

of the University with special reference to ionic regulation mechanisms in some brackish-water fauna.

In the Symposium on "Molecular Biology" Dr. L. K. Ramachandran (Osmania University) gave a talk on "Primary Structure of Proteins". This was followed by two papers on "Conformation" by the group working at the Centre of Advanced Study in Biophysics, University of Madras. Dr. V. Sasisekaran spoke on "Conformation of Nucleotides and Nucleic Acids", while Dr. V. S. R. Rao spoke on "Conformation of Polysaccharides".

In the afternoon session on the last day under Section B, Chairman Professor T. S. Sadasivan, Director, U.G.C. Centre for Advanced Studies in Mycology and Plant Pathology, Madras University, gave an address on "Physiology of Plants under Stress". Dr. A. Sreenivasan (Bio-

chemical and Food Technology Division, Atomic Energy Establishment, Trombay, Bombay) gave a talk on "Regulating Mechanisms in the Living Cell". Dr. T. N. Khoshoo, Assistant Director, National Botanic Garden, Lucknow, gave an illustrated talk on "Experimental Manipulation of Chromosomes".

Dr. (Mrs.) V. C. Anguli (Stanley Medical College, Madras) read a paper on "Emigration of Filarial Embryos from the Habitat of the Parent Worms to the Blood Streams".

There were two public lectures during the session: the first by Dr. S. Bhagavantam (Scientific Adviser to the Minister of Defence) on "The Atomic Nucleus" on the evening of the 21st, and the second on the 22nd evening by Dr. Jacob Chandy (Medical College and Hospital, Vellore) on "The Human Brain".

ABSTRACTS OF PAPERS PRESENTED AT THE 32ND ANNUAL MEETING OF THE INDIAN ACADEMY OF SCIENCES

Active Regions on the Sun and the Interplanetary Medium

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Cosmic rays from the galaxy provide unique probes to study the magnetic fields stretched out from the sun by the continually expanding corona which forms a solar wind with a radial velocity of 300 to 500 km. per second, filling up all interplanetary space. Evidence of the wind can be seen in comet tails which always point away from the sun. The earth in the solar wind is like a stationary object in a stream of water. We have the formation of a bow wave and a wake.

There are three aspects of solar activity which are of great significance to interplanetary conditions. Firstly, the activity on the sun occurs in localised regions; secondly, this activity is concentrated in regions of latitude which migrate towards the solar equator as the 11-year sun-spot cycle advances; and thirdly, the northern and southern hemispheres of the sun are not equally active and in consequence there is marked north-south asymmetry at most times. These features have been taken into account in a new model of the topology of interplanetary conditions proposed by me in 1963. In essence,

it postulates that interplanetary space has a sector structure which rotates with the sun as it spins on its axis. The sector structure reveals itself through 27-day recurrences of many cosmic ray and geomagnetic effects. The sector structure due to quasi-stationary active regions on the sun has also been demonstrated in recent space experiments.

It was shown for the first time in analysis made by us two years ago that cosmic rays from the galaxy have often a deficiency in the direction of the interplanetary magnetic field. The new experimental observation emphasised the importance of magnetic field conditions in influencing the diffusion of cosmic rays into the solar system. A model recently suggested by me in collaboration with Dr. G. Subramaniam involves diffusion of cosmic rays that does not occur symmetrically at all latitudes of the sun. The mechanism appears to present a way of understanding the semi-diurnal component of cosmic rays and the associated changes of intensity which can be observed in cosmic rays measured on the earth.

One may hope that with the use of high-counting rate cosmic ray instruments it would be possible to study the interplanetary conditions in regions away from the solar equatorial plane, about which so far we know very little.

Composition and Propagation of Solar Cosmic Rays

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In this paper the present state of our knowledge on the composition, energy spectra and propagation of solar cosmic rays are briefly reviewed and the relations of these informations to the relative abundances of elements in the solar atmosphere and the structure and configuration of the interplanetary magnetic field are discussed. It is found that the relative compositions of multiply charged nuclei in the solar cosmic rays reflect that of the sun as determined spectroscopically for those nuclei where comparisons can be made. The relative abundances of helium and neon which cannot be determined by spectroscopic means are found to be 107 ± 14 and 0.13 ± 0.02 relative to oxygen respectively. The studies of propagation of low energy solar cosmic rays at solar minimum indicate that the interplanetary magnetic field has a filamentary structure which are twisted and solar cosmic rays are constrained to move along the filaments in well-defined streams. The whole structure retains the basic Archimedes spiral and co-rotates with the sun.

