, EOS, etc. were also determined. The band structures were used to understand the nature of density of states *vis-á-vis* Fermi energy and electron transfer, if any, as a function of pressure. During discussions, it was noted that there were many queries regarding the validity of approximations made, criteria for relating to superconductivity, etc; except in cases where the already-existing experimental data gave support to some conclusions, in other cases the situation regarding predictability seems to be far from satisfactory. (iii) The *ab-initio* approaches mentioned in the above paragraph deal with systems containing say, 2 or 3 atoms/cell, at the most. However, they are not ammenable for studying more complex systems containing, say, 20 atom/cell or even 100 atom/cell in case of some minerals. Phenomenological approaches seem to be the only way to deal with such situations. Therefore, in this context, S. L. Choplot's (BARC) paper dealing with molecular dynamics of complex systems assumes significance. The phase diagrams and phase transitional nature of a variety of minerals of geophysical importance were discussed in his paper. This study brought together and depended on the full power of neutron scattering on one side and lattice dynamical calculations on the other, and finally molecular dynamics using a powerful parallel processor at BARC. These phase diagrams have revealed the nature of high pressure and temperature phase transitions observable in *in-situ* laser heated diamond anvil pressure chambers mounted on synchrotron diffraction facilities. These studies can, therefore, throw light on the nature of geophysical transition zones in the upper and lower mantles of the Earth.

(b) In the field of 'Instrumentation and techniques, methodology of calibration and experimentation', there were papers that dealt with development of image plate reader (IGCAR), a micro-strip detector (IISc), a high pressure cell for neutron diffraction (BARC), design aspects of high pressure vessels (IGCAR), pressure standards (NPL), etc. These are important developments. However, there is a definite need for development of high pressure cell for neutron diffraction which can be used at high pressure to, say, 200 kbars, with variable temperature control from low (say, 100 K) to high (say 800 K) ranges. The Paris–Edinburgh cell being used at Rutherford Appleton Laboratory routinely allows users to explore pressure ranges up to 200 kbar for neutron diffraction. The high pressure community in India must design and develop a suitable cell for meeting our own needs at Dhruva reactor.

Three papers dealt with dynamic pressure generation: (i) via high magnetic field generation by discharging high capacity capacitor banks. Anurag Shyam (BARC) presented the details of development of magnetic field-driven shock wave system, the electronic gun and the rail gun. These facilities give access to very high pressures of the order of a few megabars on small samples or can impact targets by projectiles travelling at a few km/s. In the opinion of R. Srinivasan, even the high magnetic fields generated in the discharge of capacitor banks would be of interest as an experimental environment. Anurag Shyam also drew attention to the high-velocity massive projectiles that can be generated using the rail gun facility which is of importance for defence applications.

(ii) The talk by Lalitha J. Dhareswar (BARC) on generation of laser-generated shock waves in BARC had many salient features: a 10 Giga Watt power Nd : glass laser (1 J/100 ps) has been operating to generate focused laser intensities in the range of 10^{11} to 10^{13} W/cm^2. This laser facility has been provided with diagnostic techniques involving optical shadowgraphy, optical interferometry, an optical streak camera and a velocity interferometer. Several experiments have also been performed. The most important development as a result of this intensive effort is the generation of uniform planar shocks (using X-rays from the laser-produced plasma in the ablated region of the target) of about 100 kbar/4 mm^2.

(iii) K. D. Joshi (BARC) on the effect of shock loading said that the dynamic pressure ~ 30 GPa can be generated in the BARC-developed gas technique. It is observed that the grain size plays a major role on the onset of the amorphization in $Ca(OH)_2$ and $Ni(OH)_2$.

Among the techniques discussed, there were two papers from the NAL group (T. G. Ramesh *et al.*) on AC specific heat and AC resistivity and thermoelectric power measurements; these techniques are shown to be extremely sensitive compared to conventional, say, resistivity measurements. These techniques are extremely powerful for high pressure measurements, as they help in identifying the transition pressures unequivocally. For instance, using AC resistivity technique a direct evidence for a commensurate to incommensurate transition in Cr–Mn system has been provided.

