of the flame by argon coming through a glass nozzle (1 mm dia) at a stagnation pressure of 1.5 atm and collecting the soot on a cooled copper surface positioned opposite the nozzle. We could collect ~5 g of the soot after 3 h of operation, expending 250 ml of benzene. The soot was washed with ether, and the taluene extract of the residue dried and analysed by mass spectrometry. The mass spectrum showed the 720 and the 840 mass peaks (as well as the *m*/2 peaks). The proportion of C_{60} was higher and the total yield of fullerenes was ~0.1% with respect to the soot. The yield can be improved by quenching a larger area of the flame. The observation of fullerenes in such simple benzene flames is not only of significance in understanding the origin of fullerenes as well as the formation of soot, but also suggests the possible occurrence of these species in the environment.

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Non-reflective surface for insect eye

In compound eyes of insects, the function of the 'dioptric apparatus', which is a modified cuticle, seems to be extensive and varied. The eye cuticle plays an essential role as an interference filter, in reflecting specific wavelengths from the trachea behind the receptive cells, and also in reducing reflection at the eye surface[1-3]. Although the lens is a refracting structure, small reflections are produced in it in the region where there is a sharp transition in refractive index. It has been calculated from the Fresnel formula that the intensity of reflection from the ocular refractive surface is 4% of the incident beam. Owing to this reflection from the refractive surface image quality is degraded, because of glares and ghosts, and intensity of the image is also lost.

Similar reflections are produced in the surfaces of optical lens, camera and microscope. To reduce this effect, good-quality lenses are coated with thin layers designed to reduce the reflection[4]. It is interesting that corneal cuticles of some insect species, e.g. moths, have some mechanisms to make the surface non-reflective. The reduced reflection observed in the moth cornea was attributed to the presence of an array of conical cuticular protuberances, termed corneal nipple[2]. These protuberances, a characteristic feature of the nocturnal moth, were also detected in some diurnal lepidopterans that contain reflecting tapeta in their eyes. Corneal nipples are classified according to their height as Group I (50 nm or less), Group II (between 50 nm and 200 nm) and Group III (200 nm or greater) protuberances. Although the lower-height Group I protuberances have been detected in many insect species of different orders, reports of occurrence of Group II and Group III protuberances in corneal cuticle of insects other than moths are scanty[5,6]. Here I report the occurrence of group II protuberances in the corneal surface of a diurnal fly, *Lonchae* sp.

The eyes were fixed in 2.5% glutaraldehyde in 0.1 M sodium cacodylate buffer for 4 h at 4°C, post-fixed in osmium tetroxide, and dehydrated through increasing concentration of acetone. Dehydrated samples were critical-point dried using acetone as intermediate fluid and CO_2 as transitional fluid. The dry samples were secured horizontally to brass stubs by electroconductive paint, and coated with gold in a fine-coat ion sputter. Observations were made with a JEOL JSM 35 CF scanning electron microscope operated at 15 kV. Tilt control was fixed at 0° for setting the specimen stage in a horizontal position.

The corneal surface of *Lonchaea* (Figure) is covered with nipples with a height of 160 nm and a periodicity (centre-to-centre distance) of about 200 nm. However some variations were observed in height and periodicity of the nipple in certain parts of the facet.

The corneal nipple, which covers the cornea of refractive index $n_3 = 1.5$, can be treated as a thin film n_2 of thickness *d*. The refractive index of the nipple increases smoothly from n_1 of air at the tip to that of cornea at the base. It is known that if n_2 is a gradual transition between n_1 and n_3 with a thickness $d = \lambda_0/2$, a broad-band anti-reflection effect is achieved[4]. Since corneal nipples with a height of more than 50 nm fulfil the criteria for thin-film anti-reflection coatings, it is certain that the protuberances detected in the present case also perform a similar function.

