

NISHTALA APPALA NARASIMHAM

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NISHTALA APPALA NARASIMHAM

(1922 – 2002)

Elected Fellow 1971

NISHTALA APPALA NARASIMHAM was an eminent spectroscopist, who served the Department of Atomic Energy (DAE) with distinction for a quarter of a century (1957-82). He established a world class spectroscopy laboratory in the Bhabha Atomic Research Centre (BARC), Mumbai. Narasmham set up excellent research facilities and with the help of his colleagues, carried out research in the areas of high resolution molecular and atomic spectroscopy, infrared and Raman studies, crystal spectroscopy etc. He brought world attention to his group by inviting world renowned scientists to interact with his colleagues, sending his colleagues to work in prestigious laboratories abroad and organizing international conferences on spectroscopy in BARC.

FAMILY BACKGROUND AND EDUCATION

Narasimham was born in Parlakimidi, Orissa on 15th August, 1922 in a lower middle class family. Tragedy struck him early in life, when he lost his mother at the age of twelve. He, his three younger brothers and a sister were brought up by his aunt. He did schooling till matriculation in Bobbili, a small town in Andhra Pradesh famous for the historic Bobbili Yuddham (battle). He completed B.A. (Physics) in M.R.College, Vijayanagaram in first class, securing first rank and the Andhra University Gold Medal.

Post College Period

Soon after graduation, Narasimham worked as a Demonstrator in the famous Hindu College, Machilipatnam (1942-43). During this period, he spent a few days in Vinayashram in Guntur run by Gandhiji's followers as a volunteer and learnt the importance of self help and dignity of labour. Narasimham did M.Sc. (Physics) 1943-45, in Banaras Hindu University (BHU), Varanasi. Here he came under the influence of the famous spectroscopist Professor RK Asundi (teacher to the author also), a father figure, who inspired and guided Narasimham till his death in 1982. Narasimham acknowledged very frequently that his scientific career and his accomplishments were due to his association with Asundi. Narasimham worked as a Lecturer in Smt. AVN College at Visakhapatnam during 1945-47 and as Head of the Physics Department in Vijaya College, Bijapur, Karnataka, 1947-49.

A strong desire to pursue an academic career and encouragement from Asundi, who arranged a scholarship, led Narasimham to join for research in BHU in 1949. In those days, the financial support for research scholars was meager and not so regular. So Narasimham had to give tuitions to



support himself and his family back home. Narasimham obtained a doctorate in 1952 from BHU. The Ph.D. work related to extensive spectroscopic studies, including of Joshi effect, on the ozonizer type of discharges in nitrogen gas. The author's first and brief contact with Narasimham was in 1952. Narasimham married Kum. Kamala Cherukuri in 1943. They had their only child, a son, Prasad, in 1953.

Post Doctoral Research

Narasimham got a post doctoral fellowship with Professor Julian Mack at the University of Wisconsin, Madison, USA. With difficulty Narasimham arranged for funds for his travel to USA by ship. However, when he arrived at Bombay, he found to his dismay that the funds did not reach him. Knowing this, Asundi sent money to Narasimham by telegram-money-order to enable him to leave Bombay as planned.

In Professor Mack's laboratory, Narasimham worked on the fine structure of H_{α} and other atomic lines using atomic beam techniques. During the next two years 1953-55, Narasimham worked with Professor J Rud Nielsen at the University of Oklahoma, at Norman, as a project associate. Here he worked in a different field – infrared and Raman spectral studies of fluorinated benzenes. Narasimham became familiar with infrared spectral techniques and the complementary techniques, using the recently developed Toronto-type mercury lamp and White's multiple reflection cell, for Raman studies of molecules in the gaseous state.

His excellent work at the university of Oklahoma earned Narasimham the prestigious National Research Council of Canada (NRCC) postdoctoral fellowship to work in the laboratory of Professor Gerhard Herzberg, later to receive the Nobel Prize in chemistry, and his many talented colleagues at Ottawa. Here again Narasimham worked in a different area – High Resolution Spectral Studies of Diatomic Molecules. He photographed the atomic spectra of PH^+ and P_2^+ molecules at high resolution and analysed their rotational structures. Narasimham learnt much in NRCC from Herzberg and his colleagues AE Douglas, D Ramsay and others. He always cherished his days in NRCC and his association with the active scientific group there. Next to Professor Asundi, Herzberg played a major role as a philosopher and guide to Narasimham.

