

OBITUARY

PROFESSOR RAMAMURTHY BALASUBRAMANIAM (1961-2009)*

This obituary gives notice of the passing of Professor Ramamurthy Balasubramaniam (always known simply as Bala), the most active figure researching and promulgating the study of early metallurgy in India. Prof. Balasubramaniam passed away on 9th December 2009 after a short illness at the age of 48. The loss to the whole Indian and global scientific community is great, but will be especially keenly felt by the Society, familiar to the readers of the *IJHS* as Prof. Balasubramaniam had become a major contributor to the *Journal* in recent years, particularly with his major papers on the Delhi Iron Pillar (36.1&2, 2001, pp.1-50), the Dhar Iron Pillar (37.2, 2002, pp.115-151) and his contributions to the two recent themed volumes (40.3& 4, 2006, on cannon and 42.3 & 4, 2008, on crucible steel, and see Appendix 2). It is very likely that he would have gone on to play a prominent role in the Societies' activities.

Prof. Balasubramaniam born in Salem, Tamil Nadu on the 15th April 1961 and matriculated from the Holy Cross Matriculation School in that city in 1978. He began his illustrious academic career at the Institute of Technology at the Banaras Hindu University in Varanasi. There he studied metallurgical engineering, taking his degree in 1984 and was awarded both the University and the Gandhi gold medals as well as the Vidya Bharathi Award from the Indian Institute of Metals. He subsequently undertook research on the role of hydrogen in the stress corrosion cracking of a binary aluminium-lithium alloy and of a ternary aluminium-lithium-copper alloy at the Rensselaer Polytechnic Institute at Troy, New York in the United States of America, receiving his doctorate in Materials Engineering in 1990.



**Prof R. Balasubramaniam
(1961-2009)**

* Prepared by **Paul T. Craddock**, 56, St. Margaret's Street, Rochester, Kent, MG1170, UK, e-mail: paulcraddock74@btinternet.com

On his return to India he was appointed Assistant Professor in the Department of Materials and Metallurgical Engineering at the Indian Institute of Technology Kanpur on 2nd July 1990 and was to remain there for the rest of his career, with his wife, Dr. Gaitri S. Balasubramaniam and their two daughters, Gowri and Gargi¹. He became an associate professor in 1997 and a full professor on 13th December 2001. He was appointed to the newly established B B Lal Chair in September 2009.

From February to July 1995 he held the BOYSCAST Fellowship in the Department of Chemistry at the University of Vermont, Burlington, USA and from August 1997 to July 1998 he held the Alexander von Humboldt Fellowship at the Institut für Materialphysik at the University of Göttingen, Germany. Prof. Balasubramaniam was made a Fellow of the Institution of Engineers, Calcutta in 2002, and won numerous awards including the Young Scientist award from the Indian National Science Academy in 1993, the Material Research Society of India medal and Metallurgist of the year award from the Indian Institute of Metals, both in 1999. Recently he won the Shershtha prize in History from the Marathi Sahitya Parishad in 2008. The latter award reflected Prof. Balasubramaniam's increasing interest and involvement in the study of the past. He also received the Distinguished Educator award from the Indian Institute of Metals in 2009. In addition Prof. Balasubramaniam served on the editorial board of a number of academic periodicals including the *International Journal of Corrosion*; the *International Journal of Corrosion Science, Engineering and Technology*, the *Journal of the Materials Science Research India*, Bhopal; *Transactions of the Indian Institute of Metals*, Kolkata; *The Open Corrosion Journal*; the *Collection Indologie*, Paris; the *International Journal of Corrosion*; the *Journal of South Asian Archaeology*. In addition he was, of course, on the editorial board of *IJHS* since 2004.

