UNESCO Kalinga Prize Winner-1997

Prof. Dorairajan Balsubramanian

Eminent Scientist & Science Popularizer from India

[Born: August 28, 1939…..]

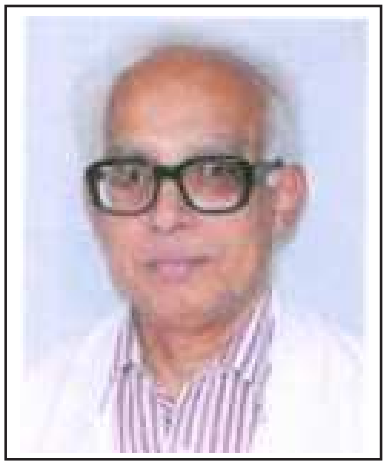
With best wishes to Dr. Mishra —

23 February 2007

"The protracted debate over nature (genetics) versus nurture (environment) in understanding human behaviour is no longer valid, the two go together,"
...D. Balasubramanian

Curriculum Vitae

Professor Dorairajan Balasubramanian, Ph.D.



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Current Position : Director of Research, L.V. Prasad Eye Institute, Banjara Hills, Hyderbad 500 034, India (since June 1998).
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Earlier Positions :
- Director, Centre for Cellular & Molecular Biology (CCMB), Hyderabad 500 007, India (until June 1998).
- Professor and Dean, University of Hyderabad, Hyderabad 500046 (1977-1982);
- Lecturer, Assistant Professor, Indian Institute of Technology (IIT), Kanpur (1967-1977).

Academic Training :
- M.Sc. Chemistry, Birla College, Pilani, India, 1959
- Ph.D. Chemistry, Columbia University, New York, USA, 1965
- Postdoctoral Fellow: Univ. Minnesota Medical School, 1965-66.

Research Interests :
- Molecular and Cellular Approaches to Understand and Treat Diseases of the Eye.
- Published 145 research papers and 2 books.

Other Major Interest :
- Work in the area of Public Understanding of Science, through popular science newspaper columns, radio and TV programs.

- Published over 300 popular articles and 6 books.
- Working with governments and agencies on issues of science and technology;
- Chairman-Biotechnology Advisory Council, Govt of Andhra Pradesh .

Honours & Awards :

- **"Padma Shri":** National honour by the President of India, 2002
- **"Chevalier de l'Ordre National de Merite" :** National honour by the President of France, 2002.
- Fellow – American Association for the Advancement of Science
- Fellow – Third World Academy of Sciences
- Fellow – International Molecular Biology Network
- Fellow of all the three Indian Science Academies
- Awarded the Bhatnagar Prize in Chemical Science, India 1981
- Won the Ranbaxy, Goyal, Bhasin and FICCI Awards, India
- Awarded the Third World Academy of Science Award in Basic Medical Sciences, 1995 and the Khwarizmi Award of Iran in Basic Medical Sciences, 1996.
- Awarded the UNESCO Kalinga Prize for the Popularization of Science, 1997, Paris, France.
- Awarded both the Indian National Science Academy's Indira Gandhi Prize for Science Popularization, and the DST/NCSTC National Prize for Science Popularization 2002.

Personal Details :

- Date of Birth : August 28, 1939; Citizen of India.
- Married to Shakti (ETV Producer), two daughters : Katyayani (Research Analyst) and Akhila (Public Health Professional).

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DETAILED CURRICULUM VITAE

OF

PROFESSOR D. BALASUBRAMANIAN
Director of Research
L.V. Prasad Eye Institute
Banjara Hills
Hyderbad 500 034
India

Prof Balasubramanian is currently the Director of Research, Hyderbad Eye Research Foundation, Hyderbad, India. He has also been the Deputy Director and later Director at Centre for Cellular and Molecular Biology (CCMB), Hyderbad; Lecturer and Assistant Professor of Chemistry, at IIT Kanpur, India and Professor and Dean at University of Hyderbad, India. His professional expertise and specialisation lies in the field of Biophysical Chemistry, Ocular biochemistry & Protein structure. He has Published over 130 research papers in international professional journals and written over 200 popular science articles in Indian newpapers. He received his PhD in chemistry from Columbia University, USA. Prof. Balasubramanian is the receipient of several professional honors the most noteworthy of them being UNESCO Award for science popularization and Third World Academy of Sciences Award for Basic Medical Research. The Government of India conferred upon him the Padma Shri in 2002. The same year, he received the prestigious Chevalier de l'Ordre National du Merite from the President of France.

Current Position : Director of Research, L.V. Prasad Eye Institute, Banjara Hills, Hyderbad 500 034, India (since June 1998). Phone +91-40-2354 3652; Fax : 2354 8271; Email : dbala@lvpei.org, dbala@operamail.com,
Also Visiting Professor, University of New South Wales, Sydney, Australia, Senior Fellow, University of Melbourne, Australia, and Adjunct Professor, BITS Pilani, India

Earlier Positions : Director, Centre for Cellular & Molecular Biology (CCMB), Hyderbad 500 007, India (until June 1998). Professor and Dean, University of Hyderabad, Hyderbad 500046, (1977-1982); Lecturer, Assistant Professor, Indian Institute of Technology (IIT), Kanpur (1967-1977).

Academic Training : M.Sc. Chemistry, Birla College, Pilani, India, 1959; Ph. D. Chemistry, Columbia University, New York, USA, 1965; Postdoctoral Fellow: Univ. Minnesota Medical School, 1965-66.

Research Interests : Molecular and Cellular Approaches to Understand and Treat Diseases of the Eye. Published 151 research papers and 2 books.

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Personal details : Date of Birth : August 28, 1939; Citizen of India. Married to Shakti (ETV Producer), two daughters : Katyayani (Research Analyst) and Akhila (Public Health Professional).

Short Summary of the Research activities of Prof. D. Balasubramanian

Professor D. Balasubramanian trained as a biophysical chemist at the doctoral degree level, and worked during the period 1965-1980 in the area of the structure and function of proteins and polypeptides. His special expertise lay in the spectroscopic analysis of their stability in solution.

Studies on the biochemistry and photochemistry of cataract :

It was around 1984-85 that he turned his full attention to eye research-to the proteins of the eye, in particular the crystallins of the lens and their role in keeping the eye lens transparent. He showed how photochemical (direct and sensitized) damage to these proteins compromise lenticular transparency and lead to cataract. This involved isolating the 'pigments' that accumulate in the human lens with age and during cataract, characterizing their chemical structre and their pro-oxidant (or antioxidant) behaviour. The major finding of these studies is that continual oxidative stress imposed on the lens, causing covalent chemical changes in the constituent molecules of this slow-turn-over tissue, leading to cataract.

Oxidative etiology of cataract and attempts to delay its progression :

Based on this finding, he has been looking at the use of chronic intake of antioxidant and cytoprotective substances in the daily diet (or as supplements) and how they can act as cataracto-static agents. Since cataract is a major cause of blindness in the world (accounting for over 50% of the blindness burden), and is of epidemic proportions in the developing nations, he has focused attention on such substances that are part of the daily diet and / or traditional medical practice of these people, and assess their potential role as cataractostatic agents. Some of these are tea polyphenols, ginkgo biloba and withania somnifera extractsubstances that are accessible, available, affordable and culturally acceptable to these people. Remarkably, all these substances are effective antioxidants and cytoprotective compounds, which retard the progression of oxidative cataract in experimental animals.

Molecular genetic analysis of some inherited eye diseases :

During the last 6 years, Dr. Balasubramanian has joined a group of ophthalmic clinicians, and extended his research to genetics and cell biology of the ye, which has been of direct clinical application. His more recent research has extended to the molecular genetic analysis of inherited forms of blindness such as primary congenital glaucoma. Work by his group on over 400 families revealed as many as 15 mutations in the gene CYP1B1, the most prevalent being the mutation R368H. Genotype-phenotype correlation has been done, as also the study of the structural changes that occur in the mutated protein, thus offering a clue to possible functional change. This has allowed (a) help to the clinician to intervene early and offer surgical care to save the sight of the infant, and (b) genetic counselling to the parents and the family.

Successful use of stem cell techniques to restore vision in patients :

More recently, his group has vigorously pursued the field of adult stem cell biology as well. With the discovery of adult stem cells in the limbus, surrounding the cornea of the eye, they have isolated these stem cells, explant cultured them on human amniotic membrane to produce transparent, stitchable corneal epithelia. These have been successfully transplanted to over 200 needy patients who has lost their vision due to chemical or fire burns, and restored vision to these eyes in significant measure. Many of these patients have not needed any subsequent corneal grafts, while others have successfully accepted a subsequent donor corneal transplant, to regain 20/20 vision. This work is perhaps the largest successful human trial of adult stem cell therapy anywhere.

Dr. Balasubramanian taught at the Indian Institute of Technology, Kanpur, and the University of Hyderbad, during 1967-80, before joining the Centre for Cellular & Molecular Biology Hyderbad (a national centre of excellence in biology), which he was Director of until 1998. He took early retirement from there to start the research wing of the L.V. Prasad Eye Institute, Hyderbad, where he is involved full time in basic aspects of eye research.

He is currently a Visiting Professor at the University of New South Wales, Sydney, Australia, Senior Fellow at the University of Melbourne, Australia, and the Birla Institute of Technology & Science, Pilani, India.

Professor Balasubramanian has published 156 research papers in peer-reviewed journals, of which 53 are in the area of eye research. A list of these publications is attached. In addition, he has authored two textbooks (in chemistry and in biotechnology).

Summary of his involvement in Science Communication and towards the Public Understanding of Science

Advice to Government in Biotechnology :

Apart from his professional research activities, he has been the Chairman of the Biotechnology Advisory Committee of the State of Andhra Pradesh. In this capaicty, he has assisted the state government in evaluating biotech enterprises, setting up the Biotech Park, and initiating the Biotech Incubator Facility. He has represented the government in the annual international trade conferences called BIO, in the US.

Efforts towards the Public Understanding of Science :

Print Media :

He is also committed to popularization of science, and has been regularly writing a fortnightly popular science column in the national English language newspaper of India. "The Hindu", every alternate Thursday- a total of over 300 articles since 1990. Prior to 1990, he wrote for the newspapers Newstime and The Times of India.

Compilations of these articles have been published as 4 popular science books, entitled :

"Cats Have Nine Lives",

"Genes and Means",

"Comet Tuttle and Space Shuttle", and

"The Mother of All Genes".

Audiovisual Media :

In addition, he appears on telvision-both educational and science-based channels and shows such as UGCTV, Door Darshan (programmes such as Countrywide Classroom, New Horizons, and Turning Point), Discovery Channel, both on air and as advisor.

He is an honorary President of the Andhra Pradesh based People's Science Movement called Jana Vignana Vedika.

Science Academies :

International :

He is a Fellow of the American Association for the Advancement of Science (AAAS), Washington DC, USA, and a Fellow of the Third World Academy of Sciences (TWAS), Trieste, Italy. He is a Consultant to TWAS & has Published, on their behalf, two public interest documents, entitled;

"Safe Drinking Water", and

"Capacity Building in Science in the Developing World".

He also consults for UNESCO, Paris, France, and is a member of their Committee on Bioethics. On behalf of UNESCO, he produced the position paper "Science for the Development of the South". for discussion by the Heads of Governments at the 1999 World Science Conference, at Budapest, Hungary.

National :

He is an elected Fellow of all the three science academies of India, and also the Andhra Pradesh Akademi of Science. He has been a Council Member and Editor of Publicaitons of The Indian National Science Academy, and an editor of the Proc. Ind. Acad. Sci. (Chem. Sci.). He is currently the Vice President of the Indian Academy of Sciences.