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Solar plasma physics

Though belated, I wish to draw attention to the discussion on solar plasma physics at the International Astronomical Union symposium on 'Basic plasma processes on the Sun' held during 1–5 December 1989 in Bangalore. The symposium was hosted by the Indian Institute of Astrophysics. Our knowledge of plasma physics comes mainly from laboratory studies, though, more recently, space missions to solar-system bodies and extremely high-quality observations of the Sun have triggered tremendous theoretical activity at a rather advanced level. The study of plasma processes in and on the Sun acquires special significance in view of the fact that most plasma processes like magnetic reconnection (rapid annihilation of magnetic fields), plasma heating, acceleration, nonthermal radiative processes, and generation of magnetic fields also occur in the rest of the universe. The rest of the universe, however, does not reveal itself the way the Sun does. Solar neutrino studies have brought out the role of rotation of plasma in the core and magnetic field. One is also aware of how the rotation and magnetic field could turn a core collapse into an outgoing wave. One would like to know the signatures of particle-acceleration processes that might occur in a supernova shock wave, of the stochastic acceleration in the turbulence generated in supernova ejecta, or the acceleration by strong pulsar electric fields. *In situ* observations of these sites will not be available in the foreseeable future. Thus, as many eminent astrophysicists have said, the best chances of testing these theories are in the solar context.

The Sun can be understood predominantly in terms of three types of interactions: (i) nuclear interactions, (ii) interaction of velocity and magnetic fields, and (iii) interaction of charged particles with electromagnetic fields. However, the boundaries of their play are not so well defined and this is what keeps solar physicists busy decade after decade.

The solar interior is in some sense more distant than the most distant galaxies since the interior and the surface are separated by a medium of optical depth of about a hundred million. The medium in between (the convection zone) is a highly turbulent one of complex interaction of velocity and magnetic fields, and cannot be seen but can be heard. The sound speed, the depth of the convection zone, and the equation of state are determined from helioseismological studies. A gratifying revelation is that the traditional solar models appear to be reasonably close to reality. The fine structure in the sound spectrum still needs to be interpreted for delineating the influence of magnetic-field geometry on sound frequencies. The project GONG (global oscillation network group) is eagerly awaited.

Cosmic magnetic fields are generally believed to arise from a dynamo mechanism in which a seed magnetic field feeds upon flows in an electrically conducting medium. Linear theory can account only for the 22-year solar cycle. Observations of many periodicities, large and small, demand the rigours of nonlinear theory, in which interaction among several modes may produce a multiperiodic or even a chaotic system. Interpretation of the ambient field, the loss or annihilation of magnetic flux, the averaging procedure, the origin and detailed characteristics of unstable convection, location of the dynamo, and the relationship of the outgoing plasma flow to the surface fields are some of the essentials that must be integrated self-consistenly into any up-and-coming theory of the solar magnetic field.

Observations have revealed that the plasma in the solar surface is dominated by structures of different sizes and lifetimes. Thus the photosphere shows granular patterns of plasma flows and the huge concentrations of magnetic fields as sunspots; the chromosphere is characterized by supergranular flows aligned with the magnetic fields, spicules rising upwards to coronal levels, and the corona itself, with its own loops and arches, moving around turbulently. These structures owe their shapes to magnetic fields, their sizes to pressure balance, and their lifetimes to their ability or otherwise to withstand the external driving. The Magnetic fields have their roots somewhere in the convection zone and are therefore being continuously churned by the convective motions. These motions can excite waves, which show up as oscillatory Doppler shifts in spectral lines, and instabilities, which show up as transitory sporadic variations in line intensities and other emissions and also as long-lasting configurations in a quasi-equilibrium state. The traditional way of modelling these processes is to look at them as responses of a given system to small disturbances, and taking nonlinear effects into account by perturbation methods. The distracting variety of perturbations that a system can be subjected to and an equally large number of resulting manifestations can be quite baffling. So new methods are being developed to describe a turbulent magnetohydrodynamic plasma in its entirety in terms of a few global properties that are in principle measurable. A turbulent state relaxes under the constraints imposed on quadratic invariants like total energy, magnetic helicity, enstrophy and cross-helicity, and higher-order invariants describing correlations among velocities and magnetic fields, combined with their differential decay rates. Minimization of a rapidly decaying invariant associated with its cascading characteristics (e.g. the total energy) and maintaining the constancy of a slowly decaying invariant (e.g. magnetic helicity) allow us to use a variational principle to scale the spatial profiles of the fields in a steady state. These ideas are being explored to examine what information structures like coronal loops, prominences and solar granulations carry. At this stage, it is not clear which invariants are the most relevant and what it is that one should minimize—the energy or its dissipation rate. This approach to studying a nonlinear, nonequilibrium, energetically open turbulent medium is rich with potentialities that await appreciation.