Despite a very full teaching and administrative programme Prof. Balasubramaniam was a dedicated researcher with an impressive array of 10 books and over 300 journal and conference publications (see Appendices 1 & 2 for details of his books and the journal articles specifically on archaeometallurgy and the history of science). This was due in part to his habit of rising very early and writing for several hours at home before breakfast and the commencement of his official Institute duties. His research interests were very wide, including materials-hydrogen interactions, environmental degradation of materials (including

corrosion, high temperature oxidation and wear), and more recently the study of early metallurgy. Thus his laboratories contained an eclectic assortment of objects from bits of ancient iron pillars, beams and sword blades to the odd length of railway line, reflecting the breadth of his knowledge and interests. His work on corrosion mechanisms may have led to a developing interest in early metals, certainly many of his papers on archaeometallurgy concern the corrosion of ancient metals. Perhaps his most significant work was to postulate a mechanism based on physical metallurgy to explain why the Delhi Iron Pillar had not corroded although exposed to the atmosphere for 1600 years. This is a question that had vexed scholars for well over a century. Various explanations, all most or less improbable, ranging from secret ingredients to a very dry environment, had been previously suggested. Prof. Balasubramaniam's entirely convincing explanation, based as it was on hard science, detailed examination and experimentation, suggested the formation of a protective passive layer on the surface due to the phosphorus content of the wrought iron, which is responsible for the excellent corrosion resistance of the pillar. This mechanism is applicable to all such early iron artefacts made by the direct, solid state process, and thus is of general importance. This work was published in his *Story of the Delhi Iron Pillar* (reviewed in the *IJHS* 43.2 pp.303-8). The book is a comprehensive study of the Pillar, starting with an explanation of the smelting of the iron by the traditional solid state process, followed by a detailed description of how the Pillar was constructed, including the complex multi-component bell-capital, in addition to giving the reasons why the portions above ground have not corroded. In this book Prof. Balasubramaniam also conjectured at length on the likely original function and location of the pillar as well as its subsequent history. This also revealed his very considerable knowledge of Indian history, philosophy and religion. In short, the account is by far the best book on the Pillar ever written, and probably the best book on Indian archaeometallurgy.

This historical knowledge was very apparent in his studies on Indian cannon and bombards. These pieces were made by a variety of very different processes; the mighty cast bronze cannon and great the bombards assembled from many pieces of wrought iron of the Mughals, to the cast iron cannon cast in the foundries that the European powers established in India, notably by the British for the East India Company at Kolkata and by the French for the Nizam at Hyderabad. For all their technical interest and their contribution to the changing military tactics and political history of India through the post medieval period in

India the cannon had previously been but little studied. Indeed there was little general appreciation of the existence of many of them, often inaccessible inside current military installations or lying half buried by roadsides. Also they had received but little attention from the agencies that should have been protecting them and Prof. Balasubramaniam's study most certainly raised public awareness of their importance as artefacts and of their plight. The cannon generated the two themed issues of the *IJHS* detailed above and the major monograph *The Saga of Indian Cannon*. This is a typical Bala publication, certainly academic and full of information but accessible to an audience beyond the dedicated scholar. It is also profusely illustrated with photographs, many taken by him on his exhaustive travels through the length and breadth of South Asia recording the various pieces of ordnance. This publication revealed Bala's attitude to research. He was not content with merely regurgitating previously published work, he had to go and see for himself, following up leads to make new discoveries and original contributions.

Yet another of Prof. Balasubramaniam's research interests were in all aspects of crucible steel, including everything from the recording of the locations of smelting sites in the Deccan, the ethnography of the smelting communities through to the metallographic examination of the steels that they made. This he was actively pursuing most recently, and, as with the cannon, the studies had already generated two themed issues in the *IJHS* (detailed above). In these issues the contributions by Bala abound, but he had also persuaded scholars from all over the world who were interested in crucible steel to contribute, and the resulting collection is now essential reading for anyone interested in the subject.

As must be apparent from the preceding paragraphs Bala was above all else an enthusiast. He always wanted to be involved directly and this is nicely illustrated by his attitude to one of his passions, cricket. He was not particularly interested in the shenanigans of Twenty20 cricket; he was too busy actually playing the game. He was keenly interested in all he undertook, displaying great energy and was able to inspire others, either on the cricket field, as well as in the lecture hall and laboratory. The enthusiasm he was able to pass on to others just in conversation, but also of course more formally in his publications and lectures. Prof. Balasubramaniam was a great teacher and an excellent speaker. His lectures contained a great deal of formal material coherently arranged, but delivered with considerable panache and most certainly considerable punch. He also had a way of engaging with his audience, be they first year students or fellow academics,

some jokes, some rhetorical questions (often real questions for the first year students), and always backed up with excellent original illustrative material.

