Patrika

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48th Annual Meeting of the Academy

At the invitation of the Kumaun University, the 48th Annual Meeting of the Academy will be held at Nainital from Saturday 9 to Monday 11 October 1982.

The tentative programme for the meeting consists of scientific symposia, popular lectures and a series of lecture presentations by Fellows of the Academy.

There will be two symposia on *'Ecology of the Himalaya Mountain'* (Convener: Prof. D D Pant) and on *'Polymerization'* (Convener: Prof. M M Sharma).

The popular lectures are on *'Computers and computing — Current trends and perspectives'* by Prof. B Nag, Jadavpur University, Calcutta and on *'India's agricultural transformation'* by Dr. H K Jain, Indian Agricultural Research Institute, New Delhi.

The lecture presentations will be by:

a) Prof. Sushil Kumar, IARI, New Delhi, on *'Functions of cyclic 3', 5' adenosine monophosphate and receptor protein complex in Escherichia coli'*.

b) Prof. S Mitra, TIFR, Bombay, on *'Electronic structure of iron in synthetic haem systems'*.

c) Prof. C L Mehta, IIT, New Delhi, on *'Light fluctuations and their applications'*.

d) Dr. B A Dasannacharya, BARC, Bombay, on 'Neutron scattering studies of disordered materials'.

e) Prof. C S Warke, TIFR, Bombay, on *'Nuclear colour chemistry'*.

f) Prof. T V Ramakrishnan, IISc., Bangalore, on *'From liquid to solid'*.

g) Prof. M Nageswara Rao, PRL, Ahmedabad, on *'Origin of our solar system — Early events, time scales and their consequences'*.

h) Dr. S Rajappa, CIBA-GEIGY Research Centre, Bombay, on *'The scope for novel synthetic chemistry in drug research'*.

i) Dr. R Krishnan, BARC, Bombay, on *'Phase transformations and structure property correlations in zirconium alloys'*.

j) Prof. T C Anand Kumar, Institute for Research in Reproduction, Bombay, on *'Ethical considerations in animal experimentation'*.

An environmental field excursion has been arranged for 12 October, 1982. During the period of the Annual Meeting, the editorial boards and sectional committees will also meet at Nainital.

The Sixth Raman Professor, Prof. George W Series, FRS, who will be in India from early October, has accepted the invitation of the Academy to attend the Annual Meeting at Nainital.

The Council of the Academy has decided that all Fellows attending the meeting and who are not able to obtain travel support from other sources will be paid first class return train fare from their place of residence to Delhi and back. Arrangements are being made by the Academy for the travel of the participants from Delhi to Nainital by bus on 8 October, 1982 and from Nainital to Delhi after the meeting on 11, 12 and 13 October. Assistance will also be provided to Fellows on arrival in Delhi, especially in connection with their overnight stay.

The Raman Chair

The Academy will have three eminent scientists occupying the Raman Chair during the last part of 1982 and the beginning of 1983. They will be the sixth, seventh and eighth Raman Professors. They are:

1. Prof. George W Series, FRS, Professor of Physics, J J Thomson Physical Laboratory, University of Reading, Whiteknights, Reading, UK. He will be in India from October 1982 to January 1983.
2. Prof. G Pontecorvo, FRS, formerly Professor of Genetics at the University of Glasgow and now Honorary Consultant Geneticist, Imperial Cancer Research Fund, London. He is expected to visit India from December 1982 to February, 1983.
3. Prof. John B Goodenough, Inorganic Chemistry Laboratory, University of Oxford, Oxford, UK, who is expected to be in India from December 1982 to March 1983.

Suitable academic programmes including visits to various universities and research institutions and meetings and discussions with younger scientists in the country have been arranged.

Proceedings – Chemical Sciences

Report by the Editors

It was in early 1977 that the Academy decided to publish a theme journal as part of Series A of the Proceedings, solely devoted to chemical sciences. An Editorial Board for Chemical Sciences was accordingly formed at that time. This step by the Academy, taken to meet the increasing demands of the chemical community for a quality theme journal, has resulted in almost a resurgence in the publication of original contributions in chemical sciences in the Proceedings. From 26 papers in chemical sciences published in 1976 in Proceedings A, the number has grown to 63 in 1981, covering approximately 550 pages. The journal which started as a quarterly is now issued bimonthly, and five volumes have been published so far. The annexure to this issue of Patrika lists all the papers published in the 27 issues of the Journal from July 1977 to December 1981.

The Proceedings – Chemical Sciences has thus emerged as a good medium with a reputation for fairly rapid publication of research articles in physical, theoretical, inorganic, analytical and organic chemistry, but the coverage of these various areas has not been uniform. For reasons that are not entirely clear, fewer papers in organic chemistry are now submitted to the Journal, despite the large number of scientists working in this area in the country. Fellows of the Academy, who are organic chemists, have therefore a special responsibility in ensuring the balanced growth of the journal. It would of course be unreasonable to expect research workers in the country to publish all their papers in Indian journals but one could surely expect at least some of the results of the research done in the country to be published in India.