(c) In the group falling under the category of 'Materials studies', I shall endeavour to draw attention to a few selected presentations owing to the large variety of experiments and results presented and lack of personal ability to be able to summarize all of them. (i) High pressure group at IGCAR has set up a world class instrumentation on high pressure X-ray diffraction in that the DAC has been coupled to the Guinier diffractometer. The system offers a truly monochromatic and focused X-ray beam. The team has been working on the pressure-induced behaviour of f-electron based systems. Because of the chemical reactivity and nuclear radioactivity, performing the experiments requires added safety regulations. N. V. Chandra Shekar described the current work done on actinide and lanthanide-based aluminides. The results on $ThAl_2$ and $CeAl_2$ are particularly interesting as both of them exhibit isostructural electronic transitions. By *ab initio* TBLMTO electronic structure calculation, the iso-structural transition in $CeAl_2$ is identified to be a Lifshitz transition. Chandra Shekar also talked about the development work that the IGCAR group has undertaken about the laser-heated diamond anvil cell to generate the high pressure, high temperature conditions simultaneously enabling them to carry out EOS studies on nuclear materials.

(ii) Anil Kumar (IISc)'s talk on 'Critical points' dealt with very many subtle aspects of a host of critical points and phenomena one comes across in liquid mixtures, magnetic systems and so on. The lucidly-presented talk began with temperature vs. concentration diagram showing a critical point and thereafter dealt with double critical points and spinodal decomposition. The nature of critical exponents, universality of the critical phenomena in a variety of systems like liquid mixtures, liquid crystals and 2D systems and nature of multicritical points were discussed. He highlighted the experimental difficulties involved in reaching close to the critical point either temperature-wise or in terms of other variable parameters that control the approach to criticality. As an example he dealt with the case of addition of D_2O to a liquid-mixture in delineating its critical properties. Application of pressure has the same function as addition of D_2O. Then he dealt with separating or opening a loop in the phase diagram by application of pressure which can also be accomplished by addition of 'a pinch of salt'. Finally he referred to the non-monotonic cross-over phenomena recently observed by his group experimentally.

(iii) The two talks related to laser Raman spectrocopy of materials under high pressures were by S. K. Deb (BARC) on porous silicon to examine photoluminescence behaviour and by A. K. Arora (IGCAR) on pressure-induced amorphization of a variety of materials. Deb discussed the role of particle size on Raman line shapes and the importance of taking into account the behaviour of phonon dispersion relation as a function of pressure, especially when one is handling nano-size particles as may occur in porous silicon. Arora dealt with pressure-induced amorphization that is found to occur in a variety of systems. He dealt with the nature of metastability and disorder in this process and discussed how Raman spectroscopy and X-ray diffraction techniques can be used for detailed investigations of this interacting phenomenon.

(iv) There was a plethora of interesting talks on a variety of topics dealing with the use of high pressure as a tool to study materials like: glasses by A. Srinivasan (IIT-Guwahati), fullerenes by Y. Hariharan (IGCAR), liquid crystals by S. Krishna Prasad (CLCR), synthesis and sintering of ceramics by S. K. Bhaumik (National Aerospace Laboratories) and so on.

There have been other highlights in this conference: (i) the evening lecture by G. Srinivasan (RRI) on 'Journey to the center of a neutron star' was a scintillating talk given by a hard core solid state physicist cum astrophysicist. He could rationalize information derived from radioastronomy with theories of evolution of neutron stars involving ordered ^{56}Fe crystal on the crust going into superfluid and superconducting nuclear sea in the interior. He brought in concepts of general relativity, quantum mechanics and condensed matter physics. The range of pressures he was referring to was of the order of 10^{25} bars or so, a 'colossal-super-ultra-hi-pressure' situation. I cannot easily forget the reference he made to the entanglement of two types of superconductivity-related vortex-lines which get pinned to the crust of the neutron star, how on release of internal energy, the crustal plates get cracking and get torn apart along with the vortex-lines. He gave analogy to breaking up of concrete slab through which embedded steel rods can get torn apart. It was an enriching lecture, enjoyable because one could see concepts of solid state physics in action to unravel mysteries of astronomical objects.