Thus he was able to introduce archaeometallurgy to the IITK and establish several research projects as well as more formal *tuition*. In fact he was able to set up a pioneering forty lecture course in the history of metals that was able to run for its first year in 2009. This was so successful that the Archaeological Survey of India requested a short course on scientific archaeology for a number of their conservators and scientists from the ASI laboratories at Dehra Dun which took place at the IITK in March 2009.

Prof. Balasubramaniam was a man of wide interests spanning science and the arts. His cultural interests extended to music, where Bala being Bala, this did not mean just listening but playing as well. He played classical guitar and was an ace drummer too. His taste in music ranged from western classical to traditional Indian music, and the sounds of a symphony or a *rāga* could often be heard coming from his office whilst he worked.

In 2007 Prof. Balasubramaniam published an appreciation of the life and work of Professor T.R. Anantharaman (see Appendix 1), his teacher and guru at the Institute of Technology at the Banaras Hindu University, Varanasi. At that time we little thought that less than two years later we would be writing an obituary for Bala himself. Although he was relatively young he had become India's leading archaeometallurgist, and a recognised authority on early iron and steel throughout the world. The loss is especially great for India and it is very sincerely to be hoped that his hands-on approach to research based on original field work and fresh scientific examination and analysis integrated with existing reports will develop and to become more generally emulated. The publications of his own researches will surely be an inspiration for many years to come.

Acknowledgement

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Appendix 1: Books Published

1. *Delhi Iron Pillar: New Insights*
R. Balasubramaniam
Indian Institute of Advanced Studies, Shimla and Āryan Books International, New Delhi, 2002. Hardbound, ISBN-81-7305-223-9.

2. *Metallurgical Marvels of Ancient India: Delhi Iron Pillar*
R. Balasubramaniam
Heritage Publications Series 49
Indian Institute of Scientific Heritage, Trivandrum, 2002.
3. *The World Heritage Complex of the Qutub*
R. Balasubramaniam
Aryan Books International, New Delhi, 2005
Hardbound, ISBN 81-7305-293-X.
4. *Story of the Delhi Iron Pillar*
R. Balasubramaniam
Foundation Books, New Delhi, 2005
Paperback, ISBN-81-7596-301-8.
5. *Callister's Materials Science and Engineering*
R. Balasubramaniam
Wiley India Pvt Ltd, New Delhi, 2007
Paperback, ISBN-81-265-1076-5.
6. *Prācīn Bhāratīya Dhātūśāstriye Āścharya:
Dilli Loha Stambha* (in Marathi)
(Ancient India's Metallurgical Marvel: Delhi Iron Pillar)
R. Balasubramaniam and Pravin P Deshpande
Sushama Prakashan, Pune, 2007.
Paperback, ISBN81-90612-20-4
7. *Professor T.R. Anantharaman:
An Inspiring and Dedicated Educator*
R. Balasubramaniam, Anish Upadhyaya, Bikramjit Basu and Deepika Sachdeva
Āryan Books International, New Delhi, 2007.
Hardbound, ISBN 81-86787-14-3
8. *Marvels of Indian Iron through Ages*
R. Balasubramaniam
Rupa and Co, New Delhi, 2007.
Hardbound, ISBN 978-81-291-1184-5.
9. *The Saga of Indian Cannons*
R. Balasubramaniam
Āryan Books International, New Delhi, 2008
Art paper, Hardbound, ISBN 978-81-7305-339-9.
10. *Dhilli Loha Ṣṭamb ki Kahāni* (in Hindi)
(Story of Delhi Iron Pillar)
R. Balasubramaniam and Gopal Dwivedi
National Publishing House, New Delhi, 2008.
Paperback, ISBN

**Appendix 2: Publications in Journals pertaining to Archaeometallurgy
and the History of Science (Selective Articles only)**