Some colleagues have complained that articles published in India do not receive sufficient attention, either in India or abroad. This is not entirely correct since the Proceedings are covered by *Current Contents* (Physical Sciences). It is also included in the Science Citation Index. A review article of one of our Honorary Fellows published sometime ago in the Proceedings, did indeed attract the largest number of requests for reprints he had ever received. If our Fellows in chemistry send at least one or two papers of their own and from members of their group, each year to the Proceedings, it would automatically ensure a steady flow of good papers to the journal. There has been a feeling among many Fellows that there has been a slight decline recently in the quality of Proceedings-Chemical Sciences but if this is at all correct, the high standards set in the beginning can be restored only if our Fellows actively work for it.

Every year the Chairman of the Editorial Board writes personal letters to Fellows in chemistry requesting them to contribute articles to the Proceedings. While this usually results in a spurt of contributions in the beginning, the number falls off after some time. While we can assure scientists of quick publication and prompt and careful refereeing, the Journal can reach the high standards set for it and a wider circulation, only if our scientists decide to publish their work in the Journal. We look forward to receiving a large number of high quality papers from our Fellows and their active help in making the Proceedings the best medium for the publication of chemical research papers in the country.

Early detection of metabolic disorders leading to mental retardation

Summary of a talk given by Dr N Appaji Rao, at the 47th Annual Meeting of the Academy, held at Trivandrum in November 1981.

Mental retardation is caused by a variety of environmental factors such as infections during pregnancy, trauma at birth and by genetic disorders. Although infectious diseases and nutritional disorders are still a major health problem, the incidence of these has decreased markedly over the past few years. With improvements in sanitation and better medical facilities, it is expected that infant mortality would also decrease very significantly. It has, however, been observed in the Western countries that coincident with this trend there is a concomitant increase in the number of deaths due to genetic disorders and it is estimated that about 4.5% of all live-born infants in the UK, for example, are affected by some form of genetically determined defect. It can therefore be predicted that a similar situation might emerge in India, i.e., a transition from an almost exclusively environmental to an increasingly genetic basis for infant mortality and morbidity.

More than 2000 disorders of genetic origin have been described in man. The incidence of these disorders, their time of onset in an individual and their effects on his life style vary greatly. In some conditions such as tyrosinemia, only a small number of cases have been described, while in others such as cystic fibrosis of the pancreas, the incidence among Caucasians is very high. The conditions may be benign as in alkaptonuria or pathological as in 'maple syrup' urine syndrome. Onset and death may be within days of birth or even be the cause of multiple spontaneous abortions. Alternatively, many of the conditions are not expressed well into the adult phase of life.

Thus, it can be seen that genetic disorders are expressed in a variety of ways and in many instances at the biochemical level, it is manifested as a change in the activity of a crucial enzyme. Enzymes are one of the products of genetic expression and catalyze interconversions of biomolecules and play a central role in life processes. One of the well characterised genetic disorders is phenylketonuria, a metabolic disorder in which the enzyme, phenylalanine hydroxylase, catalyzing the conversion of phenylalanine to tyrosine, is defective. Consequently, there is an accumulation of phenylalanine, an amino acid derived from the degradation of dietary proteins, followed by a decrease in the level of tyrosine, another amino acid, which in addition to being derived from the diet is also produced by the enzyme phenylalanine hydroxylase from phenylalanine. Tyrosine is a very important amino acid, which in addition to being a part of protein molecules like other amino acids, is also converted into several important metabolites such as thyroxine, dopa, etc. The decreased level of tyrosine due to the absence of phenylalanine hydroxylase results in the body being deprived of these essential metabolites. Another consequence of this enzyme defect is the accumulation of phenylalanine leading to its increased degradation. The products of this degradation are toxic to the developing brain of an young infant. A combination of these two effects results in the impairment of brain development in children leading to mental retardation. One simple method by which the deleterious effects of the absence of this enzyme can be overcome is by feeding children, starting within a few weeks after birth, a diet low in phenylalanine and supplemented with tyrosine. Such a diet keeps the level of phenylalanine low, thus preventing the accumulation of the degradation products and the supplemented tyrosine satisfies the requirements of the body for this amino acid. As brain development occurs during the early years of infancy, it becomes imperative that the disorder be detected as early as possible and treatment initiated before brain damage has occurred.