On behalf of the Indian National Science Academy, he organised two cross disciplinary symposia, entitled: "The Indian Human Hertiage", and "the Deccan Heritage", each of which dealt with the scientific, health, language and literature, music, geographical & historical heritage of India and the Deccan. The proceedings of these two symposia have been edited by him and published as two monographs, entitled

"The Indian Human Heritage" and

"The Deccan Heritage".

He has been a member of the National Steering Committee for the International Science Olympiads, sponsored and organized by the Homi Bhabha Centre for Science Education of the Department of Atomic Energy, India.

INVOLVEMENT IN EXTRAMURAL PROFESSIONAL ACTIVITIES IN OTHER SCIENTIFIC AND TECHNOLOGICAL INSTITUTIONS

Membership and Responsibilities in Various Committees (2005)

International :

- Member : Committee on Bioethics, UNESCO, Paris, France
- Member :International Basic Sciences Programme, UNESCO, Paris, France
- Consultant : Academy of Sciences for the Developing World (earlier called the Third World Academy of Sciences, TWAS), Trieste, Italy
- Member : Sectional Committee on Structural, Cell and Molecular Biology, TWAS, Trieste, Italy
- Co-Chairman-Joint Working Group, US-India Collaborative Program on Eye Research, between NIH (USA) and DBT (India).

National :

- Chairman : Task Force on Stem Cell Research, Department of Biotechnology, Government of India, New Delhi.
- Member : Scientific Advisory Council, Department of Biotechnology, Government of India, New Delhi.
- Member : Basic Research Programmes Committee, Department of Biotehnology, Government of India, New Delhi.
- Chairman : Life Sciences Research Programme Committee, Defence Research & Development Organization, India
- Member-High Power Advisory Committee for the Establishment of National Institutes of Science & Technology, University Grants Commission, New Delhi.
- Member : Planning Group : Proposed Indian Institute of Science Education and Research, Pune
- Vice President : Indian Academy of Sciences, Bangalore.
- Convener : Sectional Committee on Medicine, Indian Academy of Sciences, Bangalore.

- Member : Knowledge Hub, Indian School of Business, Hyderbad
- Member : Advisory Committee on Human Development, Administrative Staff College of India, Hyderbad
- Chairman : Research Advisory Council, Manovikas Kendra, Kolkata, West Bengal.
- Member : Research Advisory Panel, and Governing Body, Vision Research Foundation, Sankara Nethralaya, Chennai, Tamilnadu.
- Member : Research Advisory Panel, Madras Diabetes Research Foundation, Chennai, Tamilnadu.
- Director : VIMTA Laboratories, Hyderbad, A.P.
- Member :Research Advisory Council and Governing Board, Astra Zeneca Research Foundation, Bangalore.
- Member : Research Advisory Council, Dr. Reddy Research Foundation, Hyderbad.
- Member : Research Areas Panel & Scientific Advisory Council, Centre for DNA Fingerprinting & Diagnostics, Hyderbad.
- Member : Research Council, Indian Institute of Chemical Technology, Hyderbad.
- Member : Research Advisory Council, National Institute of Nutrition, Hyderbad.
- Member : School Board of Studies, School of Chemistry, University of Hyderbad, Hyderbad.
- Member : Sodhana Trust, Hyderbad.

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PROF. D. BALASUBRAMANIAN

LIST OF RESEARCH PUBLICATIONS
FROM 1965 TO DATE
(TOTAL OF 156)

LIST OF PUBLICATIONS
IN THE AREA OF EYE RESEARCH
SEPARATELY LISTED AS WELL
(TOTAL 53 TO DATE)

Research Papers Published

1. Kovacs, J., Ballina, R., Rodin, R., **Balasubramanian, D.** and Applequist, J.: Poly beta L-aspartic acid: Synthesis via the pentachlorophenyl ester and conformational studies. ***J. Amer. Chem. Soc.,*** 87:119, **1965.**

2. **Balasubramanian, D.** and Wetlaufer, D.: Reversible alteration of globular protein structures by general anesthetics. ***Proc. Natl. Acad. Sci.,*** 55: 762, **1966.**

3. **Balasubramanian, D.** and Wetlaufer, D.: Optical rotatory properties of diketo-piperazines. ***J. Amer. Chem. Soc.,*** 88: 3449, **1966.**

4. **Balasubramanian, D.** and Wetlaufer, D. : Optical properties of cyclic peptides : Prototypic helix systems. In: ***"Conformation of Biopolymers"*** (ed. G.N. Ramachandran), Academic Press, London, p. 147, **1967.**

5. **Balasubramanian, D.** : Conformation of Gramicidin S in solution. ***J. Amer. Chem. Soc.,*** 39:5445, **1967.**

6. **Balasubramanian, D.:** Protonation of polypeptides in strong organic acid containing media. ***Biochem. Biophys. Res. Comm.,*** 29: 538, **1967.**

7. Sanghvi, A., **Balasubramanian, D.** and Moscowitz, A.: On the beta configuration of the 4-methyl in 4-methyl delta 8, 24 cholestadiene 3 beta-ol. **Biochemistry,** 6:869, **1967.**

8. Subramanian,S., **Balasubramanian, D.** and Ahulwalia, J.C.: NMR and thermo-chemical studies on the influence of urea on water structure. ***J. Phys. Chem.,*** 73:266, **1969.**

9. **Balasubramanian, D.** and Roche, R.S.: Novel solvent systems for the study of conformational transitions in synthetic polypeptides. ***Polymer Preprints,*** 11: 127, **1970.**

10. **Balasubramanian, D.** and Roche, R.S.: The conformational transition of poly gamma methyl L-glutamate in the solvent system hexafluoropropan 2:2-diol: water. ***Polymer Preprints,*** 11: 132, **1970.**

11. **Balasubramanian, D.** and Roche, R.S.: Circular dichroism of disordered polypeptides :The 218 nm band. ***Chem. Commun.,*** 862, **1970.**

12. Singh, R.D., **Balasubramanian, D.** and Gupta, V.D.: Amide bands in cyclotetra L-alanine. ***Chem. Phys. Letters,*** 5: 700, **1970.**

13. **Balasubramanian, D.**: On the circular dichroism of constrained unordered polypeptide chains. ***Ind. J. Chem.,*** 9: 1164, **1971.**

14. Rao, C.N.R., Rao, K.G., Goel, Abha and **Balasubramanian, D.**: Configuration of secondary amides and thioamindes. ***J. Chem. Soc.,*** A: 3077, **1971.**

15. Subramanian, S., **Balasubramanian, D.,** Sarma, T.S. and Ahluwalia, J.C.: Effect of the urea-guanidinium class of protein denaturants on water structure. ***J. Phys. Chem.,*** 75: 851, **1971.**

16. **Balasubramanian, D.**: Why polymers in the living cell? ***Ind. J. Chem.,*** 3: 3, **1972.**

17. **Balasubramanian, D.,** Goel, Abha and Rao, C.N.R.: Interaction of amides with lithium ion. ***Chem. Phys. Letters,*** 17: 489, **1972.**

18. **Balasubramanian, D.** and Goel, Abha : A statistical mechanical study of the order-order transitions in some polypeptides. ***Ind. J. Biochem. Biophys.,*** 11: 61, **1973.**

19. **Balasubramanian, D.** and Subramanian, V.H.: Protonation of polypeptides: De-esterification of poly gamma benzyl L-glutamate in trifluoroacetic acid. ***Ind. J. Biochem. Biophys.,*** 11: 59, **1973.**

20. **Balasubramanian, D.,** Kalita, D. and Kovacs, J.: Conformational studies of Anthrax polypeptide, Subtilis polypeptide and synthetic poly gamma L-glutamic acid. ***Biopolymers,*** 12: 1089, **1973.**

21. B**alasubramanian, D.** and Shaikh, Rashid: On the interaction of lithium salts with amides, ***Biopolymers,*** 12: 1089, **1973.**

22. **Balasubramanian, D.:** Critique on the interpretation of the circular dichroism spectra of disordered polypeptides and proteins. ***Biopolymers,*** 13: 407, **1974.**

23. **Balasubramanian, D.** and Misra, B.C.: Relative affinities of alkali metal ions to the ligands to ionophores. ***FEBS Letters,*** 41:78, **1974.**

24. **Balasubramanian, D.** and Misra, B.C.: Physico-chemical aspects of ion transport by ionophores. In: ***"Biomembranes"*** (ed. L. Packer), Academic Press, Inc., London, p. 1854, **1974.**

25. Rao, C.N.R., Rao, K.G. and **Balasubramanian, D.:** Binding of alkali and alkaline earth cations and protons to the peptide group. ***FEBS Letters,*** 46: 192, **1974.**

26. **Balasubramanian, D.** and Misra, B.C.: Effects of metal ions on the structure and spectra of the peptide group. ***Biopolymers,*** 14: 1019, **1975.**

27. **Balasubramanian, D.,** Subramani, S.and Kumar, C.: Modification of a model membrane by an imbedded photochrome. ***Nature,*** 254, **1975.**

28. Anderson, W.L., **Balasubramanian, D.** and Wetlaufer, D. : Characterization of putative cyclic tetra L-alanine. In: ***"Peptides – Chemistry Structure and Biology"*** (eds. R. Walter and J. Meinhofer), Ann Arbor Sciene, p.991, **1975.**

29. **Balasubramanian, D.,** Chopra, P., Ardeshir, F. and Rajappa : Cyclolinopeptide – an antamanide analog. ***FEBS Letters,*** 65: 69, **1976.**

30. **Balasubramanian, D.** and Kumar, C.: Recent applications of the circular dichroism and optical rotatory dispersion to the study of biopolymes. ***Applied Spectr. Rev.***, 11: 223, **1976.**

31. Ramachandran, C. and **Balasubramanian, D.:** ESR spin probe studies on water structure. ***Chem. Phys. Letters,*** 489: 363, **1977.**

32. **Balasubramanian, D.** and Misra, B.C.: Alkali ion binding to polypeptides and polyamides. In : ***"Metal Ligand Interactions in Organic Chemistry and Biochemistry"*** (eds. B. Pullman and N. Goldblum) D. Rideal, Part 1, p. 159, **1977.**

33. **Balasubramanian, D.** an Misra, B.C.: Chain expansion of neutral polymer coils upon cation binding. ***J. Phys. Chem,*** 81: 2306, **1977.**

34. **Balasubramanian, D.,** Misra, B.C. Mitra, A. and Mishra, S.: An assessment of the binding of aniona to peptides and proteins. ***Ind. J. Biochem. Biophys.,*** 15: 733, **1977.**

35. **Balasubramanian, D.** and Ramachandran, C.: Effect of protein denaturants on the structure of water: Electron spin resonance probe study. ***Proc. Ind. Acad. Sci.,*** 87B: 53, **1978.**

36. **Balasubramanian, D.** and Sukumar, Prema: Alkali ion complexation: Two illustrative experiments. ***Ind. J. Chem. Ed.,*** 5: 11, **1978.**

37. **Balasubramanian, D.:** Let us scrap the final practical examination from university laboratory courses. ***Ind. J. Chem. Ed.,*** 5:50, **1978.**

38. **Balasubramanian, D.** and Mitra, P.: Critical solution temperatures of liquid mixtures and the hydrophobic effect. ***J. Phys. Chem.,*** 83: 2724, **1979.**

39. Kumar, C. and **Balasubramanian, D.:** Studies on the Triton X-100: Alcohol: Water reverse micellar system in cyclohexane. ***J. Colloid Interface Sci.,*** 69: 271, **1979.**

40. **Balasubramanian, D.,** Sukumar, P. and Chandani, Bina: Linear unsubstituted polyethylene glycols as phase transfer catalysts. ***Tetrahedron Letters,*** 3543, **1979.**

41. Bansal, V.K., Biswas, A.K. and **Balasubramanian, D.:** Anionic-nonionic surfactant interaction by nuclear magnetic resonance. ***Colloid and Polymer Sci.,*** 257: 1083, **1979.**