1. Studies on the Corrosion Resistance of The Delhi Iron Pillar
R. Balasubramaniam
NML Technical Journal, 37 (1995) 123-142.
2. Mixed Potential Analysis of the Corrosion Resistance of The Delhi Iron Pillar
R. Balasubramaniam
Transactions of the Indian Institute of Metals, 50 (1997) 23-35.
3. Destannification of Ancient Indian High Tin Bronze
M. C. Srivastava and R. Balasubramaniam
Practical Metallography, 34 (1997) 573-583.
4. Corrosion Behaviour of Ancient 1500-Year Old Gupta Iron
V. Puri, R. Balasubramaniam and A.V. Ramesh Kumar
Bulletin of Metals Museum, 28 (1997) 1-9.
5. New Insights on the Corrosion of the Delhi Iron Pillar based on
Historical and Dimensional Analysis
R. Balasubramaniam
Current Science, 73 (1997) 1057-1067.
6. The Decorative Bell Capital of the Delhi Iron Pillar
R. Balasubramaniam
JOM, 50, Number 3 (1998) 40-47.
7. On the Presence of Lead in the Delhi Iron Pillar
R. Balasubramaniam
Bulletin of Metals Museum, 29 (1998) 19-39.
8. Corrosion Product Analysis of Corrosion Resistant Ancient Indian Iron
A.V. Ramesh Kumar and R. Balasubramaniam
Corrosion Science, 40 (1998) 1169-1178.
9. Elucidation of Manufacturing Technology Employed to Construct
the Body of the Delhi Iron Pillar
R. Balasubramaniam
Bulletin of Metals Museum, 31 (1999) 40-63.
10. Some Aspects of Lead Presence in the Delhi Iron Pillar
R. Balasubramaniam
Current Science, 77 (1999) 681-686
11. The Protective Passive Film of the Delhi Iron Pillar
R. Balasubramaniam
Bulletin of Metals Museum, 34 (2001) 64-86.

12. Identity of Candra and Viṣṇupādagiri of the Delhi Iron Pillar Inscription: Numismatic, Archaeological and Literary Evidence
R. Balasubramaniam
Bulletin of Metals Museum, 32 (2000) 42-64.
13. Scanning Electron Microscopy Study of an Ancient Silver Punch-Marked Coin with Central Pentagonal Mark
N. Mahajan and R. Balasubramaniam
Numismatic Digest, 21-22 (1997-1998) 153-168.
14. Delhi Iron Pillar Rust Characterization by X-ray Diffraction Analysis
R. Balasubramaniam
NML Technical Journal, 41 (1999) 13-20.
15. Delhi Iron Pillar Rust Characterization by Fourier Transform Infrared Spectroscopy Analysis
A.V. Ramesh Kumar and R. Balasubramaniam
NML Technical Journal, 41 (1999) 37-41.
16. Delhi Iron Pillar Rust Characterization by Mossbauer Spectroscopy Analysis
A.V. Ramesh Kumar and R. Balasubramaniam
NML Technical Journal, 41 (1999) 57-61.
17. Characterization of Delhi Iron Pillar Rust by X-ray Diffraction, Fourier Infrared Spectroscopy and Mossbauer Spectroscopy
R. Balasubramaniam and A.V. Ramesh Kumar
Corrosion Science, 42 (2000) 2085-2101
18. On the Corrosion Resistance of the Delhi Iron Pillar
R. Balasubramaniam
Corrosion Science, 42 (2000) 2103-2129
19. Characterization of Ancient Indian Iron and Entrapped Slag Inclusions Electron, Photon and Nuclear Microprobes
P. Dillmann and R. Balasubramaniam
Bulletin of Materials Science, 24 (2001) 317-322.
20. New Insights on the 1600-Year Old Corrosion Resistant Delhi Iron Pillar
R. Balasubramaniam
Indian Journal of History of Science, 36 (2001) 1-49.
21. Some Metallurgical Aspects of Ancient Indian OCP Period Copper
R. Balasubramaniam, M.N. Mungole, V.N. Prabhakar, D.V. Sharma and D. Banerjee
Man and Environment, 26 (2002) 89-97.
22. Studies on Ancient Indian OCP Period Copper
R. Balasubramaniam, M.N. Mungole, V.N. Prabhakar, D.V. Sharma and D. Banerjee
Indian Journal of History of Science, 37 (2002) 1-15.