The incidence of these disorders in a country depends on two factors; one, the frequency of the occurrence of the mutant gene in the population and two, on the probability of the carriers of the mutant gene marrying each other. Inheritance in man is determined by the pairs of genes present in the parental chromosomes. In the sperms and the ova, the number is reduced to n from $2n$. And once again in the zygote when the sperm fertilizes the ovum, the number is restored to $2n$ Some of these metabolic disorders are expressed only if both the genes are defective and are called autosomal recessive diseases. If only one of the parents carries a mutant gene, the children can be only carriers like the parent and the defect is not expressed. On the other hand, if two carriers marry each other, Mendelian Laws of Inheritance predict that one of four offsprings would be normal, two would be carriers and one would be an affected individual. This does not mean that if the first child is affected, the subsequent three children would be normal but that each pregnancy carries a 25% risk of an affected individual being born. The chance of two affected individuals marrying each other increases when marriage occurs between close relatives and this type of marriage is known as consanguinous. This marital pattern is widely practised in South India, especially in the states of Karnataka, Andhra Pradesh and Tamilnadu and is prevalent among all religious groups and castes. It would therefore be expected that this continued consanguinity over several generations would result in an increase in the number of carriers of the mutant genes, as well as the number of affected individuals. It has also been argued that such prolonged inbreeding could also lead to a reduction in the number of recessive lethal and sublethal genes in the population. The reasoning for such an argument is that as the affected individuals are extremely susceptible to infections and in situations where several infectious diseases are endemic, they succumb early, leading to the elimination of individuals with the mutant gene. It is also believed that as a consequence of inbreeding and the resultant loss of the mutant gene, genetic disorders of this type are not present among Asiatic populations.

A study carried out at the National Institute of Mental Health and Neurosciences, Bangalore and the Indian Institute of Science, Bangalore, showed that phenylketonuria was present in 19 out of the 1400 mentally retarded children examined. In addition, several other metabolic disorders such as homocysteinuria, 'maple syrup' urine syndrome, prolinuria, hydroxyprolinuria and mucopolysaccharidosis were detected. It also became apparent that an overwhelmingly large percentage of phenylketonurics in the country originated from Karnataka, raising the possibility of the presence of a high risk group in the population of the region. But it is also possible that large numbers were detected in Karnataka merely because a systematic survey was carried out at Bangalore.

Two main features of the survey were the preselection involved in the examination of the mentally retarded patients and the fact that at this stage very little could be done to alleviate the suffering of these children, as irreversible brain damage had already set in. To obviate against these disadvantages, the screening of newborn children for aminoacidopathies leading to mental retardation was initiated at the Department of Biochemistry, Indian Institute of Science, Bangalore, during January 1980. The screening of new born children for these disorders is mandatory in several countries in the West and in Japan. The programme at Bangalore was begun to find answers to the following questions (i) given the existing socio-economic, cultural and administrative patterns in the country, can we successfully establish a screening programme for examining several thousand newborn children?, (ii) can we standardize sufficiently flexible scientific methods to undertake this task?, (iii) if the disorder is present, can we evolve for children, diets in this country which are practical, acceptable and easily available at reasonable cost?, (iv) can we provide genetic counselling? An important parameter to be kept in mind in such efforts is the cost-benefit ratio of the programme.

Initially, we attempted to screen newborns, as done in a few places in the West, by using urine as the body fluid for analysis. Very soon we found that the problems of collection of samples, their transport and preservation as well as rapid analysis, became insurmountable hurdles. We later switched on to the use of thin-layer chromatography of blood samples. The procedure is simple, elegant and relatively inexpensive. Three drops of blood are collected on Whatman No. 2 filter paper strips from a three-day old newborn, after it has been feeding normally for atleast 24-48 hours. The dried blood sample is then transported to the laboratory and a 6 mm diameter disc is punched out and extracted overnight with 70% ethanol. The ethanolic extract is subjected to thin layer chromatography on cellulose coated aluminium plates. The amino acids are detected by their reaction with ninhydrin which is included in the solvent for the second run. The individual amino acids are identified by the distance they have migrated on the chromatograms. The intensity of the spot is directly proportional to the concentration of the amino acid present in the blood. This procedure helps us to detect several amino acid disorders such as phenylketonuria, which is characterized by an increase in the amino acid phenylalanine, 'the maple syrup' urine syndrome, where elevated levels of isoleucine and valine are present, homocysteinuria, prolinemia, tyrosinemia and histidinemia, where the respective amino acids are present at elevated concentrations in the sample. The procedure is well suited for large scale analysis, as the dried blood spots are stable for more than two months and the filter strips containing the blood samples can be transported easily through the mail, enabling several distant places to be included in the screening programme. The procedure is simple as technicians can be very easily trained within a week to carry out the analysis. The procedure is elegant in that several aminoacidopathies can be detected in a single analysis. It needs no sophisticated equipment and each test costs approximately Rs 2-3 and a technician can easily perform 200 analyses in a day. When the number to be analysed is increased, the cost can be expected to decrease further.

The screening is at the present moment confined to four hospitals in Bangalore and two in Mysore. Till the end of 1981 more than 10,000 children had been examined and 2 cases of phenylketonuria, 1 of hyperphenylalanemia, 1 of prolinemia, 2 of transient tyrosinemia, and 1 of tyrosinemia identified. In addition, the analysis of sick children revealed 4 cases of homocysteinuria, 2 of ornithenemia and 1 of galactosemia. Benign disorders such as glucosuria, pentosuria, alkaptonuria and albinism have also been detected. Some of these children are under treatment.