42. Hemalatha, S. Chandani, B. and **Balasubramanian, D.:** Complexation of molecular iondine by linear poly(ethylene glycol). ***Spectroscopy Letters,*** 12: 535, **1979.**

43. Kushwaha, R.S., Mathur, K.B. and **Balasubramanian, D.:** Synthesis and conformation of poly epsilon L-lysine. ***Biopolymers,*** 19: 219, **1980.**

44. Kumar, C. and **Balasubramanian, D.:** Spectroscopic studies on the microemulsions and lamellar phases of the system Trition X-100 Hexanol: Water in cyclohexane***. J. Colloid Interface Sci.,*** 74: 64, **1980.**

45. Kumar, C. and **Balasubramanian, D.:** Structural features of water-in-oil microemulsions. ***J. Phys. Chem.,*** 84: 1895, **1980.**

46. Rao, Ch. Mohan and **Balasubramanian, D.:** Investigation of the acidity of catalyst surfaces by photoacoustic spectrosocopy. ***Spectroscopy Letters,*** 13: 329, **1980.**

47. **Balasubramanian, D.** and Mathur, K.B.: The alpha peptide selectivity in proteins: A conformational rationals. In: **"Origin and Evolution of Life"** (ISRO), p.64-70,**1980.**

48. Mathur, K.B., Pandey, R.K., Jagannadham, M.V. and **Balasubramanian, D.:** Poly delta-ornithine. ***Int. J. Peptide Protein Chem.,*** 17: 189, **1981.**

49. **Balasubramanian, D.** and Charney, E.: The effect of the charge density of linear polyelectrolytes on their orientation in an electric field: A study of Poly (rA), Poly (rU) and Poly (rA): 2 Poly (rU). ***J. Phys. Chem.,*** 85: 1943, **1981.**

50. **Balasubramanian, D.:** Water inside reverse micelles. ***J. Ind. Chem. Soc.,*** LVIII: 633, **1981.**

51. **Balasubramanian, D.** and Rao, Ch. Mohan : Photoacoustic spectroscopy of biological systems. ***Photochem. Photobiol.,*** 34: 749, **1981.**

52. **Balasubramanian, D.** and Rao, Ch. Mohan: Study of a solid-state polymerization reaction by photoacoustic spectroscopy. ***J. Phys. Chem.,*** 86: 939, **1982.**

53. **Balasubramanian, D.** and Rao, Ch. Mohan: Biological applications of photo-acoustic spectroscopy. ***Current Science,*** 51 : 111, **1982.**

54. Ganesh, K.N., Mitra, P. and **Balasubramanian, D.:** Solubilization sites of aromatic optical probes in micelles. ***J. Phys. Chem,*** 86:4291, **1982.**

55. **Balasubramanian, D.** and Kumar, C.: Water-in-oil microemulsions: Structural features and application as biological models. In: ***"Solution behavior of surfactants"*** (eds. E.J. Fendler and K. Mittal), Plenum Press, N.Y., Vol. II, p. 1207, **1982.**

56. **Balasubramanian, D.** and Chandani, B.: Polyethylene glycol. A poor chemist's crown. ***J. Chem. Ed.,*** 60: 77, **1983.**

57. **Balasubramanian, D.:** Photoacoustic spectroscopy and its use in biology. ***Bioscience Reports (London),*** 3: 1113, **1983.**

58. Panijpan, B., Rao, Ch. Mohan and **Balasubramanian, D.:** Interaction of antimalarial drugs with hemin. ***Bioscience Reports (London),*** 3: 1113, **1983.**

59. **Balasubramanian, D.,** Mitra, P. and Ganesh, K.N.: Critique of water penetration studies in micelles using extrinsic probes. In: ***"Surfactants in solution"*** (ed. K.L. Mittal) Plenum Press, N.Y., Vol. I, p. 599, **1984.**

60. **Balasubramanian, D.,** Rao Ch. Mohan and Panijpan, B.: the malaria parasite monitored by photoacoustic spectroscopy. ***Science,*** 223: 828, **1984.**

61. Mitra, P., Ganesh, K.N. and **Balasubramanian, D.:** Amplification of the surface activity of solubilizates by amphiphile aggregates. ***J. Phys. Chem.,*** 88: 318, **1984.**

62. Jagannadham, M.V. and **Balasubramanian, D.:** The molten globular intermediate form in the folding pathway of human carbonic anhydrase B. ***FEBS Letters,*** 188: 236, **1985.**

63. Sivakamasundari, N., Srinivas, V., Ganesh, K.N. and **Balasubramanian, D.:** Micellar properties of the zwitterionic detergents "CHAPS" and "CHAPSO" used in membrane biochemistry. ***J. Ind. Chem. Soc.,*** LXII: 851, **1985.**

64. Shobha, J. and **Balasubramanian, D.:** Hair-pin looping of terminally functinalized carboxylate surfactants. ***J. Phys. Chem.,*** 90: 2800, **1986.**

65. Chandani, B. and **Balasubramanian, D.:** Analysis of the factors governing the interaction of membrane-active peptides and membranes : The case of melittin in surfactant assemblies. ***Biopolymers,*** 25: 1259, **1986.**

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Professor D. Balasubramanian

ACTIVITIES IN THE AREA OF PUBLIC UNDERSTANDING OF SCIENCE

LIST OF ARTICLES PUBLISHED REGULARLY IN NEWSPAPERS, INCLUDING "THE HINDU" INCLUDED

PROFESSOR D. BALASUBRAMANIAN, Ph. D.

INTERESTS IN POPULARIZING SCIENCE

a) Writing Articles on Science

b) Writing Science Books

c) Contributing to Educational TV programmes, UGC, India

d) Participating in Science Movements for Citizens

a) Writing Popular Science Articles

i) **Since October 1990 :** Writing for a fornightly column in the Science and Technology supplement of the national newspaper The Hindu on every alternate Wednesday earlier and Thursday now.

ii) **During 1990 :** Was writing a fornightly column entitled "Cosmos" for the national newspaper The Times of India every alternate Sunday.

iii) **During 1986-88:** Was writing a fortnightly column entitled "Speaking of Science" for the Hyderabad-based newspaper Newstime, on every alternate Sunday.

iv) Occasional articles in **The Hindustan Times** and in **Science Today.**

b) Writing Science Books

i) **Author,** "University General Chemistry", a Book published by Macmillans, first edition 1973, second edition 1980.

ii) **Author,** Class 6 Science textbook, NCERT, 1975.

iii) **Author and Chairman,** Writing Group – Science Text Books for classes 7, 8, 9, and 10, CBSE syllabus, NCERT, New Delhi, India, 1986-1990.

iv) **Author,** 4 books on popular science: 1, Genes and Means, 2. Cata Have Nine Lives, 3. Mother of all Genes, and 4. Swift Tuttle and Space Shuttle.

C) Contributing to Educational TV Programmes in Sciences, UGC, India

Editor of a series on "Methods for the Determination of the Structure of Molecules and Materials"

Script Writer – Presenter of 20-minute TV programmes on:

a) Electronic absorption spectroscopy

b) Vibrational spectroscopy of molecules

c) Enzyme structure by spectroscopy

d) X-ray crystallography – recent advances, and

e) The body clock

f) Interviews with Sir Andrew Huxley, Dr. J. Narlikar & Dr John Maddox

g) Participated in the TV Quiz Programme called **The Pursuit**

h) Participated in the TV Science Programme called **Turning Point**

i) Participated in the TV Science Programme called **New Horizons**

[All these are meant for college and postgraduate students]

and most recently, in April 2002 in the US Public Broadcasting Service (PBS), talking about stem cells – biology and ethical issues.

d) Science Movements for Citizens

President, Andhra Pradesh Vigyan Parishdad

Chairman, City Organizing Committee for Bharat Jan Vigyan Jatha, 1987.

e) Science Communication Workshops

Teaching faculty, UNESCO- COSTED workshops on communicating sciences: held at Goa, India; Colombo, Sri Lanka & Kingston, Jamaica.

LIST OF POPULAR ARTICLES

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   November 2, 1986
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114. **Bringing up bacteria of a bygone era from the belly of a bee**
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July 20, 1995

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August 3, 1995

117. **Unread publications : The clap of a single hand**
August 31, 1995

118. S & T are cultural things
September 14, 1995

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October 12, 1995

120. Gene jockeying comes of age
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November 9, 1995

122. ALUs are RARE—a genetic oxymoron?
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123. Birds and bees, bards and biodiversity
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124. Molecular switches and memory devices
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125. Why do plants smell?
January 4, 1996

126. Rikki-tikki-tavi and prickly-tickly-hog
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February 1, 1996

128. Reductio ad genes absurdum
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129. On the origins of Indians
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131. The molecule that moves an elephant
April 11, 1996

132. The Tao of Authorship
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133. The gyana marga for Arogyam
May 9, 1996

134. High speed knockout in the brain
May 9, 1996

135. Bacteriophage – living antibiotics
June 6, 1996

136. Arthritis and weather – Truth in the correlation
June 20, 1996

137. 'If music be the food of mind, play on'
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138. Molecule as Mehr
July 18, 1996

139. Myths and symbols in the oil-water story
September 26, 1996

140. We two, ours how many?
October 10, 1996

141. Close encounters of the caterpillar kind
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142. Changing face of the library
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143. Rendering unto Darwin
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144. Mother knows best – about evolution too!
December 5, 1996

145. Rid polio for a dozen rupees
December 19, 1996

146. Industrial support to biological research: Lessons from the American experience
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147. Vienna, Montreal, Copenhagen and skin cancer
January 16, 1997

148. Wine helps fight cancer
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149. What size should a bacterium be?
March 26, 1997

150. On a moratorium on human cloning
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151. So that we are not condemned to repeat history
April 17, 1997

152. But, Deep Blue, can you make music?
May 29, 1997

153. 'Beating scientists into plowshares'
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154. Enemy of my enemy is my ally
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155. Green tea as a health aid
July 10, 1997

156. Koop versus Marlboro man
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157. This little thing of Ronald Ross
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158. Out of the mouths of babes
September 4, 1997

159. Sutra-molecular chemistry
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160. Time to talk of cabbage and broccoli
October 16, 1997

161. The St. Matthew effect and the Barnum effect
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162. Paracelsus challenge and birth of Janus
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163. Role of the science populariser
November 27, 1997

164. Termite tales and Gulliver's travails
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165. Nose: a spectroscope that sniffs
December 25, 1997

166. Why do some plants have laxatives in them?
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167. 'The time has come to talk of …whether fish have wings'
February 19, 1998

168. Drugs in Nagano
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169. Expanding visions of new biology
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170. Supermodels: stick insects or hourglasses?
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171. Tiny acorns, might oaks, gipsy moths, mice and mean
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172. Blow hot, blow hotter
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173. In praise of nerds
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174. Magnetic pull out of malignant cells
May 28, 1998

175. Light at the back of the knee, jerks the body clock
June 11, 1998

176. More on the herd of nerd
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177. Sloppy melting of floppy solids
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178. How biotech improved agriculture
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179. Costs and benefits of animals experimentation
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180. New eyes for old
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181. Towards the development of an electronic tongue
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183. Jai Vigyan, pronounced the Spanish way?
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184. **Olympiads in science**
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185. **The DNA dialectic**
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186. **In god we trust, all others must have data**
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187. **Does the origin of languages le in art?**
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188. **The umbilical connection even after birth**
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197. **Genetically modified food-the hope and the hype**
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July 1, 1999

200. **Crisis in Indian animal houses**
August 5, 1999

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August 19, 1999

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September 2, 1999

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December 23, 1999

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January 6, 2000

212. **Biology in the year 2010**
January 20, 2000

213. **The biology in the beholder's eye**
March 2, 2000

214. **Enlarging the paradigm – understanding traditional medicine in modern terms**
March 16, 2000

