On the morality of scientists

S. Ramaseshan (*Curr. Sci.*, 1999, **77**, 1110–1112) and Murthy *et al.* (*Curr. Sci.*, 2000, **78**, 19–22) view Haber's actions without due consideration of the circumstances leading to these actions. Paying due attention to these circumstances is necessary to obtain a true picture of Haber's morality. Germany is a late starter in industrialization. Starting from the mid-nineteenth century a growing Germany began to collide with the inexhorable expansion of England and Russia. France, for historical reasons, regarded Germany as her natural enemy. These three, with England at the helm, did everything in their power to crush the emerging Germany. It is this rivalry which led to the European war of 1914–1917.

In this war Germany was being squeezed between two fronts. On the eastern front she had to face the Russian armies while on the western front she faced the combined Anglo-French armies backed by the wealth of their worldwide possessions and by the industrial power of America as well. (It is interesting to note here that nearly one-third of the western front allocated to England was manned by Indian soldiers, shipped from India as canon fodders in the interest of England.) On the top of this, English naval blockade of Germany was total and causing massive shortage of food and raw materials vital for the functioning of the country, let alone for waging a two-front war. Widespread famine and death were looming large. It was a life and death struggle for Germany and every citizen was duty bound to lay down her/his life in defence of the fatherland. Precisely during this time Haber advocated the use of chlorine on the front.

On the other hand, atomic bombing of Japan is a different matter altogether. Here the roles were reversed. In the last months of war Japan lay defenceless on the face of massive American onslaught. Under these circumstances there was no compelling reason for America to use atomic weapons against Japan. Certainly the recommendation of the target committee and the scientific panel was immoral. Therefore, considering the circumstances under which Haber made his recommendation, it cannot be placed in the same category together with that of the American target committee and the scientific panel.

Although the security situation of India may not be as precarious as that of Germany in 1915, India, like any other nation, has an inalienable right to self-defence. India is not an initiator of nuclear armament. She is only responding to developments elsewhere and is reluctantly (after a delay of nearly fifty years) seeking to establish a deterrent force. Consequently the scientists working to create this deterrent cannot be labelled as amoral. After all they are exercising their right to self-defence.

Independent of all these discussions on the morality of the scientists, however, is the obvious truth, that against cannons and nuclear missiles, morality has no chance at all.

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Soft condensed matter physics

The topic of the fifth Kumari L. A. Meera Memorial Meeting on Frontier Areas in Physics, 'Soft Condensed Matter Physics'* happens to be the first one in Experimental Physics that the Trust has arranged, the earlier ones having been all related to topics in Theoretical Physics. Five lectures everyday, followed by student seminars and tutorial sessions comprised the timetable of the meeting. Nearly 25 young researchers had been selected by the Trust to participate in the Discussion Meeting.

Soft Condensed Matter (SCM) comprises a bewildering but ubiquitous variety of materials that cannot be classified as simple solids or liquids. For example, emulsions, foams, soaps and detergents, suspensions, polymers, membranes, surfactants, liquid crystals, magnetic ferrofluids, colloidal crystals, etc. fall into this category of materials. The constituent molecular sizes vary from a few tens of angstroms to a few microns. Understanding the nature of the structure and behaviour of this wide class of materials has been a challenging and interesting field of investigation. Such studies assume added importance because of the wide variety of applications that SCM find in day-to-day life like in plastics, milk, paints, shaving creams, cosmetic creams, blood, disk drive lubricants, display devices and in medicine, chemical engineering industry and so on. Many varieties of experimental techniques have been used in the investigations.

Sriram Ramaswamy (IISc), the course coordinator, provided the General Introduction to the subject of SCM which occupies the middle ground between solids and liquids. He said that there is much physics in this inclusive subject. Ramaswamy noted that these materials are soft as the name implies and provided a working definition of SCM by stating that the shear modulii of these materials *over a given time scale* are

*This meeting was conducted by Kumari L. A. Meera Memorial Trust, Palghat, from 27 January to 2 February 2000 at Dhvanyaloka, Mysore.

very much less than their bulk moduli. Typically, the bulk moduli are nearly 10^{12} dyn/cm^2 whereas the shear moduli could be in the range 1 to 10^6 dyn/cm^2. SCM are characterized by large polyatomic molecules; they organize themselves spontaneously, have a strong response to modest external perturbations, exhibit novel flow properties, and they generally have low density and weak conductivity. Because of the beautiful, puzzling and striking phenomena which one can see and feel, SCM are worth studying and there is subtle physics in ordinary day-to-day materials. Then he reviewed a variety of experimental techniques used in the study of SCM. In subsequent lectures, Sriram Ramaswamy reviewed general principles required to build a complete theory of long wavelength statics and dynamics of fluids, suspensions, liquid crystals, etc. all at or near thermal equilibrium. He also took up the case of simple non-equilibrium state of crystalline objects moving through dissipative media, for example, drift of flux line lattice in type II superconductors and colloidal crystal suspensions settling steadily under gravity. Finally, he dealt with the calculation of static properties of isolated membranes.