In addition to collecting the blood spots for amino acid analysis, additional information on the consanguinous relationship of the parents of the children as well as the number of children born and the number of living children were also ascertained. It is interesting to note that in spite of urbanization and changes in family patterns, about 30% of more than 10,000 mothers examined were married to close relatives, the preferred relationship being uncle-niece. In spite of this high consanguinity index in the population, fecundity parameters remained unaffected, suggesting that at least fertility was not affected. Another interesting observation is that in this limited pilot survey all the positive cases were born to non-consanguinous parents.

In conclusion, it can be said that screening of newborn children for amino-acidopathies is a feasible project in our country. A study of the cost-benefit ratio has revealed that it is cheaper to detect and treat the child than to treat the affected individual after mental retardation has set in. This analysis takes into account only the financial effects and does not consider the emotional and sociological effects surrounding the presence of the mentally retarded individual in the family and society. This study has also established that these disorders are present in our population and can be detected early and treated. There is some initial success in our attempt to evolve a low phenylalanine diet by fractionating whey proteins.

These initial successes have encouraged us to plan the screening of all children born in hospitals at Bangalore and Mysore; establish the quantitative pattern of amino acids in them; provide facilities to classify more rigorously these disorders by enzyme assays of body fluids and tissues as well as tissue culture methods; prepare inexpensive diets for more disorders and finally add a few more carefully selected tests to detect disorders that can be treated. We believe that a facility for early detection and treatment of genetic disorders should be established now, when a careful, critical scientific analysis can be carried out and not later, when the problem becomes acute and pressure builds up to find *ad hoc* and immediate solutions.

Obituaries

Rango Krishna Asundi, an eminent physicist and a pioneer in the field of molecular spectroscopy, died on February 2, 1982 at his residence in Bombay. He was born on August 14, 1895, in Asundi, a village in Karnataka. He had his early education in Gadag, Dharwar, Poona and Bombay. He obtained his Ph.D. degree in 1929 from the University of London working in O W Richardson's Laboratory. On his return to India, he worked at the Aligarh Muslim University from 1931-38 and the Banaras Hindu University from 1939-56. After his retirement from BHU, he joined the Bhabha Atomic Research Centre, Bombay as an Adviser, an association he continued till his death.

Asundi was one of the earliest to apply the new Quantum Mechanics for an understanding of the electronic spectra of simple molecules. The first spectrum that he studied was that of carbon monoxide, where he discovered an electronic band system, which has since been named the Asundi bands. This he followed with the first detailed analysis of the high pressure carbon bands for which he gave the correct interpretation that they belonged to C_2. His subsequent researches on the spectra of molecules, CN, N_2, BF, SeO_2 and SO_2 contributed to a better understanding of the electronic configurations of these molecules. The present day knowledge of the "building-up" principle of Hund-Mulliken-Herzberg of the molecular orbitals by electrons is the outgrowth of several such contributions. Asundi's experimental skills were such that he could successfully and very simply excite the electronic spectra of large molecules like benzene and toluene and provide a satisfactory analysis of all the bands of the electronic transitions involved and give a correct explanation of the perturbations observed as due to Fermi resonances.

At the request of the late H J Bhabha, Asundi joined the Department of Atomic Energy as an Adviser and organised a spectroscopy laboratory where a strong experimental group was established to meet the analytical requirements of BARC and other institutions of DAE and also for spectroscopic investigations of nuclear properties, the structure of atoms and molecules, diagnostics of plasmas and the physics of the solid state. Asundi was the first Chairman of the Physics Advisory Committee of DAE from 1957-62, and a member and later Chairman of the Disarmament Study Group from 1962-65. Several academic honours were bestowed on him in recognition of his outstanding contributions to science.

Asundi was a man of great vision. He was as deeply interested in religion, philosophy and Sanskrit literature as he was in science. In his passing away the scientific community has lost a spectroscopist of world repute and a man of wisdom and great humane qualities.

Hideki Yukawa, a distinguished theoretical physicist and the originator of the concept of the meson field theory, was born on 23 January, 1907, at Tokyo. After finishing his education at Kyoto, he joined the newly established Osaka University in 1933, where he decided to concentrate on the newly emerging area of nuclear physics.

In 1932, with the discovery of the neutron by Chadwick, the subject of nuclear physics had acquired a secure foundation. The phenomenological theories of nuclear forces were put forward soon after by Heisenberg, Wigner and Majorana. Electromagnetic interactions had been understood in the framework of the quantum field theory as arising from the exchange of light quanta between charged particles. An attempt by Tamn and Iwanenko to explain nuclear forces as arising from an exchange of an electron plus neutrino between a neutron and a proton, however, was not successful.