215. Spectroscopic tales that dead men tell
March 30, 2000

216. On the Caucasian Neanderthal
April 13, 2000

217. Nutraceuticals: functional food
April 27, 2000

218. The molten globule in milk helps prevent cancer
May 11, 2000

219. On a molecular quest for eternal youth
May 25, 2000

220. Languages born and languages gone : the quest for a common grammar
June 22, 2000

221. Anatomy of the Silicon Valley success story
June 22, 2000

222. Lizard grip and liquid helium
July 6, 2000

223. Interpreter of maladies – AIDS in the developing world
July 20, 2000

224. What? DNA is an enzyme?
August 3, 2000

225. The psychology of the consumer
August 17, 2000

226. Where Assam leaves Andhra behind
August 31, 2000

227. Noblesse oblige – not inert anymore
September 28, 2000

228. 'Gel catalysts that switch' mimick a key feature of enzmes
October 12, 2000

229. Evolutionary origins of alcoholism and addiction
October 26, 2000

230. Indian science – rubbish or rebuildable?
November 9, 2000

231. Biotechnology and the health of the nation
November 23, 2000

232. Are Animals persons?
December 7, 2000

233. Insects are more nutritious than meat or fish!
December 21, 2000

234. Elephantine etiquette – musth must be muted
January 4, 2001

235. The "ome" and "omics" of biology
February 1, 2001

236. Is a genius born or made ?
February 15, 2001

237. Surolia vs Malaria
March 1, 2001

238. What a mother receives from her child
March 15, 2001

239. Season of birth and lifespan
March 29, 2001

240. Smell of survival in plants
April 12, 2001

241. The prize that missed the mastter
April 26, 2001

242. Banana politics : A versatile, nutritive fruit of historic value
May 10, 2001

243. Offering sight to blind dogs: retinal impairment cured by gene therapy
May 24, 2001

244. Goats narrate human history: Animal domestication down the ages
June 7, 2001

245. Lactoferrin protection : Sterilizing meat with milk
June 21, 2001

246. **Potential drug for snake bites: Anti-venom substitute**
July 5, 2001

247. **The healing touch of animal**
July 19, 2001

248. **Why are chillie hot?**
August 16, 2001

249. **Reading the writings of the past**
August 30, 2001

250. **Dispersing diasporal science**
September 13, 2001

251. **Vegetarianisation of education**
September 27, 2007

252. **Moby Dick or Madonna, the music is the same**
October 11, 2001

253. **On inhaling drugs that heal, not harm**
October 25, 2001

254. **Understanding hepatitis C-a silent killer**
November 8, 2001

255. **Stuck song syndrome and the cinnamon bark**
November 29, 2001

256. **How we ape the ape for our genome**
December 20, 2001

257. **How the sequence was won**
January 3, 2002

258. **Eating some plants can make you non-veg!**
January 17, 2002

259. **Held by the eye of the beheld**
January 31, 2002

260. **Detecting cancer- try with a fly**
February 14, 2002

261. **Set a bug to kill cancer**
February 14, 2002

262. **Tales the dead dodo tells**
March 14, 2002

263. **Lincoln and mercury-poisoning of a president**
March 14, 2002

264. **Why so hot on BT cotton?**
April 11, 2002

265. **Indigo Nation: Champaran to Chandigarh**
April 11, 2002

266. **Basmati - Identity Crisis Resolved**
May 9, 2002

267. **Breast - fed Babies Brainier?**
May 23, 2002

268. **Banning the chew that chews you**
June 21, 2002

269. **Saving sight through reach and research**
July 4, 2002

270. **Amino Acid Arangetram**
July 18, 2002

271. **This Can't be Yogurt!**
August 15, 2002

272. **Corvis Sapiens: Bend it Like Betty**
August 29, 2002

273. **Vaccines as Weapons of Peace**
September 12, 2002

274. **Thammu Achaya –tribute to a gastronome scientist**
September 26, 2002

275. **Matchmaking within community or in cyberspace?**
October 24, 2002

276. **Junk science as legal evidence**
November 7, 2002

277. **Kangaroo court on animal experimentation**
November 21, 2002

278. 2002- a boom year for vaccines!
December 5, 2002

279. Animal experimentation – what is the bottom line?
December 5, 2002

280. Proline – the world's smallest enzyme
January 2, 2003

281. Eyeglasses with adjustable power
January 30, 2003

282. Size does matter – designer drugs for blood clots
February 13, 2003

283. What do scientists do?
February 27, 2003

284. One scorpion, two venoms
March 13, 2003

285. 'Stemness' of a stem cell
March 27, 2003

286. The smell of silence
April 10, 2003

287. Were we cannibal long ago?
April 24, 2003

288. The name change game
May 8, 2003

289. Who can see well under water? The Moken
June 19, 203

290. Biotech, India and the X-chromosome
July 3, 2003

291. Polypill for heart diseases : Ayurveda synthesized?
July 17, 2003

292. Huxley's hunch and simian Shakespeare
July 31, 2003

293. It's a small world after all!
August 14, 2003

294. Bharat Siksha Kosh – Take part, not take over!
August 28, 2003

295. Life in fire and brimstone
September 11, 2003

296. Mushrooms : blossoms in the dust
September 25, 2003

297. Why can't man be more like a woman?
October 23, 2003

298. Who are we, the people of India?
November 6, 2003

299. The resonance of the mind
November 20, 2003

300. Leech : The parasite physician
December 4, 2003

301. Gene Sculpting : Of mice and men; ape and essence
December 18, 2003

302. Reap or Wreak?
January 1, 2004

303. You are human if you are hairless
January 15, 2004

304. How do limbless animals move?
January 29, 2004

305. The evolutionary biology of lanuguage
March 11, 2004

306. Biology of language – the mother of all languages?
March 25, 2004

307. Kanta Subbarao-the Flu Buster!
April 8, 2004

308. SightFirst- War against Blindness
April 22, 2004

309. How Tall can a Tree Grow?
May 6, 2004

310. Bittersweet Protection against Cancer
May 20, 2004

311. **Rewriting Aesop's Fable of the Crow**
June 3, 2004

312. **Liquid Crystals and Professor Chandrasekhar – a Tribute**
June 17, 2004

313. **Vaccines: Weapons of Peace and Prosperity**
July 1, 2004

314. **Markandeya and Methuselah-How long can we live?**
July 15, 2004

315. **How Hardy is the Human Body?**
July 29, 2004

316. **Locust Swarms – the Curse of Africa**
August 12, 2004

317. **RNAi: Shoot the messenger, Silence the Gene**
September 9, 2004

318. **Open Access to Journals: A Noble Movement**
September 9, 2004

319. **Changes in the Indian Menu over the Ages**
October 21, 2004

320. **Changes in the Indian Menu over the Ages-Part**
November 4, 2004

321. **"The Morning Raga" and Indian Science**
December 16, 2004

322. **Stress clips chromosomes and avances ageing**
December 30,2004.

323. **The music of we primates: Nada Brahmam**
January 13, 2005

324. **Role of Indian Scientists in Tsunami Relief**
January 27, 2005

325. **When do adolescents grow up?**
February 130, 2005

326. **Quantum dots: the Maxwell's Demons of biology**
February 24, 2005

327. **Animal angst : No brain, no pain?**
March 10, 2005

328. **Appropriate biotechnologies and developing countries**
March 24, 2005

329. **Biotech to help clear the curse of landmines**
April 7, 2005

330. **Pomegranate juice- A Health drink**
April 21, 2005

331. **Smell rotten eggs, Go into hibernation**
May 5, 2005

332. **Chimeras – breaching the species boundary**
May 19, 2005

333. **What the young Indian scientist is wearing**
June 2, 2005

334. **The tangled web that microbes weave**
July 14, 2005

335. **Epigenetics: beyond DNA sequence**
July 28, 2005

336. **Buckingham canal buffered tsunami fury**
August 11, 2005

337. **Making meat in vitro from cells**
August 25, 2005

338. **Scientific temper and the argumentative Indian**
September 22, 2005

339. **Body or mind-Use it or lose it**
October 20, 2005

340. **The many benefits of vaccination**
November 3, 2005

341. Gypsies – the Dalits of the Euopean continent
November 17, 2005

342. The changing identity of the scientist
December 1, 2005

343. The case of the mouse that can knock out a cat
December 15, 2005

344. The evolution versus intelligent design debate
December 29, 2005

345. The biology of cuteness
January 12, 2006

346. Asbestos: the good, bad and the ugly
February 9, 2006

347. The health effects of white asbestos
February 23, 2006

349. Graphene: the magic carpet made of carbon
April 6, 2006

350. Engineering human organs in the laboratory
April 20, 2006

351. Genes and behaviour – the field of behavioural genetics
May 4, 2006

352. How do we perceive pain?
June 15, 2006

353. A land where the poor are obese
June 29, 2006

354. On the autonomy of scholarly institutions
July 13, 2006

355. What the mind conceives, man achieves
July 27, 2006

356. Moles in animal world, skin and chemistry
August 24, 2006

357. Wanted: More science, more scientists
August 24, 2006

358. We borrow the earth from our children
September 7, 2006

359. In praise of proline, the maverick amino acid
September 21, 2006

360. More on proline-the maverick imino acid
October 5, 2006

AWARDS & PRIZES

1.	**1998**	**Goyal Prize in Life Sciences**	Goyal Research Foundation, US
2.	**1998**	**J C Bose Model**	Indian National Science Academy (INSA), India
3.	**1997**	**Shri Om Prakash Bhasin Award**	Shri Om Prakash Bhasin Foundation for Science and Technology, India
4.	**1997**	**Elected as Fellow**	Third World Academy of Sciences (TWAS), Trieste, Italy
5.	**1997**	**Kalinga Prize - for popularization of science**	UNESCO, Paris, France
6.	**1997**	**10th Kharazmi International Festival Award, 1996- for "excellent" contribution in the field of Medical Sciences**	Iranian Research Organization for Science and Technology (IROST), Tehran, Iran
7.	**1996**	**Elected as Fellow**	American Association for the Advancement of Science, Washington, DC, USA
8.	**1995**	**TWAS Award in Basic Medical Sciences**	TWAS, Trieste, Italy
9.	**1994**	**Dr. Mahendra Lal Sircar Prize**	The Indian Association for the Cultivation of Science
10.	**1992**	**Honorary Professor**	Jawaharlal Nehru Centre for Advanced Scientific Research
11.	**1991**	**Fukui Award**	The National Foundation for Eye Research, USA
12.	**1990**	**Ranbaxy Research Award**	RANBAXY, India; in the field of Medical Sciences
13.	**1983**	**Sarma Memorial Award**	SBCI, India
14.	**1983**	**FICCI Award**	FICCI; in the field of Physical Sciences
15.	**1983**	**ICMR (M.O.T. Iyengar) Award**	ICMR; in Malaria Research
16.	**1981**	**Shanti Swarup Bhatnagar Prize**	CSIR, in Chemical Sciences
17.	**1977**	**Rev. Fr. L.M.Yeddanapalli Memorial Award & Medal**	Indian Chemical Society
18.	**1959**	**I RANK Medal**	Rajasthan University