23. Characterization of Protective Rust on Ancient Indian Iron using Microprobe Analyses
P. Dillmann, R. Balasubramaniam and G. Beranger
Corrosion Science, 44 (2002) 2231-2242.
24. A New Study of the Dhar Iron Pillar
R. Balasubramaniam
Indian Journal of History of Science, 37 (2002) 115-151.
25. On the Origin of High Phosphorus Content in Ancient Indian Iron
Vikas Kumar and R. Balasubramaniam
International Journal of Metals, Materials and Processes, 14 (2002) 1-14.
26. On the growth kinetics of the protective passive film of the Delhi iron pillar
R. Balasubramaniam
Current Science, 82 (2002) 1357-1365.
27. Material and Electrochemical Characterization of Ancient OCP Copper
T. Laha, J. Shankar, R. Balasubramaniam, V.N. Prabhakar, D.V. Sharma and D. Banerjee
Indian Journal of History of Science, 37 (2002) 321-329.
28. Delhi Iron Pillar and Its Relevance to Modern Technology (Letter)
R. Balasubramaniam
Current Science, 84 (2003) 126-127.
29. Effect of Material Inhomogeneity on Protective Passive Film Formation on Delhi Iron Pillar
R. Balasubramaniam
Current Science, 84 (2003) 534-541.
30. Dhar Iron Pillar
R. Balasubramaniam
Bulletin of Metals Museum, 36 (2003) 23-44.
31. Alloy Design of Ductile Phosphoric Iron: Ideas from Archaeometallurgy
Gouthama and R. Balasubramaniam
Bulletin of Materials Science, 26 (2003) 483-492.
32. On the Origin of Non-Uniform Surface Electrochemical Potentials on the Delhi Iron Pillar
R. Balasubramaniam
Current Science, 85 (2003) 378-382.
33. Corrosion Resistance of the Dhar Iron Pillar
R. Balasubramaniam and A.V. Ramesh Kumar
Corrosion Science, 45 (2003) 2451-2465.

34. Influence of Manufacturing Methodology on the Corrosion Resistance of the Delhi Iron Pillar
R. Balasubramaniam
Indian Journal of History of Science, 38 (2003)195-214.
35. Metallurgical Investigations on a Chalcolithic Copper Nail from Balathal
A. Srivastava, R. Balasubramaniam and V.N. Misra
Man and Environment, 28 (2003) 33-40.
36. Some Metallurgical Aspects of Gupta Period
Gold Coin Manufacturing Technology
R. Balasubramaniam and N. Mahajan
Indian Journal of History of Science, 38 (2003) 331-349.
37. Material Characterization of Ancient Indian Copper
A. Srivastava and R. Balasubramaniam
Bulletin of Materials Science,26 (2003) 593-600.
38. Forging and Corrosion Resistance of the Delhi Iron Pillar
R. Balasubramaniam
Bulletin of Jnana Pravaha, 6 (2003) 61-72.
39. A Marvel of Medieval Indian Metallurgy:
Thanjavur's Forge-Welded Iron Cannon
R. Balasubramaniam, A. Saxena, T.R. Anantharaman,
S. Reguer and P. Dillmann
JOM, 56, Issue 1 (2004) 17-23.
40. Characterization of Rust on Ancient Indian Iron
R. Balasubramaniam, A.V. Ramesh Kumar and P. Dillmann
Current Science,85 (2003) 1546-1555.
41. Long Term Corrosion Behavior of Copper in Soil:
A Study of Archaeological Analogues
R. Balasubramaniam, T. Laha and A. Srivastava
Materials and Corrosion, 55 (2004) 194-202.
42. On the Role of Environment on the Corrosion Resistance
of the Delhi Iron Pillar
S. Halder, G.K. Gupta and R. Balasubramaniam
Current Science, 86 (2004) 559-566.
43. Estimation of the Original Erection Site of the
Delhi Iron Pillar at Udayagiri
M.I. Dass and R. Balasubramaniam
Indian Journal of History of Science, 39.1 (2004) 54-71.
44. On the Astronomical Significance of the Delhi Iron Pillar
R. Balasubramaniam and M.I. Dass
Current Science, 86 (2004) 1134-1142.