Yukawa, at this stage, realised that the crucial feature of the nuclear force was its short range. He postulated, around October 1934, the existence of an entirely new field unrelated to any fields known at that time, whose quanta 'mesons' would mediate the nuclear force. Taking the range of the nuclear force to be about 2 Fermi, he deduced that these new quanta would have a mass of about 200 electron masses and suggested a search for them in cosmic rays. The paper incorporating these ideas was the very first paper published by Yukawa and appeared in the Proceedings of the Physical and Mathematical Society of Japan.

The suggestion of the existence of a new particle was so revolutionary that it was initially not taken seriously. Then Anderson and Neddermyer during 1936-37 discovered in cosmic.rays a new particle, now called muon, which had a mass of about 200 electron masses. Muons, confused with Yukawa's meson, gave a boost to the meson theory. The particles of the Yukawa theory, now known as pions, were discovered by Powell in 1947. Yukawa was awarded the Nobel prize for this work in 1949. He was the first Japanese and third Asian to win this prize.

Yukawa initiated the study of the quantum field theory and theoretical nuclear physics in Japan. Apart from developing the meson theory with his brilliant co-workers like Sakata, Taketani and others, the main effort of Yukawa was spent with his group, in developing the non-local field theory as a way out of the divergence difficulties of the quantum field theory. The recent researches on dual-model field theory bear many resemblances to the ideas of Yukawa. He founded a new journal 'Progress of Theoretical Physics' in 1946 for the encouragement of physics in Japan.

Yukawa was fascinated by Chinese classics for which he had developed a taste in his childhood. Lao-Tse and Chuang-Tzu had a profound influence on his philosophy. He has also written about his concern with the problems of creativity and the role of intuition in science and life. As a young man he was an extreme introvert, but the logic of his life led him eventually to be active in movements against the use of nuclear weapons and other peace movements.

He was awarded the Imperial Prize of the Japan Academy in 1940 and the Decoration of Cultural Merit in 1943.

He passed away at the age of 74 in October 1981.

Academy Building

With the rapid increase in the activities of the Academy during the last few years, the accommodation available to the Academy office for its editorial and other activities had become quite inadequate. The Council therefore decided last year to augment the available accommodation by constructing an additional floor on the existing building. Accordingly plans and estimates were prepared and the work has now been entrusted on contract at a cost of about Rs. 5 lakhs.

The offices of the Academy and Current Science are now temporarily housed in 'Panchavati', belonging to the Raman Research Institute Trust and located in 'Panchavati', Malleswaram The offices of the Academy and Current Science will function from 'Panchavati' till the construction of the additional floor is completed next year.

Scattering of light

From 1919 to 1949, Prof. C V Raman published about 100 papers either by himself or with his students, on the general subject of the scattering of light. These were reprinted in 1978 in a volume entitled Scattering of Light, the scientific papers on scattering of light by Sir C V Raman, on the 50th anniversary of the discovery of the Raman Effect. This volume includes papers on colloid scattering, molecular scattering, surface scattering, Raman scattering and Brillouin scattering, as also his pioneering publications on molecular anisotropy. The monograph he wrote in 1922 on the Molecular Diffraction of Light and his investigations on X-ray scattering and Compton scattering are included in the volume, as these played a significant role in his discovery of the Raman Effect in 1928. The classical papers he wrote on magnetic, electric and flow birefringence with his gifted student K S Krishnan also find a place in this volume. Extracts from an Introduction by S. Ramaseshan to the Scientific Papers by Sir C. V. Raman on Scattering of Light are reproduced below

Prof. Raman's first paper on the scattering of light appeared in 1919. It was on the Doppler effect in molecular scattering. At that time he had also begun to take interest in the phenomenon of the scattering of light by sulphur suspensions. The paper on this subject makes interesting reading now, as one can see many elements in it that were to be introduced later into the Raman-Nath theory.

It is definite that the intense interest he developed in the scattering of light was due to the visual impact the blue of the Mediterranean sea made on him on his first voyage to Europe in 1921. That he was puzzled by the problem of the colour of the sea is clear from the fact that even on his onward journey he had prepared himself well for experimental observations, for he carried in his pocket nicol prisms, a small telescope to which polarisers and analysers could be attached, a slit and even a diffraction grating.

He wrote two papers on board the ship SS Markund, on which he returned to India. The one entitled *"The Colour of the Sea"* questioned the validity of the view expressed by Lord Rayleigh that the much admired dark blue of the deep sea was simply the blue of the sky seen by reflection. While on the Mediterranean and the Red Seas, Raman quenched the surface reflection by a nicol prism and noticed that the colour of the sea was by no means impoverished by this, but actually improved wonderfully. Using the diffraction grating he showed that the maximum spectral intensity differed in the case of the blue sky and that of the blue sea. He suggested that the local fluctuations in density postulated by Einstein and Smoluchowski should not only explain the scattering of light in liquids but also in solids. He proceeded to make measurements on water and crystal quartz and showed that this was indeed true. He also examined amorphous substances and proposed that the intense scattering of light by these was due to the permanent local fluctuations in density similar to those that arise transitorily in liquids. To avoid dust haze he measured the depolarisation of light scattered by the sky on Mount Doddabetta in the Nilgiris and ascribed the residual depolarisation to molecular anisotropy.