ENDOWMENT MEDALS & LECTURES

1.	**2001**	**Dr. Ram Mohan Rao Oration**	Guntur Medical College, Guntur, A.P.
2.	**2001**	**Dr. K. Gopalakrishna Oration**	Chennai
3.	**1998**	**Foundation Day Lecture**	Birbal Sahni Institute of Paleobotany, Lucknow
4.	**1998**	**Jana Reddy Venkata Reddy Endowment Lecture**	ANGRAU, Rajendranagar, Hyderbad
5.	**1998**	**Sri Venugopal Oration**	Medical Research Foundation, Chennai
6.	**1998**	**10th Convocation Address**	Elite School of Optometry, Chennai
7.	**1998**	**Foundation Day Lecture**	Regional Research Laboratory, Bhubaneswar
8.	**1998**	**Dr P S Murthy Memorial Lecture**	Indian Institute of Chemical Technology, Hyderabad
9.	**1997**	**6th Kumari L A Meera Memorial Lecture**	Indian Institute of World Culture, Bangalore
10.	**1997**	**2nd Prof. McBain Memorial Lecture**	NCL Research Foundation, Pune
11.	**1996**	**The 13th Convocation Address**	Madurai Kamaraj University , Madurai
12.	**1996**	**The Third Annual Lecture**	The Ranganathan Centre for Information Studies, Madras
13.	**1996**	**IX J.C. Ray Memorial Oration Award**	Indian Institute of Chemical Biology, Calcutta
14.	**1996**	**C.V. Raman Lecture**r	Indian Science News Association
15.	**1996**	**Third B.C. Guha Memorial Lecture**	Indian Science News Association
16.	**1996**	**Lily Pithavadian Endowment Lecture**	Women's Christian College, Madras India
17.	**1996**	**Foundation Lecture**	Molecular Biology Unit, Banaras Hindu University, India
18.	**1996**	**TNAU-MFL Endowment Lecture**	Tamil Nadu Agricultural University, Coimbatore, India.
19.	**1995**	**Pasteur Centenary Lecture**	IMTECH, Chandigarh, India
20.	**1995**	**R.P. Mitra Memorial Lecture**	University of Delhi, India
21.	**1995**	**The Platinum Jubilee Lecture**	The Indian Science Congress Association
22.	**1991**	**KSG Doss Memorial Lecture**	SAEST, India
23.	**1991**	**SERC National Lecture**	Department of Science & Technology, India
24.	**1986**	**Prof. K. Venkataraman Endowment Lecture**	University of Bombay, India
23.	**1985-86**	**National Lecture**	University Grants Commission, India

RESEARCH THESES GUIDED FOR THE DOCTORAL DEGREE (Ph.D.)

Recognised Guide for Ph.D in I.I.T., Kanpur, University of Hyderabad, Osmania University and Jawaharlal Nehru University and fourteen candidates obtained their Doctoral degrees over the past 20 years.

1.	**V K Bansal**	Collector-Frother Interactions	1976
2.	**C Ramachandran**	ESR Spin Probe Studies on the effect of solutes on water structure	1976
3.	**B C Misra**	Alkali ion binding properties and proteins	1977
4.	**C Kumar**	Water-in-oil microemulsions : structural and biological applications	1980
5.	**Ch Mohan Rao**	Photoacoustic spectroscopy: some applications in chemistry and in biology	1984
6.	**P Mitra**	Studies on aqueous consolute pairs and on micelles	1984
7.	**M V Jagannadham**	Studies on the folding of polypeptides and proteins: polyisopeptides, Papain and human carbonic anhydrase B	1985
8.	**Bina Chandani**	Some studies on the structure and aggregation of Melittin in aqueous and membrane-mimetic media	1985
9.	**J Shobha**	Studies on the structural features of micelles of conventional and of functionalized surfactants	1987
10.	**S Chenchal Rao**	Molecular aspects of the eye lens and its proteins	1991
11.	**P Guptasarma**	Physico-chemical studies on the role of the crystallins in the maintenance of eye lens transparency	1993
12.	**Manni Luthra**	Covalent modifications of eye lens proteins by oxidation and glycation	1994
13.	**L Uma**	Proteins of the corneal stroma: a spectroscopic study	1996
14.	**V Srinivas**	Molecular aspects of hydrotropy	1998
15.	**Ritu Kanwar**	Studies on some post-translational modifications of lens crystallins	2000
16.	**C. Sivakama Sundari**	Amphiphilic properties of saccharide chains	2000

THESES/ DISSERTATIONS GUIDED FOR THE M.Phil AND M.Sc., DEGREES

Three candidates obtained their M.Phil. degrees and 12 candidates obtained their M.Sc. degrees after submitting their project theses/ dissertations.

M.Phil. Theses Guided

1.	**Bina Chandani**	Aggregation of Rhodamine B in solution	1978
2.	**G Vijayalakshmi**	Aggregation of Rhodamine 6G in solution	1978
3.	**Prema Sukumar**	Metal ion complexation by polyethylene glycols	1978

M.Sc. Dissertations Guided

1.	P Balaram	Optical properties of peptides	1968
2	Abha Goel	Order-disorder transitions in polypeptides	1969
3	G Rama Rao	Structure of cyclic peptides in solution	1969
4	V H Subramanian	Protonation of polypeptide chains by acids	1971
5	J Jesunathadas	M.O. calculations of the amide moiety	1972
6	S Subramani	Modification of the structure of a model membrane by a photochrome	1974
7	Umesh Gaur	Viscometric studies on polyvinyl pyrrolidone	1974
8	Pratibha Chopra	Cyclic peptide from linseed	1975
9	Feroza Ardeshir	Cyclolinopeptide A	1975
10	R Ramanathan	Conformational studies on peptides	1976
11	S Mishra	Anion binding to peptides and proteins	1976
12	Rashid Shaikh	Li ion interaction with amides	1978
13	S Hemalatha	I_2 : PEG interactions	1979
14	Kasturi Lahiri	Comparison of the micellar and reverse micellar environemnts and polarity	1980

UNITED NATIONS EDUCATIONAL,
SCIENTIFIC AND CULTURAL ORGANISATION

ADDRESS
by
Mr Federico Mayor

Director-General
of the United Nations Educational,
Scientific and Cultural Organization
(UNESCO)

on the occasion of the Award Giving Ceremony
of the UNESCO Science Prizes

UNESCO, 5 November 1997

Mr President of the General Conference,
Mr Chairperson of the Executive Board,
Excellencies,
Colleagues,
Ladies and Gentlemen,

I take great pleasure in welcoming you to this ceremony to present the five UNESCO Science prizes for 1997-the kalinga prize for the popularization of science, the UNESCO science prize, the Javed Husain prize for young scientists, the carlos J. Finlay prize for Microbiology, the Sultan Qaboos Prize for Environmental preservation and also the Institute pasteur/UNESCO Medal.

I am delighted that all the prize winners have been able to join us at UNESCO this evening as it gives us the opportunity to pay personal tribute to them for their contributions to science.

This event, celebrating excellence in science, brings to mind the words of the French philosopher Michel Foucault when he said "all modern thought is permeated by the idea of thinking the unthinkable". The words on the reverse side of the pasteur medal to be awarded to-day remind us of another guiding principle of science: they express pasteur's belief that science has no native land, since knowledge is the heritage of humanity.

All our prize-winners-in their different ways-have demonstrated how meaningful and farsighted these thoughts are Each has made a significant contribution to the promotion of scientific knowledge in areas where progress is made by thinking the unthinkable - whether investigating the structure of matter or the functioning of the molecular mechanisms of life. Each has furthered knowledge while working in countries with different cultural backgrounds, yet the knowledge they have developed stems from and returns to the shared scientific heritage of mankind.

I extend my warmest congratulations to all today's laureates. I would also like to express my sincere gratitude to the distinguished members of the international jury panels for their invaluable help in the difficult task of recommending laureates from among this year's excellent candidates.

I begin with the ***KALINGA PRIZE FOR THE POPULARIZATION OF SCIENCE.*** It has been awarded annually since 1952 for an outstanding contribution to the communication of science and technology to a wide public. The kalinga prize was established by Mr Bijoyanand Patnaik, an Indian industrialist and founder and president of the Kalinga Foundation Trust. I was deeply saddened to learn that Mr Patnaik passed away this year. I take this opportunity to express our sincere condolences and sympathy to his family and to the Kalinga Foundation Trust. We all pay tribute to Mr Patnaik's far-sighted generosity in setting up this prize back in 1951. Let us observe a moment's silence in honour of Mr Patnaik who was a brilliant, generous personality and whose profound devotion to, and remarkable role in stimulating public awareness of science and technology is recognized world-wide.

Ladies and Gentlemen,

A basic understanding of science is more vital than ever in our rapidly changing world. The Kalinga Prize helps contribute to the spread of the scientific culture which our societies need. It gives me great pleasure to announce that the Kalinga Prize for 1997 has been awarded to **Professor Dorairajan Balasubramanian** of India.

Professor **Balasubramanian** is a distingusished scientist whose areas of specialization are chemistry, biophysics and melecular biology. He is the Director of the Centre for Cellular and Molecular Biology at Hyderbad, India, and has published over 120 repute. Professor Balasubramanian has also written books on chemistry, biotechnology and school textbooks. He has taught a variety of undergraduate and post-graduate courses in the most reputed institutions in his country.

This year's Kalinga prize-winner also has a remarkable record as a popularizer of science. His numerous science articles in leading daily newspapers cover many issues raised by modern science and vividly demonstrate the links between science and peoples' everyday lives. By choosing original angles, he makes the reader want to find out more. Under headlines like "Newton's Laws of Motion and the American Constitution" or "Is Anything that Tastes Good, Bad for Health?", a lively presentaion leads the reader through the scientific topic.

Professor Balasubramanian is also a well-known presenter of TV science programmes such as "The Pursuit", "Turning Point" and "New Horizons" and has written scripts for a wide range of TV science documentaries. He plays an important role in science movements for citizens in India. He was Chairman of the City Organizing Committee for Bharat Jan Vigyan Jatha and organizer of a meeting "Writers meet with publishers".

Professor Balasubramanian has received no fewer than twelve awards and prizes for his work in promoting science and them: the Award of the Third World Academy of Sciences and the Dr Mahendra Lal Sircar prize. He is often invited to speak at national and international scientific meetings and is also editor of publications of the Indian National Science Acadey and member of several Editiorial Boards in India and abroad.

Professor Balasubramanian, in recognition of your outstanding contribution to the public understanding of science, I am very pleased to present you with the cheque, diploma and medal that go with the 1997 Kalinga Prize. I congratulate you most warmly.

❑

Prof D. Balasubramanian conferred "Chevalier de I' Ordre National du Merite"

Wednesday, June 12, 2002 08:00 IST
Our Bureau, Hyderbad

Prof. D Balasubramanian, director (research), L.V Prasad Eye Institute (L VPEL) has been honoured with the award of "Chevalier de l'Ordre National du Merite", or "Knight of the Order of Merit", by the President of France Jacques Chirac. The honour has been conferred on him as a tribute to 'his contributions to the development of Indo-French relations and the high qualities he has always manifested in his activities with the Alliance Francaise of Hyderbad'. The actual date and venue of the conferment of the honour will be decided in consultation with the French government, stated a LVPEL release.

Professor Balasubramanian is the director of research at L V Prasad Eye Institute, Hyderbad. He joined this non-profit world-class comprehensive eye care institution in mid-1998, after voluntary retirement from the Centre for Cellular and Molecular Biology, Hyderbad, as its Director. He is known for his basic research work on the biological aspects of eye diseases. In addition, he is active in popularizing science through his fortnightly newspaper column, and appearances in the electronic media. This French honour to him comes close on the heels of the conferment of "Padma Shri" to him by the President of India earlier this year.

LVPEI is a center for excellence in eye care. It functions on a vision that combines medicine and scientific research. This commitment has seen the institute scale new heights in determining treatment strategies that would help cure eye diseases, the release said.

❑

D Balasubramanian, PhD

Director of Research,
L V Prasad Eye Institute,
Hyderbad

Professor D Balasubramanian joint LVPEI's Prof Brien Holden Eye Research Centre after an illustrious scientific career, which included positions such as Director, Centre for Cellular and Melecular Biology, and Professor and Dean, University of Hyderbad. He was honoured by the Government of India with the Padma Shri in 2002, and has received several other awards from professional and institutional bodies. Notable among them are the Kalinga Prize for the popularization of science, and the Chevalier de l'Ordre National du Merite from the President of France. Prof Balasubramanian's research focuses on the biology of eye diseases. He has over 160 publications in national and international journals and has authored three books. He is a member of several editorial boards and serves on a range of national and international scientific committees. Currently, he is President of the Indian Academy of Sciences, and Secretary General of the Academy of Sciences for the Developing World (TWAS), Trieste, Italy.