The heating of the solar corona is a million-degree question, the answer to which remains elusive in spite of the concerted efforts of many over many decades. The corona is continuously losing energy and momentum through radiative, conductive and convective processes. Its replenishment in the form of mechanical and magnetic energy must come from within the convection zone. Since the solar corona is highly structured owing to the presence of open and closed magnetic field lines, the energy requirements vary accordingly. There are basically two different mechanisms of heating depending upon the dominance or otherwise of the magnetic field. The nonmagnetic or mechanical heating processes operate when mechanical energy in the form of acoustic waves is available for dissipation. The magnetic heating mechanisms comprise dissipation of hydromagnetic waves, anomalous dissipation of electric currents, and magnetic reconnection. However, one must realize that these processes, listed as different mechanisms, are in fact different manifestations of the same process occurring on different spatial and time scales in a complex configuration of flows and fields.

Hydromagnetic waves can accelerate particles, which then produce electrostatic fields and electromagnetic waves in the plasma medium by thermal and nonthermal means. The excitation of strong electron plasma waves plays a crucial role in the generation mechanisms of nonthermal radio radiation. Modelling the radiation characteristics—spectral, spatial and temporal—

requires a knowledge of the macroscopic configuration of the emitting plasma as well as the microscopic particle-distribution functions that can obtain in a complex magnetic-field geometry. Thus the cause of the bursty nature of the electromagnetic radiation must be traced to one or more of the processes of acceleration of charged particles, the macroscopic oscillatory nature of the emission region, and the switching on and off of plasma instabilities. A multiplicity of nonlinear wave–wave and wave–particle interactions must be investigated, including complications resulting from inhomogeneity of plasma parameters.

While the IAU symposium reviewed our knowledge of the Sun, it also highlighted our need of more information on solar plasma processes.

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MEETINGS/SYMPOSIA/SEMINARS

Solid State Physics Symposium

Place: Varanasi
Date: 21–24 December 1991
Topics Include: Phonon physics; Electron states and electronic properties; Magnetism and magnetic properties; Semiconductor physics; physics of defects and disordered materials; Transport properties; Superconductivity and superfluidity; Liquids, liquid crystals and plastic crystals; phase transitions and critical phenomena; Surface and interface physics; Nonlinear dynamics, instabilities and chaos; Resonance studies and relaxation phenomena; Solid state devices, techniques and instrumentation.

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Fourth National Bioorganic Symposium

Place: Bombay
Date: 27–29 January 1992
Themes include: Biotransformations, biocatalysis, synzymes, biosynthesis, bioconjugation and biomimetism; Molecular recognition and molecular interactions; Chemical ecology, bioactive terrestrial and marine natural products; Peptides, proteins, carbohydrates and nucleic acids; Biomembranes, receptors and chemical messengers; Biomolecular spectroscopy and techniques in bioorganic chemistry; Biotechnological and environmental aspects of bioorganic chemistry.
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DAE Symposium on Radiation and Photochemistry

Place: Bombay
Date: 27–30 January 1992
Sessions include: Primary processes, excited states, ionic processes, ultrafast phenomena, radiation chemistry in gas and condensed phase, technological applications of radiation and photochemistry, Photosynthesis and biomimetic chemistry, intra- and inter-molecular processes, selectivity and vibrational photochemistry, chemiluminescence, molecular beams and jets—spectroscopy and excited state chemistry, chemical lasers and chemical aspects of an active laser medium.
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First National Group Discussion on Tobacco

Place: Rajahmundry
Date: 21–22 January 1992
Papers relating to varietal improvement, biotechnology, agrotechniques, plant protection, chemical quality parameters, chemistry of leaf and soils, statistics, transfer of technology, economics and marketing, will be discussed.
Contact: Secretary
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National Seminar on Urban–Rural Alternative Energy Management

Place: Pondicherry
Date: 7–8 February 1992
Contact: Prof. S. A. Abbasi
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