PROFESSIONAL AND RESEARCH CAREER

Return to India

When Narasimham was working in NRCC, Dr. Homi Bhabha happened to visit that laboratory where he met Narasimham and suggested to him to come to Bombay and work in the Atomic Energy Establishment, Trombay (AEET), renamed Bhabha Atomic Research Centre (BARC) after Bhabha's death in 1966. In February 1957, Professor Asundi, after his retirement from BHU, became Honorary Advisor to AEET on Dr. Bhabha's invitation. Bhabha's suggestion and Asundi's association with AEET worked as irresistible temptations for Narasimham to join AEET in 1957, after completion of his fellowship in NRCC.

Research Career at BARC

When Narasimham joined AEET, it had a small spectroscopy unit as a part of the Analytical Chemistry Division, catering to the requirements of spectrochemical analysis of nuclear materials.



Bhabha requested Asundi and Narasimham to strengthen, enlarge the scope and modernize the existing spectroscopy group to cope up with all future spectrochemical analytical requirements of the AEET and simultaneously gave them freedom to establish a spectroscopy research laboratory. Asundi and Narasimham had a vision to establish a world class spectroscopy laboratory covering the complete electromagnetic spectrum from x-rays to RF. Narasimham started recruiting youngsters with B.Sc., M.Sc. and Ph.D. degrees in physics and chemistry in good numbers soon after his joining. By about April – May 1958, the spectroscopy laboratory in AEET started humming with activity. In the next two years basic spectroscopic and related equipment for carrying out research from the X-ray region to the infrared were procured and several research programs initiated. In 1963, the spectroscopy section was separated from the Analytical division and made into an independent division. The main research contributions of Narasimham are summarized.

Spectra and Structure of Diatomic Molecules

During 1961, Narasimham spent a few months at the Argonne National Laboratory in USA where he, along with JK Brody of that laboratory, photographed under high resolution the ultraviolet bands of S_2 molecule on the laboratory's Big Circle (the 30ft. Paschen mounted concave grating spectrograph) and thoroughly analysed the fine structure.

By detailed high resolution studies of the spectra, including isotope substitution studies, of NH, NS, PS, PO and AIO molecules, Narasimham and his colleagues were able to discover several new electronic transitions in these molecules and in some cases correct errors in previous studies. By a fine structure analysis of the ${}^3\Pi_g - {}^3\Sigma_u^+$ bands of the ${}^{34}S_2$ molecule, apart from independently confirming the spin of the ${}^{34}S$ nucleus to be zero, Narasimham could explain the peculiar intensity distribution in the bands as due to intermediate nature of the coupling in the ${}^3\Sigma_u^+$ state.

By identifying and understanding predissociations in the rotational structure of NH, NH^+ and S_2 bands, the dissociation energies of the electronic states of these molecules were obtained. The ionization potential of the ground state of the S_2 molecule was determined from an analysis of the Rydberg series identified in the vacuum ultraviolet spectrum of the molecule.

Other significant research contributions of Narasimham relate to establishing that the High Pressure Carbon Bands, for which the emitter and electronic transition were uncertain and under debate, actually form part of the Swan band system of the C_2 molecule. Narasimham showed that for the O_2^+ molecule, the spin rotation coupling constant changes from a negative value at low vibrational quantum numbers to a positive value at higher vibrational numbers. These high resolution spectral studies were made on the 21 ft. Eagle mounted concave grating spectrograph, set up in the division in early 1960s. With a frequency stabilized He – Ne laser developed in the laboratory, Narasimham and his colleagues obtained and analysed the hyperfine structure of the rotational lines in the electronic spectrum of the ${}^{127}I_2$ molecule at a resolution of 10^{-6} cm^{-1} .