45. The Original Image atop the Delhi Iron Pillar
R. Balasubramaniam, M. I. Dass and E. M. Raven
Indian Journal of History of Science, 39.2 (2004) 177-203.
46. Conservation Issues Relating to the Forge-Welded
Iron Cannon at Thanjavur
A. Saxena and R. Balasubramaniam
Conservation of Cultural Property in India, Journal of the
Indian Association for the Study of Conservation of
Cultural Property, 32-33 (1999-2000) 75-81.
47. The Importance of Summer Solstice at Udayagiri
A.M. Sharan and R. Balasubramaniam
Bharti, 28 (2003-4) 71-86.
48. Detecting Non-uniform Phosphorus Distribution in
Ancient Indian Iron by Color Metallography
P. Piccardo, M.G. Ienco, R. Balasubramaniam and P. Dillmann
Current Science, 87 (2004) 650-653.
49. Date of Sanakanika Inscription and its Astronomical Significance for
Archaeological Structures at Udayagiri
A.M. Sharan and R. Balasubramaniam
Current Science, 87 (2004) 1562-1566.
50. Material Selection of High-Level Nuclear Waste
Storage Canisters: Lessons from Archaeometallurgy (Letter)
R. Balasubramaniam
Current Science, 88 (2005) 337-338.
51. *Rajagopala* - The Massive Iron Cannon at Thanjavur in Tamil Nadu
R. Balasubramaniam, A. Saxena and T.R. Anantharaman
Indian Journal of History of Science, 40(3) (2005) 269-294
52. *Dal Mardan* - The Medieval Forge Welded Iron Cannon at Bishnupur
R. Balasubramaniam, K. Bhattacharya and A.K. Nigam
Indian Journal of History of Science, 40(3) (2005) 295-320.
53. The Forge Welded Iron Cannon at Bada Burj of Golconda Fort Rampart
R. Balasubramaniam, M. Surender and S. Sankaran
Indian Journal of History of Science, 40(3) (2005) 321-336.
54. The Forge Welded Iron Cannon near Fateh Burj of Golconda Fort Rampart
R. Balasubramaniam, S. Sankaran and M. Surender
Indian Journal of History of Science, 40(3) (2005) 337-348
55. *Bhavani Shankar* - The Forge Welded Iron Cannon at Jhansi Fort
D. Neff and R. Balasubramaniam.
Indian Journal of History of Science, 40(3) (2005) 349-370.

56. *Kadak Bijli* - The Forge Welded Iron Cannon at Jhansi Fort
R. Balasubramaniam.
Indian Journal of History of Science, 40(3) (2005) 371-388.
57. On the First Catalogue of Forge-Welded Iron Canons by Neogi
R. Balasubramaniam
Indian Journal of History of Science, 40(3) (2005) 259-268.
58. *Azdaha Paikar* - The Composite Iron-Bronze Canon
at Musa Burj of Golconda Fort
R. Balasubramaniam
Indian Journal of History of Science, 40(3) (2005) 389-408.
59. *Fath Raihbar* - The Massive Bronze Cannon
at Petla Burj of Golconda Fort
R. Balasubramaniam
Indian Journal of History of Science, 40(3) (2005) 409-430.
60. Microstructural characterization of copper corrosion in aqueous and soil environments
A. Srivastava and R. Balasubramaniam
Materials Characterization, 55 (2005) 127-135.
61. Development of Cannon Technology in India
R. Balasubramaniam
Indian Journal of History of Science, 40(4) (2005) 503-538.
62. Saltpetre Manufacture and Marketing in Medieval India
R. Balasubramaniam and S. Jai Kishan
Indian Journal of History of Science, 40(4) (2005) 663-672.
63. European Mercenary Artillerymen in Indian Subcontinent (1500-1800)
R. Balasubramaniam
Indian Journal of History of Science, 40(4) (2005) 673-678.
64. Technical Report on Analysis of Iron Slags from Kamrej
R. Balasubramaniam and Tanushree
65. Electrochemical Impedance Spectroscopy Study of Surface Films Formed on Copper
in Aqueous Environments
A. Srivastava and R. Balasubramaniam
Materials and Corrosion, 56 (2005) 611-618.
66. Catalogue of Massive Forge Welded Iron Cannon of India-I
R. Balasubramaniam
Journal of Ordnance Society, 17 (2005) 67-90.
67. Studies on Phosphoric Irons for Concrete Reinforcement Applications
Sahoo Gadadhar and R. Balasubramaniam
Transactions of the Indian Institute of Metals, 59 (2006) 245-253.