Email ID :dbala@lvpei.org

❑

Contours of a Changing Horizon : Science, Social Sciences and India

by

Professor Dorairajan Balasubramanian
L.V. Prasad Eye Institute, Hyderabad

Professor Emmanuel Dongala's article, "Clearing the Horizon: Science, Social Sciences and Africa", makes several points about how local historical experiences mould the approach and the applicability of science and technology to a given region of the world. He points out that the representations of man or woman in society and the political, economic and social structures must take into account simultaneously all the myriad forces passing through them in all their dynamics and complexity. Indeed, this thesis is relevant and applicable to India as well.

It would seem that the dynamics that operate here owe their origin, in part, to the history of colonization by the European West, since the situation that obtains in the other great countries with equally hoary cultures, namely China and Japan, is somewhat different. Western Science, it would seem, has come to be accepted and practised with less societal misgivings and reluctance in these countries, which were not colonized by the West for any significant length of time as to leave its cultural marks.

India has been a country in transition for over six hundred years. Well before the Moghuls came to rule a large portion of the country, India had a tradition of scholarship and native forms of science and technology. A point of note is that technology in societies of this kind developed quite separately from science. Largely the province of the artisan and the craftsman, it grew out of empiricism and need-based approaches as well as out of aesthetic compulsions. It was largely plebian in creation and practice, quite divorced from the concerns of the philosopher and the metaphysician who created science as natural philosophy. Arabian science entered India through the Persians and the Moghuls. But it did not cause any fundamentl philosophical problems of acceptance or practice. The approaches of "Islamic Science" and "Indian Science" have both been largely "holistic"; they did not remove the practising person as a confounder but included him as part of the process. Reductionism did not find a place in them in the insistent manner in which it had been embadded in "Western" science. Thus there was no clash of approach and applicability in the scientific systems of the Shah and his subjects in Moghul India. Even philosophical systems tended to borrow from one another, absorb mutually between them and generate an acceptable hybrid-as with Sufi mystics or the acceptance, nay ownership, of the

writings of Kahlil Gibran. Mahatma Gandhi was heir to such a synthesis and absorption of philosophical systems. Non-violence, kinship with and respect for all forms of life (plants, animals and human) and similar ideas could easily fit into existing systems of scientific thought. Science was thought to be an enhancer of the intellect, and not to be used for material purposes or for winning over Nature.

A perceptible shift occurred with the introduction of the British type of Western education in India about two hundred years ago. The introduction of the English language opened the doors to Western knowledge and European science. the Colonials might well have introduced them with the idea of using the natives as clerks in administration but it also had other consequences. Western science was seen to be applicable in terms of the technology and the public use that it could be put it. The fruits and uses of Western science and the spillovers of the Industrial Revolution began to be felt in the colonies. The geological, botanical and zoological surveys of the subcontinent, census of the people, the railways, and medicine to treat and heal communicable diseases were some of the introcuctions. With the opening of universities and departments of science, engineering and medicine (and law), youngsters in search of better jobs and greater opportunities went into them. At the same time, this also produced a competent set of intellectuals and patriots ready to work towards the freedom of Colonial India and running the liberated nations. Mahatma Gandhi, Pandit Jawaharlal Nehru (the first Prime Minister of Free India and architect of its course during its infancy), Mohammed Ali Jinnah (the father of Pakistan), D.S. Senanayak (of free Ceylon or Sri Lanka) and several other leaders of the newly independent nations of the subcontinent were products, in part, of the British educational system.

(Interestingly, all of these, and many of their contemporaries, traversed both worlds-the East and the West-with a strong grasp and appreciation of the values and traditions of the East and the spirit of freedom, adventure and utility of the West, and did not seem to have suffered from any "existential angst".) On the other hand, however, it led to the sidelinging of the traditional sciences and technology, for example architecture, water harvesting and storing, medicine and health practices. There were some valiant, if unsuccessful, attempts to marry Western science with traditional Indian thought. An example is provided by the Calcutta physicist Jagadis Charndra Bose. He was an eminent experimental physicist, who trained in England under Lord Raleigh, and invented remote radio signalling before Marconi did, and a semiconductor junction before semiconductors were known. In later years, he also concerned himself with the effect of electromagnetism on plants and suggested that plants feel pain and have feelings. He tried to build a theoretical system that would encompass the living and the non-living and suggest a seamless transition between the two, an ida in keeping with his philosophical and metaphysical beliefs. His pronouncement of these ideas at the lectures he gave in England gave rise to "alarming reservations about the oriental mind being prone to mysticism and synthesis".

The marginalization of traditional medical practices such as the Indian Ayurveda, Arabic/Greek Unani, folk tradition of Siddha and Tibetan medicine, and the Hindu/Buddhist system of Yoga has been particularly unfortunate in this context. The success of reductionist science in improving national development, particularly in food production, in reducing mortality and increasing longevity was a major factor behind this process. Added to this were the lure to the young of being "modern" or "with it" and the anxiety of the bureaucracy to "deliver". Which have made them ignore or refuse to analyse whatever appropriate or useful that is in tradition. When Nehru declared upon opening national laboratories of science that "these are the new temples of India", modernization of India was usheredin, but not what Dongala has termed modernity. The synthesis that

Nehru could achieve in his personal life was not transmitted to the young of the nation. Instead, it was trivialized into a disdain and neglect of all traditional systems of scientific and technological approaches from the "modern" educational curriculum and research laboratories. The insular coexistence in two separate boxes of traditional knowledge and of Western science and technology leads to incongruous situations; one encounters some active Indian physical scientists who practice rituals to ward off the evil effects of lunar or solar eclipses. This is perhaps true of other societies with long histories, but is striking in a country which is counted to be among the top dozen science nations of the world.

A particular feature of Indian society is its stratification into castes, each with a defined professional role. Moving out of its pigeonhole to pursue endeavours out of what is assigned for it to do was difficult. Bureaucracy that came with the rulers, be they the Moghuls or the British, reinforced the boxing in and added further layers. Even as democracy was ushered into free India, in the form of "a socialistic pattern of society", the Orwellian dictum of some being more equal than others has continued. Herein perhaps is a clue to the poignant question that Dongala asks - "Why has the graft of democracy not taken or why do we continue to have all the outer signs of democracy without actually achieving democracy?"

India is in transition again today. It is going through a grand sociological experiment. Science and technology are being used to improve the quality of the livelihood of its billion people. And the people have taken to these with enthusiasm. We have found that education is the key to development and an improved quality of life. Enabling a girl child to go one further year of primary school and notdrop out in the middle has the result of a reduction in infant mortality. That extra year gives her the ability to read and comprehend instructions about the steps to be taken when, at a later date, her own child falls sick. Among all the nations of the Indian subcontinent, Sri Lanka has the highest human development index, thanks to its higher literacy rate. As an aside, sociological or ideological impediments and objections to scientific practices and procedures have not come from the traditional section of society in the villages and small towns of India. The introduction of hybrid high-yield dwarf wheat from Mexico, cattle from New Zealand and soya bean from the U.S. have been received and absorbed just as enthusiastically as the dozens of fruits, vegetables and plants from the colonizing Portuguese were over the centuries. On the other hand, it is a tiny but vociferous activist minority that has raised objections to laboratory experimentation using animals, or the introduction of transgenic plants. As Richard Leaky pithily remarked, "You have to have at least one square meal a day to be a conservationist or an environmentalist".

Currently, India is going through a churning experience. The once untouchable castes have gained political voice and power in a few states of the country, realizing in part Mahatma Gandhi's dream. A quota system in education, government jobs and career ladders has been introduced, providing new openings to the centuries-long disadvantaged classes. Expectedly, the process has been awkward, best with opposition, occasional misuse and bending-over-backwards. We shall know the results only a decade or two later, but that this is a profound experiment and a new paradigm has been agreed upon by many sociologists. A similar move to reserve a certain proportion of seats in the state legislatures and the national parliament is under discussion. Would these steps attack and win over the hidden structural obstacles of the Indian society? We need social scientists to monitor the course of the experiment and help us understand how well "the old order change yielding place to new", and what new contours emerge.

Dorairajan Balasubramanian is Director of Research, L. V. Prasad Eye Institute, Hyderbad, India and was formerly, Director, Centre for Cellular & Molecular Biology, Hyderabad as well as Professor and Dean, University of Hyderbad. Foremost among his research interests is 'Molecular and Cellular Approaches to Understand and Treat Diseases of the Eye' and he has published 145 research papers and two books on related topics. Other major interests include work in the area of 'Public Understanding of Science' through popular science newspaper columns, radio and TV programs and more than 300 popular articles and six books. This interest is furthered by working with governments and agencies on issues of science and technology. Among professor Balasubramanian's many Honours & Awards are the "Kalinga" Award for Popularization of Science awarded by UNESCO in 1997, the "Padma Shri" : National honour by the President of India, 2002 and the "Chevalier de l'Ordre National du Merit" : National honour by the President of France, 2002.

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INTERVIEW

'Genes are not hard-wired'

...Dr. D Balsubramanian

Frontline: **Volume 18- Issue 11, May 26 - June 8, 2001**

India's National Magazine
from the Publishers of THE HINDU

"The protracted debate over nature (genetics) versus nurture (environment) in understanding human behaviour is no longer valid, the two go togehter," says Prof. D. Balasubramanian. Director of Research, L.V. Prasad Eye Institute, Hyderbad, and a popular science writer.

A specialist in biophysical chemistry, ocular biochemistry and protein structure, Prof. Balasubramanian has written three books (on chemistry, biotechnology and human bilogy), published 130 research articles in international journals and contributed over 200 newspapers articles. A fellow of the American Association of the Advancement of Science, the Third World Academy of Sciences, the International Molecular Biology Network, the Indian National Science Academy, and the Indain Academy of Sciences, he has received the UNESCO Award for Science Popularisation 91977), the Third World Academy of Sciences Award for Basic Medical Sciences (1995), the Khwarizmi Award of Iran in Medicine (1996) and the Bhatnagar Prize in Chemical Science (1981).

Prof. Balasubramanian was in Chennai to deliver the 16th K. Gopalkrishna Endowment Lecture on "The Impact of Heredity and Enviornment on the Growing Child. "(The K. Gopalkrishna Endowment Lecture is sponsored by the Chatnath Trust and the K. Gopalkrishna Department of Neurology at the Voluntary Health Services (VHS) Medical Centre. The family members of K. Gopalkrishna, who was a pioneer of the automobile industry, created an endowment at the department, which has completed 36 years at the VHS Medical Centre.)

Prof. Balasubramanian spoke to **Asha Krishnakumar** on a range of subjects, including genetics and environment, the human genome project, and state-of-the-art research on genetics. Excerpts from the interview:

How important are genetics (nature) and environment (nature) in the development of personality and human behaviour?

The biology of human behaviour is broadly determined by three factors. One, genetic endowment-biologically inherited from parents. Two, environmental impact-in terms of perception and so on. And, three, the way the individual collates everything to determine his long-term personality. Each of this is important and very often slides into another. Therefore, in some sense, it is no longer

appropriate to talk of nature versus nurture. It is not as if one goes against the other. They go together.

We say this with greater confidence because we now understand that while genes give you the entire physiology - that is, the body or the hardware-what you put in the brain-the software - is not genetically written in the form of gene sequences. The knowledge and perception you gather and analyse from the environment cannot be passed on to your children. They cease the moment you cease to exist.

Will two clones behave exactly the same way?

They cannot. They are essentially carbon of one another or are identical. But what you put in their brain, which is really their perceptive ability, could be vastly different and hence their personalities could also vary significantly. Genes, by and large, go for the physiology, not necessarily for the psychology or the knowledge base.