Ionospheric Effect of Solar Flares

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The value of regular recording of ionospheric effects of solar flares in the studies of solar and ionospheric physics are discussed. The principal solar emissions responsible for these effects are the X-rays below 100 Å, and the EUV lines, He 304, Fe XV 284 and Fe XVI 335. Almost the entire bottom side ionosphere is affected, conspicuously at heights less than 100 Km, and less obviously, in the E and F regions.

Although the detection capabilities (for H flares) of most SIDs are no more than 30% for flares of Class 2 and above, far short of the capability of centimeter wave radio bursts, their association with X-ray flares and 2800 Mc./s. bursts is well marked. The SID does not occur until the X-ray flux ($\lambda < 10 \text{ Å}$) exceeds $2 \times 10^{-3} \text{ ergs/cm}^2/\text{sec}$, and unless the quiet day solar radio flux exceeds a threshold value; the time curves of the three types of events are often identical, excepting for a time lag (relative to the time of maximum of the X-ray event) in the SID by a few minutes (4 minutes

for SCNA, 5 minutes for SPA and 10 minutes for SEA); and short-lived X-ray events have clear counterparts in SCNAs.

The transient nature of the X-ray flare provides some unusual opportunities for studying the photochemical processes in the D region. For a complete study, one requires, on one hand, a complete description of all SIDs, and, on the other, X-ray flux variations both in wavelength and in time, for wavelengths below 10 Å for the entire period of the event. In the few cases where both information is available, an exhaustive examination in this laboratory has revealed that the electrons are lost in this region mainly through the dissociative recombination with NO^+ with a rate as fast as $1 \times 10^{-7} \text{ cm}^3/\text{s}$, and through attachment with O_2 to form negative ions, which are about 10 times as large as the number of electrons at 60 Km. On occasions there is evidence of a substantial lowering of the D region ionisation caused by a hardening of the X-ray spectrum beyond that possible with purely thermal emission. Evidence is also given of small changes at heights above 100 Km. caused by softer X-rays and several strong EUV lines.

Geomagnetic Effects Associated with Active Solar Regions

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Quiet-sun wind as well as emission of particle and wave radiation from solar flares are described. Terrestrial magnetic and related ionospheric, auroral and cosmic-ray disturbances associated with solar radiation are briefly reviewed. Recurrent magnetic activity during the declining phase of the solar cycle is also briefly discussed.

Velocity Fields in Sunspots

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Line of sight velocity fields have been obtained using three non-Zeeman sensitive lines: the 4912 NiI, 5576 FeI and 5691 FeI. Velocity field configurations have been obtained during the two successive passages of a single sunspot across the solar disk. Velocities appear systematically larger during the well-developed phase of the spot's life compared to its initial phases. The observed line of sight velocities have been resolved into three mutually perpendicular directions; the radial, tangential and

vertical components. The radial velocity curves show a steep rise and gradual decline in the penumbra and peter off in the photospheric region. Using Makita's penumbral model a gradient of maximum radial velocity of the order of 4×10^{-3} km./sec./km. in depth, between an optical depth of 0.02 and 0.1, has been obtained. A small vertical component of the order of -0.3 km./sec. directed downwards in the penumbral region has been detected. No systematic pattern in the tangential velocity variation has been observed. However, the existence or otherwise of the tangential component of the order of 0.8 km./sec. and less, has not been confirmed.

Asymmetry, in the penumbral lines, has been measured on three disk positions of the sunspot. The asymmetry appears to increase with depth in the sunspot atmosphere. Fluctuations in the continuum brightness and equivalent widths of lines have been observed in the penumbral region. Darker (cooler) regions show widening of lines compared to the brighter (hotter) regions, in the penumbra.

Physiology of Plants under Stress

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Phytopathologists have been intensely interested for many years not only on the cause but also on the effect of a pathogenic condition on host physiology. Abnormal metabolism under pathogenesis has, therefore, been a subject of study in recent years, particularly as it indicates the specific substrate(s) that are involved in the sequence of events that lead to a crippling of normal metabolic processes. Let us take the obligate parasite, viruses, as an example. It is now known that all plant viruses are RNA viruses and that their nucleic acid is the infective part. Virus multiplication represents a derangement of the nucleic acid metabolism of the host cell with effects of a secondary nature on protein metabolism. Even so, the stress for nitrogen at the sub-cellular level in chloroplasts has been clearly demonstrated. It is getting increasingly clear, therefore, that the primary thing is a derangement of the nucleic acid metabolism of the host cell with a side effect on protein metabolism. The discovery of one of the smallest known plant viruses, the satellite virus, which probably cannot multiply on its own and can do so only in the presence of the unrelated tobacco necrosis virus, raises new issues. It probably has to spare few nucleotides after coding for its structural protein and,

therefore, not only fails to multiply unaided but also fails to produce symptoms.