Spectra and Structure of Polyatomic Molecules

Significant contributions in this area include the discovery of diffuse emission bands of Xenon and Krypton fluorides, explaining that they involve bound-free transition and correlating the electronic levels of the molecules with the ground state doublets of the Xenon and Krypton ions.



Vibrational spectra of borazine were studied in the solid state. In the vapour state the D-H bond - stretching vibration of borazine was studied under ultra high resolution, using a semi-conductor diode laser. From these studies it was established that the molecule belongs to the D_{3h} point group. Infrared spectra and normal coordinate analysis studies of dihalogenated benzenes like fluorochloro and fluorobromo benzenes, some trihalogenated benzenes and other polyatomic molecules were carried out by Narasimham and his colleagues.

Miscellaneous Other Researches

X-ray spectroscopic studies include the measurement of the widths of K - levels of heavy elements and determination of the intensity ratios of mesonic x-ray lines, $K_{\alpha 1}$, $K_{\alpha 2}$, $L_{\alpha 1}$, and $L_{\alpha 2}$. In the area of solid state spectroscopy, an apparatus for growing single crystals by the Stockbarger technique was set up. Single crystals of a number of rare earth compounds, like $PrCl_3$, pure and doped, were grown. Fluorescence spectra of these compounds obtained by optical and X-ray excitation were studied to understand the crystal field effects.

DEVELOPMENT OF SPECTROSCOPY LABORATORY IN TROMBAY

After the spectroscopy laboratory was shifted in early 1967 from its temporary location in the Bombay Dyeing Company's premises in Central Bombay to Trombay, much more space became available. Narasimham initiated more research activities and obtained more sophisticated spectroscopic and related equipment. To improve the scope and speed of spectrochemical analysis, a multichannel direct reader spectrometer, an x-ray fluorescence spectrometer and an inductively coupled plasma spectrometer were procured. To enhance the capability of high resolution studies in the ultra violet and visible regions, a 35 ft. Eagle mounted concave grating spectrograph was set up and an automatic spectral line measuring device was procured.

The optics activity was started by Narasimham by recruiting a few scientists with requisite experience. Soon this unit established precision optical grinding, polishing and surface planeness measuring techniques and started supplying to various BARC divisions their special requirements of mirrors, prisms, fabry – perot plates etc. A little later, Narasimham established an optical coating facility, one of the most sophisticated in the country, with the necessary equipment and trained members in different type of optical coatings – metallic, dielectric multilayer etc. Soon this facility was making high reflectors, beam splitters, beam combiners, interferometer coatings to meet the requirements of various divisions in BARC and even of other institutions. The Optics Laboratory and the Optical Coating Facility became very sophisticated infrastructural facilities for spectroscopic research.

In 1974, the author of this memoir deviated from the regular activities of the spectroscopy division to organize a new multi-disciplinary laboratory for developing laser techniques for uranium enrichment, basically an applied laser spectroscopy activity.

LOOKING BACK

By the time Narasimham retired end August 1982, he could look back with satisfaction that a good part of his vision was fulfilled. An active world class spectroscopy laboratory was functioning with



many research activities in several aspects of spectroscopy. The analytical wing of the laboratory was fully and quickly coping up with all the spectrochemical analytical needs of DAE units. Besides, it helped in setting up in-house spectrochemical analytical facilities in some DAE units.

The laser isotope separation activity was closing in to the stage of demonstrating that uranium can indeed be enriched by laser techniques (the demonstration experiments were successfully carried out in December, 1982). More than a hundred young scientists were groomed in the methodology of spectroscopic research, about thirty of them getting Ph. D. degrees. A few of them became leaders in their specializations. The spectroscopy laboratory in BARC was recognized as a premier research laboratory comparable to the best in the world by distinguished scientists from abroad.

MISCELLANEOUS ACTIVITIES

Convention of Spectroscopists of India

Around 1958, Asundi and Narasimham founded the convention of spectroscopists of India to bring together the spectroscopists in India once an year. A one day meeting of the convention was organized at the venue of the Indian Science Congress, a day before the commencement of the Congress to facilitate spectroscopists attending the Science Congress to participate in the convention with minimum additional effort. The convention meetings were lively and purposeful, about eight to ten speakers giving talks. They offered an avenue for the Indian spectroscopists young and old to know and interact with one another. Sometimes distinguished scientists from abroad used to participate in the convention, having been invited by the Science Congress.

