

Centre for indian knowledge systems



No.2, 25th east street, Tiruvonmiyur, Madras-600 041. Ph:415909.

27th October 1993.

Dr. Niranjan Joshi
Centre for Environmental Sciences
Indian Institute of Science
Maleeswaram
BANGALORE - 560 012.

Dear Joshi,

It is long time since I heard from you - however I have been seeing with great interest the papers you have been publishing recently in Current Science. I am likely to come over to Bangalore just for a day on 19th November (I will be visiting Dr. Ramanna's Institute) and I hope to see ~~ing~~ you then.

You may recall that I had spoken to you about a project that we had initiated to study Traditional Techniques of Metallurgy and Metal working. I am enclosing a copy of the May 1993 issue to India Magazine in which I have written a popular article regarding this. The first phase of the project has been completed and furnaces of the traditional design have been reconstructed in few locations. While ~~however~~ studies will continue, there is a crucial question relating to the use of charcoal which is a fuel for the traditional processes - I would very much like to discuss this with you and get your advice and help. I am enclosing a small note in which I have summarised the points that I want to discuss with you. Please drop a line and let me know if we could meet on 19th November probably in the afternoon.

With warm regards,

Yours sincerely,

A.V. Balasubramanian.

P.S: Please note our new address - and send all future correspondence to this address.

NVJ

USE OF CHARCOAL AS FUEL IN TRADITIONAL IRON AND STEEL MAKING

SOME POINTS FOR DISCUSSION

Background Information

1. Modern Iron and Steel making uses coke as the fuel - this is obtained by processing coal which is a fossil fuel.
2. The Traditional Iron and Steel making process of India uses charcoal as fuel. This is obtained from certain specific varieties of wood - some species are preferred but the range is not too narrow.
3. One of the reasons why the Traditional Process was driven out of existence (largely) in the last century was that the pressure on the forests increased and forests went out of the control of local population.
4. One of the questions that comes up in a discussion regarding the Traditional process is - when forests are vanishing & wood is scarce, how can we spend this precious resources for Iron and Steel making ?

SOME QUESTIONS IN THIS CONNECTION

1. Although the use of coke made from coal appears attractive we must bear in mind that coal is a fossil fuel produced over geological time scales - i.e. we are eating into the capital.

2. This cannot be used renewably - i.e. we cannot regenerate and replace this coal in a short span of time.

3. However charcoal can in principle be used in a renewable fashion. For example if we choose a species of tree that can regenerate itself once in every twenty years then this can renew itself over a time scale of this order of magnitude.

4. I would like to work out the elements for a model of producing Iron and Steel using Charcoal. This model would require looking into the following features.

* What are the various species of wood from which charcoal can be produced for use in the Traditional Iron making process.

* What is the relative efficiency of use in terms of - conservation of wood to charcoal, impact of various types of charcoal ^{on} and the quality of Iron and Steel etc.,.

* What are the rates of growth and regeneration of this species \rightarrow wood taken as monocultures or as a mixture of some selected species.

* How best can ^{we} ~~be~~ harvest and use such a plantation~~s~~ renewably.

* What would be the ^{area of} ~~above~~ ~~all~~ land that has to be

planted for producing a unit amount of Iron and Steel.

WHAT I WOULD LIKE TO DISCUSS WITH YOU

I want your first reaction *to* this note. I would be interested in teaming up with somebody - may be from CES if we can locate *an* interested person *f* to look into these matters. If required we can write it up as a small project and find some funds for it. There are lots of reasons for looking at Traditional Iron and Steel processes afresh - I will give you the report of our project when I meet you. For the present I am enclosing a three page summary based on the first phase of the project that we have completed.

Centre for Indian knowledge systems



No.2, 25th east street, Tiruvonmiyur, Madras-600 041. Ph:415909.

23rd February 1994

Dr. Niranjan Joshi
Centre for Ecological Science
Indian Institute of Science
Malleswaram
BANGALORE - 560 012.

Dear Joshi,

Thank you very much for getting the material xeroxed. I have received it from Darshan Shankar. I am quite sorry that my trip had been pre-poned due to reasons beyond my control and for the inconvenience caused to you.

Kindly send me a reprint of the following paper -
Joshi, N.V. and Gadgil, M. 1991. On the role of refugia
in promoting prudent use of biological resources.
Theor. Popul. Biol. 40: 211-229.

With best wishes,

Yours sincerely,

A.V. Balasubramanian.

AVN
could you
pl. do
this next
week?
Thanks
NVJ

Sw
28/2/94

अन्तर्देशीय पत्र कार्ड
INLAND LETTER CARD



Dr Manayam Jushi
Centre for Ecological Science
Indian Institute of Science
Mallawaram
BANGALORE 560012

Third Fold तीसरा मोड़

भेजनेवाले का नाम और पता

Sender's Name And Address

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PIN CODE

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BANGALORE - 560 012
Mallawaram
Indian Institute of Science
Centre for Ecological Science
Dr. Manayam Jushi

Dear Jushi,

I have received it from Dr. Manayam Jushi. I am very glad to hear that you have received it from Dr. Manayam Jushi. I am very glad to hear that you have received it from Dr. Manayam Jushi.

First Fold फर्ला मोड़

First Fold फर्ला मोड़

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INVESTIGATION INTO INDIGENOUS TECHNIQUES OF METALLURGY WITH SPECIAL REFERENCE TO IRON AND STEEL TECHNOLOGY

SUMMARY

OBJECTIVE

The objectives of this project were to -

1. Make a survey of literature relating to this area
2. Undertake field surveys to locate artisans who have a knowledge of the process of Traditional Iron and Steel making and
3. Reconstruct and characterise the traditional process both under field conditions and in the laboratory.