68. Archaeometallurgy of Ancient Indian Copper
R. Balasubramaniam
Transactions of the Indian Institute of Metals, 59 (2006) 899-909.
69. On the Steeling of Iron and the Second Urbanization of Indian Subcontinent
R. Balasubramaniam
Man and Environment, 32 (2007) 102-107.
70. Characterisation of Long Term Corrosion Product on a Chalcolithic Period Copper Axe
A. Srivastava, R. Balasubramaniam and V.N. Misra
Transactions of the Indian Institute of Metals, 60 (2007) 61-64.
71. Influence of Arsenic, Antimony and Phosphorous on the Microstructure and Corrosion Behavior of Brasses
R. Karpagavalli and R. Balasubramaniam
Journal of Materials Science, 42 (2007) 5954-5958.
72. On the History of the Delhi Iron Pillar Revealed by Technical Analysis of Characters of the Oldest Inscription
R. Balasubramaniam
IFCAI Journal of History and Culture, 1 (2007) 7-24.
73. On Technical Analysis of Characters of the Oldest Delhi Iron Pillar Inscription
R. Balasubramaniam and V.N. Prabhakar
Current Science, 92 (2007) 1709-1719.
74. On Phase Distribution and Phase Transformations in Phosphoric Irons Studied by Metallography
Gadadhar Sahoo and R. Balasubramaniam
Metallurgical and Materials Transactions 38 (2007) 1692-1697
75. *Zafarbaksh* - The Composite Mughal Cannon of Aurangzeb at Fort William in Kolkata
R. Balasubramaniam and P.K. Chattopadhyay
Indian Journal of History of Science, 42 (2007) 205-223.
76. On the Origin of the Terms *Wootz*, *Hinduwan* and *Pulad*
Ann Feuerbach, R. Balasubramaniam and S. Kalyanaraman
Indian Journal of History of Science, 42 (2007) 377-386.
77. New Insights on Classification of Iron-Carbon Alloys, Specially High Carbon Steels in *Rasaratnasamuccaya*
R. Balasubramaniam and S. Kalyanaraman
Indian Journal of History of Science, 42 (2007) 427-444.
78. Material Evidences of Wootz Steel Production in Northern Telangana
S. Jaikishan and R. Balasubramaniam
Indian Journal of History of Science, 42 (2007) 461-480.
79. Social aspects of Wootz Steel Manufacture in Northern Telangana
S. Jaikishan and R. Balasubramaniam
Indian Journal of History of Science, 42 (2007) 481-492.

80. On the Varied Applications of Wootz Steel
R. Balasubramaniam
Indian Journal of History of Science, 42 (2007) 493-510.
81. On Wootz Steel Received by Alexander
R. Balasubramaniam
Indian Journal of History of Science, 42 (2007) 511-516.
82. Recreating Wootz Steel outside India
R. Balasubramaniam
Indian Journal of History of Science, 42 (2007) 523-535.
83. Microstructural Characterization along the Length of a Wedge Shaped Wootz Steel Implement
Vinod Kumar, M. R. Barnett, R. Balasubramaniam and S. Jaikishan
Indian Journal of History of Science, 42 (2007) 609-632..
84. New Insights on the Mechanism of Carbide Banding in Thermomechanically Processed Woot Steel obtained using Electron Back Scattering Diffraction
M. R. Barnett and R. Balasubramaniam
Indian Journal of History of Science, 42 (2007) 633-648.
85. Analysis of Wootz Steel Crucibles from Northern Telangana
R. Balasubramaniam, Anubhav Pandey and S. Jaikishan
Indian Journal of History of Science, 42 (2007) 649-672.
86. Konosamudram - The Famous Wootz Steel Production Centre
S. Jaikishan and R. Balasubramaniam
Indian Journal of History of Science, 42 (2007) 697-704.
87. Interview with Wootz Steel Worker from Konapuram Village in North Telengana
S. Jaikishan and R. Balasubramaniam
Indian Journal of History of Science, 42 (2007) 705-712.
88. Scientific Materials, Equipments and Techniques in Conservation: the Delhi Iron Pillar Example
R. Balasubramaniam
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