Visiting of Foreign Scientists

Many eminent scientists – A Kastler, J LeComte, P Jacquinot and R Vodar from France, RS Mulliken, H Sponer Franck, GH Dieke and J Rud Nielsen from USA, G Herzberg from Canada, P Swings from Belgium and PFA Klinkenberg from Holland spent a few days to several weeks in BARC, giving lectures and discussing the research work of the youngsters.

POST RETIREMENT PERIOD

Narasimham lived for nearly twenty years after retirement and was scientifically active till almost his end. A few months before his demise, he attended a meeting of the Indian Academy of Sciences in Tirupati. For about fifteen years after retirement, Narasimham used to actively participate in research, review and selection committee meetings of DRDO, of many Universities and other institutions. In 1985, Narasimham was chosen as one of the first awardees of the INSA Senior Scientist Scheme and utilized this opportunity to associate and participate in the activities of the Indian Institute of Astrophysics (IIA). Around this period he was also associated with the Central Scientific Instrument Organisation (CSIO) in Chandigarh, as Chairman of its Research Advisory Council. This proved useful in coordinating between the optics unit of CSIO and the team setting up of the 2.34 m optical telescope in Kavalur, Tamil Nadu.



Narasimham organised an International Conference in Mumbai in January, 1996 entitled “Spectroscopy, Perspectives and Frontiers” to coincide with the birth centenary year of Professor RK Asundi. Narasimham used to participate in all the meetings of INSA and the Indian Academy of Sciences. Narasimham visited USA and Canada for four months, September to December 1997 – to meet all his spectroscopist friends and visit their laboratories. He gave seminar in MIT, Chicago, Indianapolis, Pittsburg, Washington D.C. and Huntsville in USA and in Toronto, Ottawa, Fredericton and St. John’s in Canada.

AWARDS AND HONOURS

In his scientific career, Dr Narasimham held various positions such as Head, Spectroscopy Section, Analytical Division, Bhabha Atomic Research Center (BARC) (1957-1963); Head, Spectroscopy Division, BARC (1963-1979); Head, Analysis Group, BARC (1979-1982); INSA Senior Scientist (1985-1987) and received Academy Fellowships of Indian Academy of Sciences (1966); Indian National Science Academy (1971); Andhra Pradesh Academy of Sciences (1973); Founder member, Maharashtra Academy of Sciences. He was also holding Membership of Policy Making Bodies at International & National level such as Member, Indian National Committee of International Union of Pure & Applied Physics (IUPAP) (1975-1978); Chairman Indian National Committee of IUPAP (1978-1981); Member, IUPAP Commission C-15 on Atomic & Molecular Physics and Spectroscopy (1981-1987); Member, Advisory Committee for the Award of Shanti Swarup Bhatnagar Prize (1978-1981); Member, Governing Council of the Indian Institute of Astrophysics, IIA, Bangalore (1979-1992); Member, Research Advisory Council and Executive Committee of National Physical Laboratory, NPL, Delhi (1980-1982); Chairman, Indian National Science Academy (INSA) Council (1981-1982). He was Chairman, Research Advisory Council of Central Scientific Instrument Organisation (CSIO), Chandigarh; Member, Instrumentation Advisory Committee of Department of Science and Technology (DST), Delhi and Member, Physics Research Committee of Council of Scientific & Industrial Research (CSIR), Delhi.

Dr Narasimham received several awards & honours such as: K. Rangadhama Rao Memorial Lecture (INSA), 1983, Bangalore; Silver Jubilee Lecture, Andhra Pradesh Academy of Sciences, 1988, Hyderabad; Sanjeeviah Memorial Lecture, Sri Venkateshwara University, 1990, Tirupati; Plaque and Citation, Instrument Society of India, 1983, New Delhi and Sir C.V.Raman Birth Centenary Medal, 1988, Calcutta.