C. Manohar (IIT, Mumbai) dealt with surfactants. Surfactants are molecules having terminal hydrophilic and hydrophobic groups. The aggregation of these molecules into micelles of various shapes depends on the pH, temperature, and other characteristics of the solvents in which they are dissolved. Manohar reviewed a variety of experimental results pertaining to various properties of surfactants like their aggregation number, surface charge, critical micellar concentration, clouding phenomenon, etc. derived from light scattering and small angle neutron scattering (SANS). Many other techniques have also been used including electron microscopy, conductivity, and birefringence. The kinetics of micelles depends on the nature of aggregation. Manohar also dealt with several applications of surfactants in solubilisaton, wetting, and catalysis, etc. and with biomineralization. In his last lecture, Manohar dealt with emulsions, microemulsions and liquid crystals. He also covered some applications in preparation of nano-particles, reactions and formulations.

R. V. Mehta (Bhavnagar University) discussed the nature of ferrofluids, which are colloidal dispersions of non-magnetic particles; they are complex as well as intelligent and exhibit characteristics of ferro-ferri-magnetic materials and those of fluids. It is possible to tailor a ferrofluid for a particular application, whether it is for vacuum sealing or for printing or for rotating shaft seals or for transformer oil cooling. The Bhavnagar group has pioneered experimental activities in the area of ferrofluids with synthesis at one end, through basic research to patenting applications at the other end. Mehta covered several aspects of this interesting SCM taking examples from personal experience. He dealt with the nature of the so-called body force that affects the hydrodynamics of ferrofluids. While the lectures dealt with several spectacular phenomena like spike phenomenon, levitation, non-mechanical fluid motion, patterns and their theoretical modeling, the lectures were followed by equally spectacular demonstration experiments using ferrofluids synthesized at Bhavnagar.

P. S. Goyal (IUC-DAEF, Mumbai) discussed the role of small angle neutron scattering (SANS) in study of SCM. While discussing details of the technique, one of the important points that he brought out is the richness of contrast variation technique that one can employ to view different components of SCM assemblages. Based on use of a SANS spectrometer at CIRUS and DHRUVA reactors at BARC, Mumbai, Goyal and collaborators have investigated a number of micellar solutions like SDS, CTAB, Gemini surfactants and di-block copolymers. He presented many results from his studies.

G. S. Ranganath (RRI, Bangalore) gave a detailed review of the subject matter of liquid crystals. In his three lectures, Ranganath dealt with the basic structure, properties and texture of various phases of plastic and liquid crystals. After covering the magnetic and electric field effects and consequent instabilities that arise in such systems, he proceeded to discuss the nature of topological defects, namely, the disclinations, dislocations and domain walls. Light scattering techniques have been used extensively in the study of liquid crystals. The lectures included interesting demonstrations of phenomena exhibited by some liquid crystals under polarised light.

A. K. Sood's (IISc, Bangalore) lectures complimented many aspects dealt earlier by Sriram Ramaswamy, mainly dealing with the study of colloidal systems. Colloidal crystals are being used as temperature sensors, chemical sensors and so on. Dealing with opals formed of silica particles in colloidal suspensions along with amorphous silica, Sood discussed the nature of beautiful diffraction effects. He pointed out how charge stabilization and steric stabilization play important roles in colloidal stability. He dealt with the nature of interactions in a mixture containing hard and soft spheres; one of the unresolved questions is whether addition of short-range interaction to van der Waal interaction brings about overall attraction among the constituents. The nature of phase diagrams in colloidal systems, physics issues pertaining to field-induced ordering, shear-induced melting, fractal aggregation, etc were described. Experimental techniques like dynamical light scattering and fluorescence spectroscopy are being employed to study dynamics of colloids. Rheological studies of micellar systems were also discussed.

Gautam Menon (Institute of Mathematical Sciences, Chennai) dealt with 'Brownian Motion and Biology inspired Physics'. Beginning with a general survey of diffusion starting from elementary ideas about random walks, he established the connection between random walks and models for ideal polymers and their generalizations. He spoke of applications of diffusion physics in a biological context using the example of how the lac repressor protein finds an operator site in the DNA of *E. coli* through a combination of 1-D and 3-D diffusional searches. Later he described how polymerization processes out of equilibrium could be used to generate forces in the biological context. Such force generation is a vital ingredient in cell division. Finally, Menon detailed some of his own work on molecular motors and modeling interactions among motors using tools of non-equilibrium statistical mechanics.