Can music or mathematics, or business 'run in the family'?

In a crude sense, one can talk about families with a certain genetic make-up as, say, a Pentium or a 486 or a Macintosh family. Each would have an innate mechanical capability. To that extent, certain families may be genetically endowed to do some things-not music or mathematics or business. So, it is not quite right to say that music or mathematics runs in the family.

Have the preliminary results of the human genome project and developments in neuro-biology impacted or changed the understanding of human behaviour?

We now know that the brain is quite plastic or mouldable. There are many issues in this. The brain cells, or the neurons, run into billions. With time, they keep dying. Unfortunately, they do not turn over as blood does-every 100 days we get new blood cells. But the turnover time of neurons is extremely slow-taking almost a lifetime. So once a neuron is dead it is gone forever. But now two things can be said with increasing certainty. One, there are in the adult mammalian brain stem cells that can be harboured and called over. And, under appropriate conditions they will differentiate and proliferate. Thus we understand that neuro density is not as static or as one-way as we thought it to be. We knew this was possible in the case of the liver. And, 14 years ago, in muscles. But now we know it is possible even in the case of stem cells.

Have experiments been done on humans to show that it is possible to regenerate stem cells?

We have done experiments on mice, rats and monkeys. As the genetic make-up is similar for mammals, we take it that it applies to humans as well.

Recent research has shown that 98.4 per cent of the genetic mack-up of the chimpanzee is similar to that of humans. Yet there is a vast difference between the two. How do you explain this?

This only shows that we have 98.4 per cent of the machinery that the chimpanzee has, but in a slightly modified form. The genes are not entirely identical but are mostly so. The body parts are remarkably similar. It is only the 1.6 per cent variation in the genetic make-up that makes a human. A part of the 1.6 per cent goes into making the vocal apparatus-chimpanzees only grunt. The rest is devoted to making the neuro-cortex, a part of the brain. Thus is why humans are able to collect, collate and use information, which is not given only by the genes.

What other recent research has changed our understanding of human behaviour?

First, the plasticity of the brain in terms of the regenerative possibilities of the stem cells and, therefore, the brain cells. Secondly, we now understand that the human brain can rewrite itself in parts in very minor ways and aid in learning and memory. Animal experiments are very clear on this. While looking at magnetic resonance imaging (MRI) when the tasks are being performed, we find neurons, including new ones, being fired. So we know that

new circuits are being made. This is another aspect of the plasticity of the brain, which we have understood in the last couple of years.

In the case of humans, unfortunately, no anecdotal inferences can be made on large sets of people. That is why one keeps working with rats and rabbits and monkeys-we can grow colonies of them and work with them. There is thus an inherent inadequacy while translating the results directly into humans. Yet we know that there are situations where humans seem to have some of this behaviour. Two issues are important. One is the motor or mirror neurons. That is, we know that when we do a certain task, certain kinds of neurons fire in our bodies. But neuro possibility discovered in the last two years, that if a monkey is watching another monkey doing a task, not only does the neurons of the monkey performing the task but those of the ones watching also fire. This has remarkable applications.

The third issue is with respect to certain people who are thought to have prodigal abilities in one area. A very intersting experiment was done in France and reported in the January issue of Nature and Medicine. R. Gamm (26) in Paris does remarkable mental arithmetic calculations like Shakuntala Devi and Leelavati. He was put to test in a laboratory. Doctors wired him up and started monitoring functionally through MRI his brain as he performed the mental calculations. At least five or six different areas were activated in his brain than would have in normal individuals. The study suggests that the extra neural areas that are being activated when he is performing the calculations shows that he is parking mid-way calculations in those and calls them back. Therefore, it now appears that it is possible to activate some areas specifically.

Even more striking is the fact that Gamm was not a born prodigy but learnt to do all this at the age of 20. Therefore it is clear that you can actually teach yourself, as it were, to park short-term memories. We are, however, on dangerous ground as we do not have enough numbers.

Another intersting example is of the Hungarian chess family of Judith Polgar and her two sisters. The three girls were taught chess fairly late (in their teens) by their father but became masters. Their father even said : "I can make a genius." He proved what Thomas Alva Edison said: "Genius is only 1 per cent inspiration, but 99 per cent perspiration. "It means that you can work towards it. Of course, it does not mean that anybody can become a genius. Only that it is possible to consider territories in the brain that we until now thought were not pliable.

Thus, in the past two years or so we have had three major suggestions-stem cells proliferation, short-medium-and long-term memory parking spaces that can borrow from one anohter, and that you can actually do so - that seem to point to the possibility of working through the mode of perception and analysis of the brain, which was thought to be non-pliable. The important point to note here is that all these prodigies are so only in specific areas. Otherswise they are normal people.

So it appears that there is far more you can do with what you have got. And one is not imprisoned with what you get from the genes.

Now we know that humans have far fewer genes - 30,000 or so - as against hundreds of thousands of genes suggested earlier. What does this mean?

That means that the 30,000 genes have to do a lot of functions. A gene is a sentence of instruction for the body, which is read and transcribed by RNA (ribonucleic acid) which then translates it into an action molecule called protein. The genotype is the genetic information and the phenotype is what the protein does.

While the number of genes may be around 30,000, the number of proteins may be 100,000 to 15,000 - nobody knows for sure yet.

How are there more products than inputs (genes)?

That clearly means that the rest of the body parts,

apart from the 30,000 genes, are also doing some things in a manner that may activate the genes. The other possibility is that the 30,000 genes are repeatedly used in multiple ways. For example, a gene may duplicate itself. In other words, a sentence can be read twice. The protein which comes out of the same gene can differ. Thus the functions of the gene could differ if it is used twice rather than once. How you do that and what is going to happen if you do that depend on the interaction between the genes and what they perceive as the environment.

Genes are also triggered by some diseases and occasionally by some drugs such as steroids. So, genes are not completely hard-wired. There is the give-and-take between genes and the environment, which is becoming increasingly important.

What are the other major discoveries in the human genome?

The human genome tells us that all of us share 99.1 per cent of the gene make-up (some say 99.9 per cent). We only differ in the 0.9 per cent or 0.1 per cent. There are differences even among siblings born from the same chromosomes. These differences are called polymorphism-some large and some only in a single character.

If everyone on earth is 99.9 per cent similar, then why are we talking about races? Are they not more of a cultural construct than a genetic one?

Does the discovery that mammals have significant similarities in the genetic make-up throw more light on the evolution theory?

That there is continuity in the flow of evolution is clear. It flows in one direction. With time, species have moved and we can even date them. There is remarkable consistency and constancy in this. We have genes similar to that of the donkey up to 80 per cent and the microbes up to 40 per cent. Thus, our ancestry can be pulled all the way up from there. It is what one does with those genes and how they are organized that seem important. Different species have taken various methods in organizing the genes. For example, a bacterium has a simple chromosome, while a human being has 23 and a hermit crab 137. Thus, it is not the number of chromoscomes that is important. From the human genome it is also clear that we seem to have pinched a large number of genes, over 200, from bacteria.

We also seem to have a large number of sequences, which at the moment do not seem to mean anything because they are not yet transcribed and are therefore called “junk DNA”. Also, the ‘jumping or transposing sequences’ seem to be abundant, about which we do not know anything. These may be mechanisms by which specific genes could be initiated, stopped or controlled. Humans have the same genes in the blood and the heart. Yet the heart does not make haemoglobin. Thus there seem to be tissue-specific silencing or activating of genes.

What kind of genetic research is going on in India?

A lot on developmental genetics. That is, studies to understand what happens during the development of an organism given its genome. The other kind of work looks at genetics of lower organisms such as bacteria for certain purposes. In human genetics, the push has been with respect to diseases. It was Indian territory some time ago- not any longer. Earlier they looked at the chromosomes, It is possible to take blood, isolate the genetic element from the nucleus of the cell and set apart all the 23 chromosomes (meaning the coloured part of the cell) and stain them in different colours. The chromosomes are then banded in different parts. Thus, some time ago, when work on cell genetics (cytogenetics) was dominant (prior to the development of molecular genetics), significant work was done in India using banding of cells.

Now we have moved into molecular genetics. Significant work is done in human disease-gene

connection. For example, we have identified the gene that causes glaucoma (pressure in the eye), and also the mutation in the gene. Other areas of work include muscular dystrophy and pigmentation of the skin.

How far away are we from gene therapy?

Quite far away from everyday experience. But there are some signs of hope from an Indian scientist, Prof. Inder Verma of the Salk Institute in the United States. The problems are three-fold: How do you deliver. Once delivered, how well would the gene express itself. And, how long will it stay.

The first seems to have been solved reasonably by Prof. Verma. The worry is whether the immunity would be affected and so on. But there is hope. In the next few years we would have developed very good methodology for this. But the second and third issues are yet to be resolved. Those would take time.

Would the ban on animal experiments in India affect research in biology?

Of course. All experiments are done on monkeys, rats and rabbits. It is vital that we experiment on them. We know now that we are all one family. And what the monkey does is translatable in some measure to humans. Therefore it is important that the experiments are done. In drug therapy it is crucial as what we do in a cell is not necessarily the final answer, for what happens in one tissue, organ or the whole body may be different from what happens in another-the reactions may be different.

There are fool-proof international guidelines for using animals in experiments. The three 'R's must be the bottomline: Where possible, Reduce the number of animals, Replace the animals with cell culture, and Refine the methods with statistical and mathematical analysis. All these are done in India. The international guidelines are backed by professional guidelines and national laws, as also an institutional animal welfare committee, which consists of a spectrum of people-professional scientists, veterinarians and ethically oriented people and so on. Clearance for any experiment is to be got by the animal ethics committee. Just because there have been some infringement in some places it is not right to stop animal experiments. This notion that we can do away with animal experiments is merely romantic and has, in fact, damaged research efforts in the country . It may also be a hangover from what happened elsewhere in the world.

You can police animal experiments; there must be regulation in anything. But it is also important to understand the qualification of the people involved in the experiments, their background and so on. Just removing a bunch of monkeys from experiments is not a lofty act. These laboratory-bred monkeys are innocent of outside life. The 30-odd monkeys that are taken out and let into the forest face the danger of being killed by other species, even by their own kind. What was thought to be a compassionate gesture might well have backfired.

The rules have made any experiment using monkeys in India extremely difficult. The power of overseeing the experiment should not rest with agencies that are far removed from the laboratories. Ample laws and guidelines exist around the world. We need no further spokes in the wheel. The rule can set back the pace of neuro-biological research.

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Books by D. Balasubramanian

1. **The mother of all genes and other adventures in popular science**
   by D. Balasubramanian
   Price : $17.29

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   by D. Balasubramanian
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5. **Deccan Heritage**
   By Harsh K. Gupta, Aloka Parasher-Sen, Indian National Science Academy, D. Balasubramanian
   Hardcover, Universities Press, ISBN 8173712859 (81-7371-285-9)

6. **The Indian Human Heritiage**
   By D. Balasubramanian, N. Appaji Rao
   Hardcover, University Press, ISBN 8173711283 (81-7371-128-3)

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PHOTO FEATURES ON
Prof. D. Balsubramanian

Dr. C. R. Mishra with Prof. D. Balsubramanian at LV Prasad Eye Institute Hyderabad on 23.02.2007

Prof. D. Balsubramanian at Work.