NARASIMHAM AS A MAN

Narasimham imbibed the extraordinary qualities of his teacher Asundi, in treating his colleagues and their families as members of an extended Spectroscopy family. Whenever he would go out in India or abroad, he would rather stay with his friend’s families. Similarly all his friends in India and abroad would consider Narasimham’s house as a “Four Star Guest House” always available, even when Narasimhams are away.

A couple of anecdotes in this context might be interesting. Professor KVLN Sastry of the University of New Brunswick, Canada landed in Saras Baug with his family one morning to find



Narasimham's house locked, but with a note to contact me. Sastry came to stay full four days with him, to give a lecture in BARC and to discuss with Narasimham the programme chalked out for him for the month he would be spending in India. Except for sleeping in Narasimham's house, Sastry and family spent all the four days with us and on the fifth day morning they left for the airport to go to Hyderabad. After entertaining the guests for four days, we were looking forward to a day of relaxation, when we noticed Sastry's family returning from the airport. Sastry saw a huge crowd of pilgrims returning from Haj and wanting to go back to Hyderabad crowding every nook and corner of the airport and even the adjoining area. Sastry decided not to travel in that flight.

One day late at night, Professor BD Nageswararao (BDN) of Indianapolis University, USA landed at Narasimham's house to find a caretaker boy sleeping in the house, who would not let him in. BDN, the good scientist that he was, hit upon a brilliant idea. He asked the boy to take him to the house of a friend of Narasimham, who could vouch about his genuineness. So around 11 p.m., the boy brought BDN to our house and on my assurance let him to stay in Narasimham's house. Narasimham brought visibility to his younger colleagues by making them interact with distinguished scientists and by giving them plenty of opportunities to show their worth. He was a very helpful person and helped his colleagues, friends and relatives in various ways.

Narasimham was a visionary but not a down-to-earth pragmatist. After the demise of Professor Asundi, Narasimham wanted to establish an active School of Spectroscopy in a place in India associated with Asundi and could even get a huge grant from DRDO. The effort ended in a failure since the people chosen for such a stupendous task were neither competent nor even interested. Narasimham used to mention this episode to me several times and feel sorry.

LAST DAYS

Narasimham had basically excellent health. In his twenty-five years of service, he took leave (even casual leave) on very few occasions on health or any other grounds. Narasimham started experiencing frequent health problems only about two years before his demise. During the last several years, Narasimham used to visit our house very frequently and shared with me the many vicissitudes of his long life and career, persons he came in contact with, the successes and failures in his life etc. In spite of his age, he would participate in some of the important programmes of the scientific and social organizations with which I was associated.

During the last year or so he began to turn philosophical and would often remark that he may not live long. On several occasions, when he visited us, I had to escort him back to his house in view of his frail physical condition. A few months before his demise, his problem was diagnosed as cancer of esophagus. The doctors took care to hide the test results from Narasimham, taking into confidence his wife and son. For about a month before his demise Narasimham was shuttling between his house and BARC hospital, which happens to be barely 300 yards from his house.

On Friday April 5th, 2002, I went to see Narasimham about 12 noon. He was in a delicate condition and badly needed hospitalization. However, he was resisting suggestions of hospitalization. His son, Prasad was to come Saturday (6th) night from Varanasi and his younger brother on 8th from Visakhapatnam. I sat for some time by his side and hesitatingly suggested to him that it would be best for all if he agreed to be hospitalised. He said it is OK if all of us feel so and was immediately admitted. His body functions began to fail one after the other very rapidly and on Sunday he could hardly recognize his relatives and friends. Prasad reached Mumbai on 6th night and Narasimham



younger brother in the early hours of 8th morning. Narasimham passed away on 8th April 2002 at 11:30 A.M. with all his near and dear present by his side and became part of history. The day happened to be auspicious Ekadasi (11th day), which great people like Bhishma of Mahabharata waited for to leave their mortal frames.

Narasimham is survived by his wife Kamala, son Prasad, daughter-in-law Vijayalakshmi and grandsons Srikant and Sridhar. Prasad is a Professor of Metallurgy at BHU, the alma mater of Narasimham.

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