LITERATURE SURVEY

The survey of literature reveals that -

1. Indian Iron and Steel has been famous at least since the Roman times and exported to several parts of the World till the Eighteenth century.
2. The Traditional process of Iron and Steel making suffered a decline after the Eighteenth century due to various reasons including - extensive deforestation, levy of repressive taxes under the colonial rule and loss of control of the local community over the forest resources.
3. Various attempts to reproduce the superior Indian Steel and discover its "secret" had been made in England, France and Russia since the Eighteenth century and these efforts continued in Russia till the turn of this century.
4. Traditional Iron and Steel making and studies on it receded into the background during the end of the Nineteenth century.
5. Recently there has been a revival of interest in Traditional techniques of Iron and Steel making due to a number of reasons (outlined later).

FIELD SURVEY

The highlights of the field work are summarised as follows -

1. A detailed survey was taken up in Tamil Nadu. It revealed that there were no artisans today who have a living knowledge of the smelting process and it appears to have ceased around the turn of the century. Many families of Traditional Iron smelters are now engaged in Ironsmithy, reworking scrap Iron etc. Heaps of slags and crucibles are scattered widely in hundreds of villages all over the state.

2. In Kerala, preliminary field work enabled us to identify Mallapuram as a prospective area to locate artisans. A detailed survey of Mallapuram resulted in locating several artisans who were part of teams that were involved in smelting Iron as recently as forty to fifty years back.
3. Selected localities in Karnataka in the Mysore District and around Bangalore were surveyed. While no artisans could be found who have a knowledge of smelting, it was observed that the town of Chennapatna which was famous for producing Steel wires (used as strings in the Veena) had still at least one member of a family which was practising this art, till recently.
4. A visit was made to Ghatgaon village in the Raigad district of Madhya Pradesh - this is a rare instance known to us of a village where artisans are still smelting Iron in an unbroken tradition continuing to this very day. The Iron smelting was observed and recorded.
5. A visit was made to Bishunpur in the Gumla District of Bihar and the Iron reconstruction was observed and recorded.
6. A survey was undertaken in and around Varanasi in regions where Traditionally the Agaria tribesmen were smelting Iron. While no smelting was found to be in progress now, a number of artisans were located who have a knowledge of the Traditional Iron smelting techniques and who can reconstruct the furnace if suitable assistance is provided.

RECONSTRUCTION AND CHARACTERISATION

1. The Traditional furnace of the Malabar design was reconstructed at the Poonthavanam village in the Malabar district of Kerala. Several smelting cycles were performed but no significant amount of Iron could be recovered. The construction needs to be modified and improved.
2. A furnace of the Bishunpur design was reconstructed and the process characterised in collaboration with the Department of Metallurgy at the Indian Institute of Technology, Bombay. Several trials were performed and Iron was smelted. Various parameters could be studied including - effect of composition of charges, ore to fuel ratio, effect of airflow, addition of fluxing material etc.
3. A reconstruction of the small furnace of South Indian design was performed at Madras in collaboration with the Department of Metallurgy at the Indian Institute of Technology, Madras. In the preliminary trials the smelting was successful and iron could be recovered - but only in poor yeild. Trials need to be continued.

CONCLUSION

1. India has had a flourishing and widespread technology of Iron and Steel that was in existence till the Eighteenth century which declined during the colonial period.
2. Our survey reveals that even today there are artisans in Kerala State who have a living knowledge of this process and with whose help furnaces have been reconstructed.
3. Several communities of such artisans still exist in various other parts of India including Uttar Pradesh, Madhya Pradesh and Bihar.

4. The basic process of smelting can be reproduced both under field conditions and laboratory conditions to obtain the Iron.
5. Besides the smelting of Iron there are artisans who are skilled in a wide variety of metal working and metal shaping activities including - Heat treatment, production of Steel wires, production of metallic mirrors, production of various tools and implements including agricultural tools etc.

RECOMMENDATIONS FOR FUTURE WORK

1. Field trials need to be continued at Kerala to reconstruct and characterise Iron by the furnace of Malabar design. Characterisation under laboratory conditions must be taken up both of the furnaces of the Bishunpur model and of the Tamil Nadu model to work out conditions under which Iron can be obtained in optimal yield and of satisfactory quality.
2. Characterisation of other metal shaping and metal working operations such as - production of metallic mirrors, production of Steel wires, processes used for metal shaping, metal forming, heat treatment and other such procedures need to be studied in detail.
3. Field work needs to be undertaken in various other States on a larger scale to locate artisans who have a living knowledge of this process so that they can form the nucleus for future efforts.
4. Attempts should be made to produce the Traditional Indian Wootz steel with the help of our artisans.
5. A techno-economic survey should be taken up in selected areas to find out the spectrum of Iron and Steel articles currently in use, uses that they are put to as well as Traditional metal working artisans in terms of their numbers and types of skills that they have.

THE IMPORTANCE AND FUTURE PROSPECTS OF THIS LINE OF WORK

There is a World-wide revival of interest in reconstructing and characterising Traditional Iron making and particularly Traditional Indian Iron and Steel making. It is significant that at present there are at least three different laboratories just in United States of America where efforts are in progress to reproduce Traditional Indian Wootz Steel. Study of Traditional metallurgy opens up the following possibilities -

1. The setting up of decentralised cottage scale Iron smelting industries.
2. Production of alloys that have certain special properties such as - corrosion resistance and superplasticity.
3. The possibility of evolving a technology starting from the Traditional process that makes optimum use of our own resources - not only of the ores and fuels but also the knowledge of our artisans and
4. The use of the Traditional skills of our artisans in the modern as well as the Traditional sectors to suit today's needs.