Turning our attention to the rusts and mildews, much is now known to indicate that the enhancement of respiration in infected tissues may be partly due to the nullifying of the Pasteur-effect by a toxin uncoupling respiration from energy-yielding mechanisms of the cell. The basis of this stimulation is that the rate of respiration is governed by the level of tissue phosphate acceptors. Such a situation of interfering with oxidative phosphorylation is also evident in the case of antibiotics such as gramicidin, usnic acid, aureomycin. The normal host cells are geared to an efficient economy and what might be termed a regulated metabolism and any interference in this puts a severe strain on the regulated expenditure of reserves. The invading pathogen is then in a position to obtain some intermediates for its own metabolism.

There are other metabolic events that follow a pathological condition. One such is a change in hormone levels. Hyper- or hypoauxiny is now regarded as a sequel of many metabolic disorders consequent on fundamental tissue changes. This has been ascribed to removal of a growth inhibitor or a direct increase in growth stimulating substance in the invaded tissue. It has been suggested that alteration of the metabolic processes concerned with growth may be a method for successful establishment of obligate parasites. In cases where toxins have been detected and characterized, apart from auxin changes, water relationships of affected tissues have been questioned. A further consequence of these metabolic events is a change in enzymes, such as cytochrome oxidase, peroxidase and polyphenoloxidase. These oxidative changes are largely regarded as defence mechanisms as they bring in their trail chemical entities that may hinder the spread and development of the parasite, one such being the new group of chromanocoumaranes collectively termed phytoalexins. Indeed, the pathways of energy-yielding processes operating in the healthy tissues are in some ways inadequate to couple with the synthetic processes of the parasite.

Some Aspects of Regulatory Mechanisms in the Cell

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The multiplicity of functions and patterns in the cell are co-ordinated in a highly organised manner. This is typified by the intracellular

flow of information during the elementary processes of transcription and translation in protein biosynthesis. Superimposed on this are other molecular mechanisms of regulation such as feed-back inhibition, induction and repression.

Illustrative examples of regulation in cellular activity by molecular action and interaction are detailed with reference to experimental data of the author and his associates on stability and changes in the profiles of ribonucleic acids during protein deprivation or thyrotoxicosis in the rat and during phosphate starvation in cells of *Escherichia coli* or *Saccharomyces cerevisiae*. The functional significance of the increased ribonuclease activity under these conditions and some aspects of adaptive enzyme synthesis are also referred to.

That changes in cell metabolism brought about by physiological or environmental stress states may reside more in altered patterns of enzyme organization rather than in altered enzymes alone, is discussed from the point of view of mitochondrial genesis and turnover. An attempt has been made to aim at a definition of reversibility and irreversibility in cell damage in terms of early metabolic lesions.

Conformation of Polysaccharides

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The conformation of a polysaccharide depends on the ring conformation of the sugar residue. It is generally accepted that the ring conformation of the sugar residue in the polysaccharide is the same as in monomer unit except in the case of amylose. Some of the results obtained earlier on the conformation of amylose by optical rotation, NMR, X-Ray Diffraction and other chemical methods are reviewed briefly.

The recent results obtained on the conformation of amylose by using the potential energy functions are presented.

Aspects of the Primary Structure of Proteins

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Remarkable progress has been made in the determination of the sequence of amino-acids in many proteins during the past two decades. It all started with Sanger's elucidation of the structure of insulin, and today the primary structures of some two dozen proteins are known with certainty. In a few cases, even the variations in structure of a given protein

derived from different species are clearly known. The relation between alteration of the structure, by mutation, of a biologically active ribonucleic acid and the alteration in the structure of the protein whose synthesis it directs has become amenable to understanding.

The consequence of these advances has been the impetus given to the chemist to synthesize polypeptides with interesting biological properties. The hypertensins, oxytocin, vasopressin, adrenocorticotropin, insulin, and so on, are now available synthetically. These advances in synthesis, and the development of newer reagents for selective modification of a protein and for its selective break-down are enabling the protein chemist to pursue effectively a cherished goal, namely, to unravel the relation between structure and biological activity. The day may not be far when man shall be able to accomplish in simpler ways the same things which complex biologically active proteins are designed for.