(ii) The organizers had conducted a 'session on diamonds' late in the evening preceding dinner on the beaches of Mamallapuram. The session was compered by Govinda Rajan and included a brief talk by Michael Bonke of Aditi Diamonds (P) Ltd of Pondicherry and Germany. Bonke discussed various aspects of choice of proper diamonds for high pressure diamond anvil cell (DAC) processes involved in cleaving along required planes, cuts on diamond, checking the perfect parallelism between the culet and the table of the diamond anvil, etc. His team from Pondicherry had put together several tools for demonstration of cutting, polishing, etc. Aditi Diamonds have been providing specially prepared and characterized diamonds for the DAC based on the technology developed at IGCAR. The DAC is available for sale. This session, I must say, was a rather unusual one, the type of which one does not come across in conferences. The audience participation in the question–answer session was quite good and informative.

(iii) Another important highlight of this conference was inclusion of nearly a dozen papers dealing with mineral science, geophysics, geochemistry and planetary sciences in the proceedings. These papers covered a variety of topics wherein high pressure plays an important role in various phenomena: behaviour of chromium as a fluorescing element, variation of coordination of silicon, phase transformation of minerals, high pressure and high temperature metamorphization of various types of rocks, etc. Facilities available for synthesis of minerals at Mysore University had been made use of in preparing many synthetic minerals with and without H_2O. This effort of the organizers to bring together geologists and solid state physicists is commendable as such, inter-disciplinary approaches provide an opportunity for appreciating each other's points of view and promote collaboration to further studies in mineral physics, Earth's structure and planetary sciences.

K. R. Rao, 'Gokula' 29/2, 11th Cross, 3rd Main, Malleswaram, Bangalore 560 003, India

RESEARCH NEWS

1997 Nobel Prize for Medicine: Prions as proteinaceous infectious particles

The term 'prion' was introduced in 1982 by Stanley B. Prusiner of the University of California (San Francisco), who has been awarded the 1997 Nobel Prize for Medicine. Earlier, he also won the prestigious Lasker Award in 1994. The term 'prion' was used by him to characterize the proteinaceous infectious particles causing a variety of mammalian neurodegenerative diseases which are generally fatal and are referred to as transmissible spongiform encephalopathies (TSEs)[1]. These diseases included scrapie in sheep and CJD (Creutzfeldt–Jakob Disease), FFI (fatal familial insomnia), GSS (Gerstmann–Straussler–Scheinker disease) and kuru in humans. Kuru is a fatal disease, which occurred among cannabilistic tribals of Papua New Guinea. Aberrant infectious proteins are also believed to cause the 'mad cow disease' or 'bovine spongiform encephalopathy' (BSE) in cattle, which in 1996 created a panic in Britain following reports of human cases that were suspected to be caused due to eating BSE-tainted beef. Two prion-like determinants {[PSI], [URE3]} have also been described in yeast.

Despite being infectious, prions differ from viruses, viroids, virusoides or satellite RNAs and retroviruses in having no nucleic acid components whatsoever (viruses have their own DNA/RNA and proteins; viroids are RNA molecules not encapsidated; virusoids are nucleic acid molecules encapsulated by protein coat derived from other viruses, and the retroviruses carry cellular oncogenes). The absence of nucleic acids and presence of only proteins in these infectious particles were initially proved, when it was observed that UV and ionizing radiations (which damage nucleic acids) did not cause any loss of infectivity[2], while treatments involving modification or hydrolysis of proteins caused loss of infectivity[3]. Prion-like elements of yeast are also discussed as cases of 'protein conformation-based inheritance', thus challenging the paradigm that nucleic acids are the sole hereditary determinants in all living organisms. However, there are workers, who still believe that some undiscovered viruses and/or nucleic acids may be associated with the above prion diseases and the prion-like elements of yeast.

Earlier in 1994 and more recently, in 1997 (see ref. 15), experiments have been reported, where a change in one protein due to another protein has been successfully achieved in the test tube, thus giving further strong support to the 'prion hypothesis'. However, it could not be proved beyond any doubt, that prion proteins can cause these diseases without another 'helper' molecule (e.g. a lipid molecule, a sulphated glycosaminoglycan, or a chaperone protein). Such a final proof would actually require designing of an experiment involving the following steps: (i) *in vitro* synthesis of prion protein under conditions guaranteed to be free of viral nucleic acid; (ii) change of the protein synthesized *in vitro*, into its 'rogue state', and (iii) the ability of this modified 'rogue state' of protein to cause disease on infection. Although success