Dr. C. R. Mishra with Prof. D. Balsubramanian at LV Prasad Eye Institute Hyderabad on 23.02.2007

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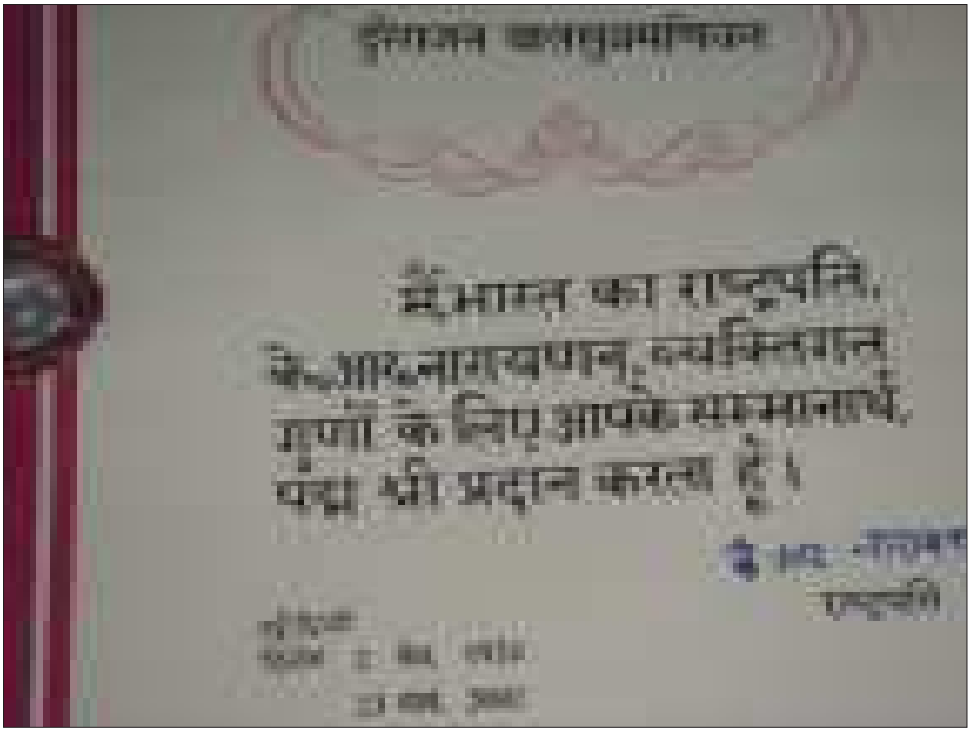
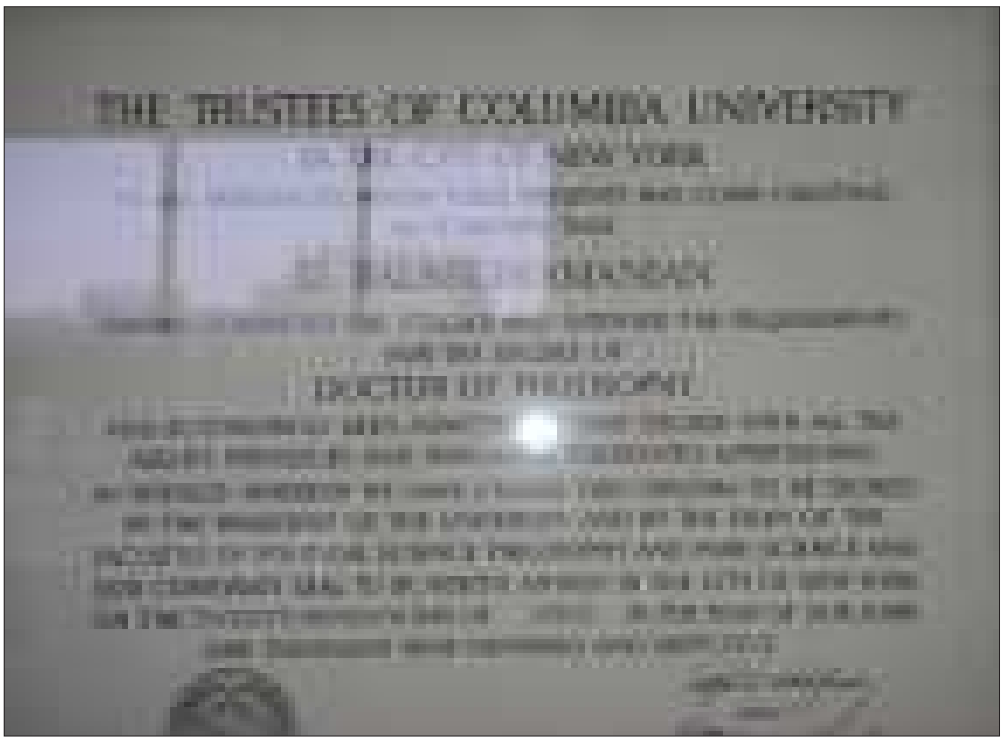
Gallery of Certificates of Prof. D. Balsubramanian with "Padmashri" Certificate from President of India at the Centre of Attraction

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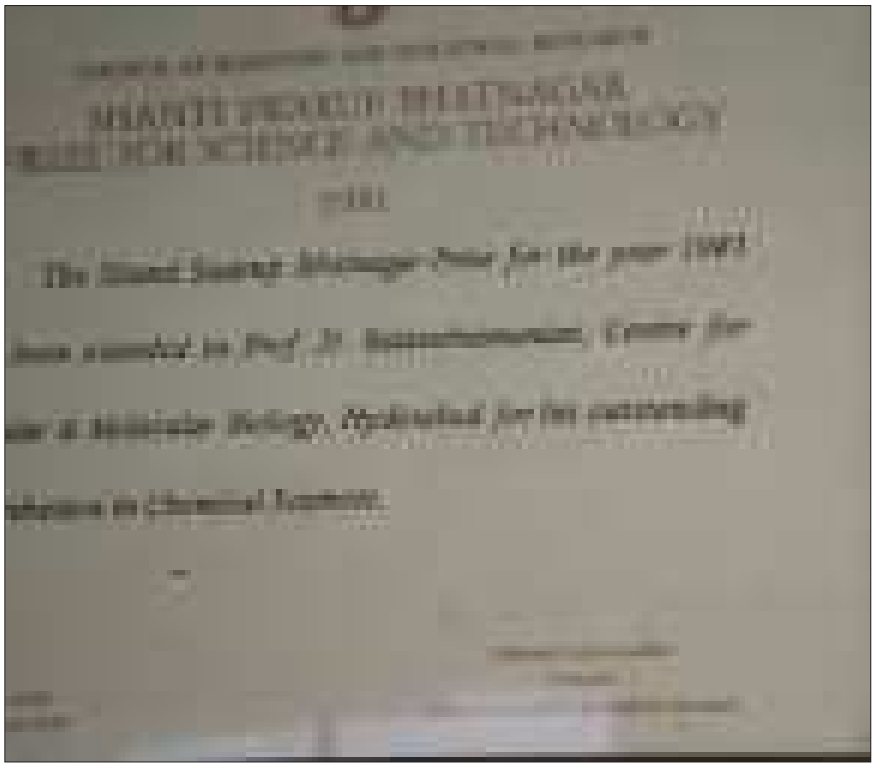

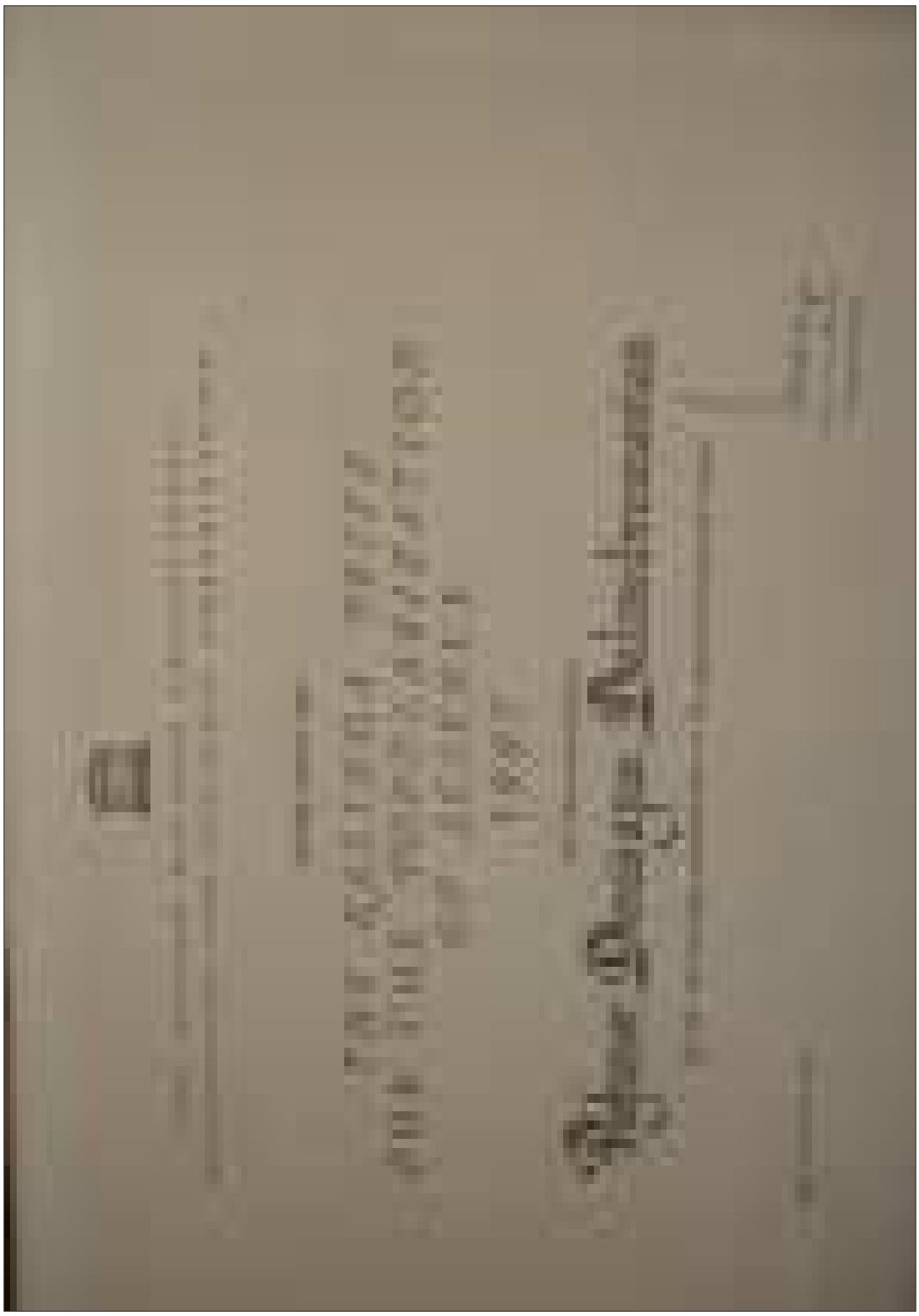

Chief Guest Prof. D. Balsubramanian addressing the Orissa Vigyan Academy Annual Convocation held on 20.12.2007 at Bhubaneswar.

Prof. D. Balsubramanian Exchaining Pleaseantries with Shri Navin Pattnaik , Hon'able Chief Minister Orissa at the Orissa Vigyan Academy Annual Convocation held on 20.12.2007 at Bhubaneswar.

Shri Navin Pattnaik , Hon'able Chief Minister Orissa Presenting a Memento to Prof. D. Balsubramanian at the Orissa Vigyan Academy Annual Convocation held on 20.12.2007 at Bhubaneswar.

Prof. D. Balsubramanian & Shri Navin Pattnaik , Hon'able Chief Minister Orissa sharing the Dias at Orissa Vigyan Academy Annual Convocation held on 20.12.2007 at Bhubaneswar.

Prof. D. Balsubramanian & Shri Navin Pattnaik , Hon'able Chief Minister Orissa discussing a point at the Orissa Vigyan Academy Annual Convocation held on 20.12.2007 at Bhubaneswar.

Prof. D. Balsubramanian with Shri Sanjeev Kumar Sahu, Hon'ble Minister of Science & Technology, Govt. of Orissa and Members of Kalinga Foundation Trust and other Dignitaries at the Venue of Orissa Vigyan Academy Annual Convocation held on 20.12.2007 at Bhubaneswar.

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