Experimental Manipulation of Chromosomes

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Experimental manipulation of chromosomes, affected in a variety of ways, helps not only to unravel the cytogenetic architecture but also in improvement of a species. Where natural variation is of insufficient interest to a breeder, judicious adjustments made in the chromosomes can help to generate new variability. Not only chromosome parts, but also whole chromosomes or even full genomes of one species can be manipulated into the genetic-cytoplasmic background of another species. Such alien transfers may cause disharmonies of various kinds and degrees by upsetting the intricate balance that exists in genetic system of a species. It is possible to restore the balance under certain conditions.

So far such techniques have been employed in the study of crop plants. The present lecture stresses the need for making such correlated studies of chromosomes and Mendelian heredity in other economic plants.

Studies on the Benthic Fauna of Cochin Backwater

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Studies on the macrofauna from five selected stations spread over a distance of about

25 km. in the Cochin backwater showed that the benthic biomass was greater in the regions which were near the sea. The abundance of organisms decreased progressively towards the more estuarine zone. The bivalves, gastropods and polychaetes were the most predominant forms in the sample. The presence of larger bivalve, *Meretrix ovum* and the polychaete, *Diopatra neopolitana* at the stations near the sea considerably increased the benthic biomass at these stations. Organisms of lesser importance were crabs, fish, ophiuroids, sea anemones and worms. Studies on meiobenthos which were restricted to estuarine zone only, showed a high degree of abundance of foraminiferans and nematodes. Foraminiferans were more abundant at stations nearer the sea suggesting their preference for marine conditions. The nematodes on the other hand were more dominant at stations away from the sea. An examination of the substrata at five stations showed that the conditions were different from one place to the other. A substratum of fine and coarse sand seems to support a denser benthic population.

The distribution and abundance of macro and meiobenthos compared with the seasonal changes in physico-chemical conditions of the backwater was investigated. It appeared that perhaps the most important factor governing the quantitative distribution of benthos is the salinity. Settling stages of bivalves and gastropods which are of purely marine origin, though appear in large numbers, do not survive in estuarine conditions. Areas of high salinity in the backwater are those which are rich in nutrients and chlorophyll and were found to support a denser benthic population.

Emigration of the Filarial Embryos to Systemic Circulation

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The infective filarial larvæ penetrate the skin of the sites of mosquito bites and attain sexual maturity in the lymph nodes after their lymphatic sojourn. The adult worms are found in the afferent lymphatics, subcapsular and cortical sinuses of the lymph nodes. The viviparous-embryo worms—microfilariae are delivered into the afferent lymph space, from where, they get into the venous circulation through the thoracic duct.

Filtration experiments on the lymph nodes show that : (1) Inanimate particles are held up : (2) Red cells are retained and phagocytosed. (3) Bacteria and organisms are filtered. (4) Microfilariae undergo destruction.

It does not appear possible for the microfilariae to appear in such large numbers in the peripheral blood after passing through one or more sets of lymph nodes.

Lymphatico-venous shunts are present in 30% of the lymph nodes examined and experimented. This observation with correlated findings suggest this as the pathway of emigration of the filarial embryos to systemic circulation.

On the Monsoons of the World and the General Circulation of the Atmosphere

C. RAMASWAMY

The monsoons of the world can be classified into tropical, sub-tropical, middle-latitude and sub-polar types. Besides these, there is the stratospheric monsoon between 20 and 80 km. above the ground.

The broad zonal character of the monsoonal systems besides their other characteristics have led to a recent concept that the monsoons are essentially due to the thermal response of the continental atmosphere to the annual variation of solar radiation. Indeed, there is a growing mass of evidence to show that the monsoon is a feature of the general circulation itself with world-wide associations.

Considerable amount of research is currently in progress regarding the genesis of the vast anticyclone which develops over the Tibetan plateau and of the easterly jet-stream which builds up over the Asian tropics during the south-west monsoon period and on the inter-connection between these two and the south-west monsoon. There is also the burning question whether the millions of tons of water which are released over the Indian peninsula in the form of monsoon-rainfall are brought in from the southern hemisphere across the equator or whether they are provided "locally" by evaporation from the Arabian Sea itself. These and a few other exciting problems will continue to engage the attention of meteorologists as well as specialists in tracer-techniques in the next few years to come.