To clarify his own views he wrote a monograph on the Molecular Diffraction of Light. He dedicated it to the enlightened Vice Chancellor of the Calcutta University, Sir Asutosh Mukherjee, who had made Raman a full time scientist by offering him the Palit Chair of Physics. In this volume Raman examines the molecular scattering of light by gases, by the atmosphere and by liquids. He deals with the colour of the sea, the albedo of the earth, scattering of light in crystals and in amorphous solids and the problem of the Doppler effect in molecular scattering, a topic to which he was to come back in later years.

In the concluding chapter on this essay entitled *"The Scattering of Light and the Quantum theory"*, he points out that if the process of scattering could be regarded as a collision between a light quantum localised in space and an individual molecule, the observed laws of light scattering would be different from that anticipated on the classical principles of the electromagnetic theory of light. According to the latter, the variation of the spacings and the orientation of the molecules in the fluid and the consequent local fluctuations in the optical density would determine the magnitude and the characteristics of scattering; while according to the quantum hypothesis the individual scattering process will be wholly incoherent with each other and the resulting intensity of scattering will be determined by the density of the fluid as a whole and not by its fluctuations. He makes reference to cases in which the classical wave theory fails to explain the facts relating to molecular scattering in a satisfactory manner. In fact Raman was convinced that accurate measurements of the intensity of scattered light would bring out these contradictions. The review of this Monograph in Nature (1922) mentions: "Prof. Raman makes the interesting suggestion that the failure may mean that the continuous wave theory of light does not strictly represent the facts and that we may perhaps find experimental support for the Einstein conception that light itself consists of quantum units".

He began looking for this effect in the molecular clustering in liquids and in the "weak fluorescence" exhibited by water and organic liquids when they scatter light.

Students, many of whom were university teachers and who came as vacation workers, were assigned problems connected with the scattering of light. In 1923 the study of the scattering of light in water was taken up by K R Ramanathan. Sunlight was focussed on the liquid contained in a flask and the scattered light was seen as a track in the transverse direction. By the proper use of a system of complementary filters a "weak fluorescence" was detected in the scattered track. This was attributed to impurities in the liquid. Ramanathan wrote much later, "Raman was not satisfied with the explanation that it was due to fluorescence. He felt that it was characteristic of the substance and wondered whether it might not be akin to the Compton effect in X-ray scattering", which had just been discovered that year. Raman saw this "feeble fluorescence" as a disturbing effect superposed on the classical scattering of light. It is interesting that Compton too attributed the softening of X-rays by scattering to what he called a "general fluorescent radiation" almost in the manner Raman labelled the phenomenon he observed as "a special type of feeble fluorescence". Because of the close analogy with the Compton effect Raman became interested in X-ray scattering again.

Raman with Ramanathan had broken new ground in the field of X-ray scattering in liquids in 1923. He showed that the scattering at very low angles was governed by the Einstein-Smoluchowski fluctuations. For explaining the scattering at larger angles the discrete structure of the medium must be taken into account. For this the distribution of matter in the fluid must be analysed into a continuous "structural spectrum" which has its peak of intensity at a wavelength equal to the mean distance between the neighbouring molecules. Raman once said, "we were so preoccupied with light scattering that we did not apply the idea of Fourier transforms to X-ray scattering of liquids although we were so close to it". This was done later in 1927 by Zernicke and Prins.

Raman attempted to understand the Compton effect from the point of view of the classical wave theory. In this process he derived what is now known as the Raman-Compton formula. It was then that the true nature of the "feeble fluorescence" phenomenon became evident to him. The Compton effect could be considered as due to a kind of "fluctuation" in the state of the scattering atom in the field of the radiation. If much milder fluctuations were possible they should give rise to a change in wavelength in the light scattered by the molecule. He was more convinced than ever that the "weak fluorescence" phenomenon was the optical analogue of the Compton effect.

So he pressed on with the experimental study of this phenomenon. S. Venkateswaran, a part time worker in his laboratory succeeded in purifying many organic liquids by slow distillation in *vacuo* and observed a greenish blue track in pure glycerine. With K S Krishnan, Raman observed that all the pure organic liquids available in the laboratory showed this "feeble fluorescence". He was convinced that this was the modified scattering of altered wavelength corresponding to the "milder fluctuations" in the state of the scattering molecule. The real discovery of the Raman Effect took place on the 28th of February 1928 when Raman pointed a direct vision spectroscope on to the scattered track and saw that the scattered light contained not only the incident colour but at least another, separated by a dark space.

Filtered sunlight, which till then had been used as the incident light, was replaced by a quartz mercury arc and sharp modified Raman lines were recorded. The shift in the frequencies was identified with some of the characteristic infra-red frequencies of the molecule. Not only the degradation but the enhancement of the frequency of the scattered radiation was also observed. Scores of papers were published by his students on Raman scattering. Before long many laboratories round the world also took up the study of the Raman Effect, particularly in simpler molecules. But in Raman's laboratory the accent was on the study of more fundamental problems connected with the physics of the solid and liquid states.