B. V. R. Tata (IGCAR, Kalpakkam) dealt with ordering, dynamics and phase transitions in charged colloids investigated by techniques of laser light scat-

tering, ultra small angle X-ray scattering, digital video microscopy and confocal laser scanning microscopy. His talks overlapped those of Sood when he discussed experimental and simulational work on understanding the origin of attractive interactions in colloidal systems with detailed illustrations. So also his presentations dealing with phase transitions observed in colloidal systems by varying particle concentration, salt concentration and charge had echoes of behaviour described earlier in surfactants by Goyal and Manohar.

D. Khakhar (IIT, Mumbai) dealing with suspensions and powders described some of his work on coalescence in emulsions; these processes are of vital interest to industries in the preparation of paints, coatings, cosmetics, cutting oils, foods, etc. Another topic that Khakhar spoke about related to ubiquity of problems involving granular matter. In a striking tabletop demonstration, he illustrated segregation and pattern formation in a rotating drum, filled with particles of two different sizes.

The Meeting was notable because of several highlights: (a) Theoretical ideas and models went hand-in-hand with tabletop experiments, for example, by Mehta and coworkers on ferrofluids, by Ranganath on liquid crystals and by Khakhar and his students on granular media; some of the video presentations were also illustrative (b) The breadth of topics covered by speakers illustrated the vital character of the field of SCM (c) The interdisciplinary nature of the meeting – as it included physicists, chemists, biologists, chemical engineers and industrial scientists – helped to focus attention on common problems (d) The lecture by V. M. Naik (Hindustan Lever Research Centre, Bangalore) related research aspects of SCM physics and chemistry to industrial needs and requirements (e) Participant seminars (f) Extensive and informal interactions among all the participants, thanks to the residential nature of the Meeting at Dhvanyaloka. C. D. Narasimhaiah of Dhvanyaloka has been a key factor in the success of these meetings. It would be in the fitness of current trends in Science that the Trust should arrange more such meetings taking into account borderlessness amongst various disciplines of science although physics continues to play a catalysing role in all science activities.

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ICQ7 discussed behaviour of quasicrystalline intermetallics

The 7th International Conference on Quasicrystals (ICQ7) held at Stuttgart (Germany) during 20–24 September 1999 ended after a meaningful deliberation on the problems and the prospects of structure–property correlation in the entire gamut of metallic systems having large unit cell or no unit cell (may be a quasiunit cell in the intermetallics). ICQ7 attracted over 250 participants from 25 countries. The technical programmes were rich in both quality and quantity. Various aspects of quasiperiodic and long period metallic systems were covered in the following broad catagories – (A) Synthesis, metallurgy and characterization; (B) Structure and mathematical modelling; (C) Electronic and magnetic properties; (D) Thermal and dynamic properties; (E) Mechanical properties; (F) Surface and thin films. The latest developments in these areas were reviewed by 22 invited speakers and the state-of-the-art was presented through 37 oral contributions and more than 200 posters. The theoretical and experimental results clearly demonstrated the interdisciplinary nature of the subject. The proceedings of the conference will be published in the international journal *Materials Science and Engineering A* after peer review. India has been invited to host ICQ8 at the Indian Institute of Science, Bangalore during September 2002.

We shall summarize some of the important results, which may be helpful in addressing the unresolved issues in metallic systems having long finite periods and also without any periodicity comparable to the size of the system.

A) Synthesis, metallurgy and characterization: 4 invited lectures, 5 contributed talks and 45 posters were presented in this category. J. M. Dubois (France) stressed the need of precise knowledge of phase diagrams of the multicomponent systems for quasicrystals to be a potential candidate for technological applications. He began his talk with two products commercialized from these materials which refer to precipitation hardened steel and low adhesion coating. The other applications could be in the area of high performance tools, reduction of friction and wear, energy storage and thermal barrier materials. Other important papers pertained to the growth of single grain quasicrystals, phase transitions in qcs, conditions of formation of quasicrystals in Mg–Zn–RE, Al–Co–Ni, Al–Pd–Mn, Al–Cu–Fe and other systems. Newer methods of synthesis of materials were also discussed. Processing of composites by various routes was also presented.

B) Structure and mathematical modelling: In this category, there were 6 invited lectures, 13 contributed talks and 73 poster presentations. Knowing the underlying atomic arrangements in amorphous, crystalline and quasicrystalline solids has always fascinated scientists for comprehending structures and consequently their properties. Realizing the importance of this topic, the organizing committee supported the satellite workshop on 'Structure analysis of quasicrystals' by C. Beeli and W. Steurer after the conference during 24–25 September 1999. As a part of recommendations of this workshop, all published literature pertaining to structure will be kept in public domain which can be accessed free of cost by all the internet users. The website will be created by Walter Steurer and his colleagues at Zurich (Switzerland). The above theme in the ICQ7 included lectures like those of (a) Jefferry Lagarias (AT&T Bell lab, USA) on the concept of quasi-unit cell for a class of decagonal phases (b) F. Frey (Munchen, Germany) on diffuse scattering and those concerning subtle details of HREM and X-ray diffraction studies using imaging plates.