In his lecture entitled "The New Radiation" delivered by Raman to the South Indian Science Association at Bangalore on 16 March, 1928, he first announced the discovery of the Raman Effect to a scientific audience. The lecture at the Bristol meeting of the Faraday Society in the fall of 1929 and the Nobel lecture, "The Molecular Scattering of Light", delivered by him at Stockholm on 11 December, 1930 are included in the Scientific Papers.

Even in their earliest photographs, Raman and Krishnan noticed an asymmetric nebulosity accompanying the spectral line of the incident radiation when scattered by liquids. This they suggested was the effect of those collisions of the incident light quanta with molecules which result in a change of their rotational state. Four later papers by Raman and Bhagavantam, on the experimental and theoretical investigations of the wings of the Rayleigh line are included in this volume. They found that, even on increasing the spectral resolution as far as possible, the depolarisation ratio of the central line to the entire Rayleigh line did not fall to the value of one fourth predicted by the Kramers-Heisenberg formula. Stray light, instrumental polarisation and imperfect spectral resolution would all tend to increase the measured depolarisation of the central component. The authors were fully aware of the experimental problems.

Prompted perhaps by their not so accurate results from this very difficult experiment and the relentless urge to find an *experimentum crucis* for the quantum picture of the photon spin, Raman and Bhagavantam were led, though temporarily, to question the validity of the Kramers-Heisenberg formula for light scattering and to postulate a new effect arising from the spin of the photon. However, we now know that the search for an effect lying entirely outside the province of the semi-classical theory did not end till the late 1940's when the Lamb shift and the deviation of the electron g-factor from 2 were discovered.

The Doppler Effect in molecular scattering intrigued Raman even in 1919. He was attracted by the theory of Brillouin that the medium which scatters radiation can be treated as a continuum filled with moving high frequency sound waves of various wavelengths, which reflect the light rays in the same manner a moving crystal would give Bragg reflections of X-rays. Raman showed that, as in Compton scattering, Brillouin scattering can only take place when both the energy and the momentum equations are satisfied. Even in the monograph of 1922 Raman had suggested an experimental technique for studying the Doppler Effect in light scattering. Using a similar set-up with a Fabry-Perot etalon, Brillouin scattering was observed in many liquids and Raman discussed the paradox of the appearance of the central component. The velocities of the "hypersonic" waves in these liquids were determined. Perhaps the most exciting result obtained by Raman and his collaborators in the field is that viscous liquids at these high frequencies behave like amorphous solids capable of sustaining both longitudinal and transverse waves.

His studies on Brillouin scattering made Raman reconsider the thermodynamic theory of light scattering. Einstein considered the density fluctuations to be static and isothermal, while in the theory of Brillouin they are considered to be dynamic stratification of sound waves and therefore presumably adiabatic in character. To test this, the adiabatic piezo-optic coefficients of some common liquids were measured. Using these experimental values and assuming the density fluctuations to be adiabatic in character, the intensity of scattering was calculated. The observed intensities were found to support the adiabatic hypothesis.

Raman with Nedungadi published a beautiful paper in December 1939 on the alpha-beta transformation of quartz. As the temperature is raised it was noticed that 220 cm^{-1} line in the Raman spectrum behaves in an exceptional way, spreading out greatly towards exciting the line and becoming a weak diffuse band as the transition temperature is approached. On the other hand, the other intense lines having both larger and smaller frequency shifts continue to be easily visible, though appreciably broadened and displaced. Raman conjectured that "the behaviour of the 220 cm^{-1} line clearly indicates that the binding forces which determine the frequency of the corresponding mode of vibration of the crystal lattices diminish rapidly with rising temperature." He inferred that "the increasing excitation of this particular mode of vibration with rising temperature and the deformations of the atomic arrangement resulting therefrom are in a special measure responsible for the remarkable changes in the properties of the crystals already mentioned, as well as for inducing the transformation from the alpha to the beta form". Almost twenty years later this effect was rediscovered and is now known as the "soft mode".

The Golden Jubilee of Current Science

1982 is the Golden Jubilee Year of *Current Science*. The publication of the first issue of the journal in July 1932, fifty years ago, was hailed as "an event of major importance to the development of science in India" by Dr L L Fermor, the President of the Indian Science Congress, in his Presidential address in January 1933. The Indian Academy of Sciences, which came into being two years after *Current Science*, congratulates *Current Science* on its golden jubilee and the completion of fifty years of outstanding service to the cause of science in India.

The idea of starting a scientific journal covering diverse fields of knowledge, which would help in consolidating science in India, first germinated in the minds of some scientists in Bangalore, mostly from the Indian Institute of Science and the Central College. Sir Martin Forster, Director of the Indian Institute of Science, helped their efforts by obtaining through a formal questionnaire of August 1931, the response of the scientific community in India, to starting an Indian Science News Journal; and the response was overwhelming. Even in the early stages they seem to have involved Prof. C V Raman, who was then at the Indian Association for the Cultivation of Science in Calcutta. The presence in Bangalore of a large number of scientists to attend the sessions of the Indian Science Congress in January 1932 and the appointment of a Working Committee finally helped to launch *Current Science*, the first issue of which appeared in July 1932.

The journal was conducted by an editor, assisted by an editorial board. Prof C R Narayana Rao, Professor of Zoology, Central College, Bangalore, was the first editor. The editorial board laid the foundations of the editorial practice for the journal; their service was of a pioneering nature. They secured the editorial co-operation of a number of scientists in India and the advice of editors of similar journals outside India, namely Sir Richard Gregory of *Nature*, Dr Arnold Berliner of *Die Naturwissenschaften* and Dr J M Catell of *Science*, who acted as corresponding editors of

Current Science.

The *Current Science* Office was housed originally at the Indian Institute of Science. In 1947, Prof. C V Raman was elected President of the Current Science Association and held this office till his death in 1970. A close and fruitful association between the Academy and the Association has naturally developed over the decades. In fact, for the past several years the *Current Science* Office has been housed in the Academy premises.

The journal which started as a monthly continued as such till 1964, when it was converted into a fortnightly journal to accommodate a larger number of letters and articles. There has been a steady growth in the size of the journal. It now publishes about 1000—1300 pages every year. Its main strength over the years has been its evolution as a letter journal, providing a means for fast publication of the results of original investigations.

During the past fifty years, many articles have been published in *Current Science*, covering a wide range of subjects and issues relating generally to the organisation and cultivation of science in the country. Some of these have been seminal in nature. Among the first was an unsigned article in May 1933 entitled "An Indian Academy of Science", which resulted in the establishment of the Indian Academy of Sciences in 1934 (this article was reproduced in the first issue *Patrika* of December, 1980). A second was an editorial by Prof. C V Raman in July 1943 on "Astronomical Research in India". Writing in *Current Science* in May 1971 on "Raman and Astronomy" in the Raman Memorial number, Dr M K Vainu Bappu wrote "Recent developments in the country, in the form of support to the astronomical cause, augur well for the future. Poised as we are on such a threshold, let us hope that the contributions of the Indian astronomical community will, in the years to come, be such as to bear out Raman's convictions on the role of astronomy in his country's welfare'

The main features of the journal were from the beginning planned to be (a) editorial, (b) special articles, (c) letters to the editor, consisting of short notes of original investigations, (d) research notes consisting of news and references to important publications, announcements and similar topics, (e) science news consisting of news and notes of lectures, addresses, meetings and important scientific events, (f) industrial outlook consisting of notes and articles on industrial topics including all branches of applied science, (g) coming events, and (h) book reviews. And these have continued, with the accent on letters to the editor, book reviews and short scientific notes.

It was felt some years ago that the collaboration and close association, which had developed between the Academy and the Current Science Association, should be strengthened through mutual consultation and discussion. The charcter of *Current Science* as a letter journal complements that of the Academy journals and the publications of the two organisations could well be seen as a total whole. At the same time the need for a judicious reorganisation of the *Current Science* was also recognized.

The Academy and the Association therefore, decided upon a plan of reorganising Current *Science* to bring about a widening of its services to the scientific community and linking it to the journals of the Academy, at the same time retaining its charcter as a news journal. While the Current Science Association retains its independence and autonomous charcter, the Academy has temporarily accepted certain financial and managerial responsibilities for *Current Science*, from the beginning of 1981.

Three types of services are planned to be provided to the scientific community in *Current Science*, first, information on important developments in science and information of general interest to the scientific community. Secondly, discussion on new technological and developmental projects contemplated, on government proposals touching aspects of science and science policy and on the problems of the scientific community or groups of scientists or individuals. And finally, review articles on scientific subjects, by continuing reviewing of scientific books and by periodically reviewing scientific instruments and equipment developed in the country.

A coordinating committee has been appointed jointly by the Association and the Academy to review the progress made in the reorganisation of the journal, the working of the link-up and finances and all relevant matters and take decisions at an operational level. The Chairman of the Editorial Board of *Current Science* and the Editor of the Publications of the Academy will jointly supervise the publication of *Current Science*.

This collaborative arrangement is now for a four-year period 1981-1984 and will be reviewed jointly by the Academy and the Association at the end of 1982, the golden jubilee year, and at the end of 1984.

The journal is now being printed by photocomposing and offset process. Each of the Golden Jubilee Year issues of *Current Science* begins with one or more review articles on new emerging areas in which original research work is being done in the country. Since these articles are topical and semi-popular in nature, the publication of a collection of these articles will be useful to University students and those who wish to learn of recent developments in science and technology in India.

Editor: Anna Mani

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