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*for a sustainable future*

## OCCASION

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12 November 1990  
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JUTE RESEARCH AND DEVELOPMENT

DP/IND/86/037/11-01

INDIA

Technical report: (Seventh mission)\*

Prepared for the Government of India  
by the United Nations Industrial Development Organization,  
acting as executing agency for the United Nations Development Programme

Based on the work of R.R. Atkinson  
Chief Technical Adviser

Backstopping officer: J.P. Moll, Agro-based Industries Branch

United Nations Industrial Development Organization

Vienna

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\* This document has not been edited.

V.90-69331

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## INTRODUCTION

As the project enters its last stages a considerable amount of work remains to be done. Some aspects of the project are going well but others are being retarded by external circumstances. The Report gives a brief summary of the progress which has been made in each Output, then goes on to deal in more detail with the UNDP/UNIDO inputs of equipment, Fellowships, Experts and Contracts. The mission lasted from 18 August to 19 September, 1990.

OUTPUT I

FIBRE PREPARATION PROCESS

1. Enzyme Plant

Progress with the plant has slipped by a further 4 months due to the late completion of building work. The completed building was expected about May originally but it now looks as though it will be Oct/Nov before it is finished. Local labour problems have caused the contractor many difficulties and these have not been fully resolved yet.

This being so, the plant cannot be expected to be operational until Dec/Jan. One of the first jobs to be done is to prepare enzyme and check it thoroughly. It is doubtful if the mills will be receiving enzyme much earlier than February 1991.

Discussions were held with the microbiologists on an ultra-filtration process which would concentrate the enzyme. There is some doubt that this could be beneficial but it was emphasised that such thoughts were secondary to the main task, namely to get the plant up and running. The Expert, whose visit coincided with that of the Technical coordinator, who has had practical experience of starting up a similar plant reiterated his opinion that day-to-day snags would be manifold and sufficiently taxing without adding further processes at this point of time..

The Biology Division is supplying six mills from the small lab-scale plant at IJIRA and requests for more enzymes are being received from the mills. The priority therefore is to get the plant working - modifications and fine tuning can come later.

The Expert, Dr. Wood, has, in my opinion a most constructive part to play in this activity and he should be invited to return to IJIRA for 2-3 weeks in 1991 when the plant will be working.

The Fellowships have both been completed.

The equipment (being made in India) is partly delivered and the remainder will be ready in time for erection at Kinnison Jute Mill.

Some anxiety has been expressed by the Central Food Technology Research Institute (CFTRI) where the plant was designed about a possible health hazard and the scientists there have recommended additional filtration points to contain the spores during manufacture. In view of the sensitive nature of the labour relations at Kinnison, it is strongly recommended that all these precautions should be taken. (See also the second mission report of the Expert, Dr. B. Wood on this point).

## 2. Biomodification by tamarind Kernel Powder

Tamarind kernel powder (TKP) is used as a sizing agent on warp yarn preparatory to weaving. The same enzyme, *A. terreus* used

for fibre softening can modify the TKP paste in such a manner that substantial savings in steam can be made during its preparation. This is an interesting and most worthwhile additional use of the enzymes which will be made. Work continues in this field.

### 3. Chemical Softening of Jute

A technical report on the work which has been completed at Reliance Jute Mill and JK Jute Mills has been edited to a form suitable for mill personnel. This Technical Note is almost ready for dissemination. It will contain costings which show the benefit of using this technique. The follow-up should, in the writer's opinion, be a positive one emanating from IJIRA, rather than relying on reaction by the mills. Local visits and short seminars etc may yield results. IJIRA should have enough confidence in the technique to "sell" it to the mills.

The behaviour of some other chemicals is being examined but full scale mill trials have been hampered by the production pressures on the mill where the work is being done. This work will continue on an ad hoc basis.

In essence, the development work for this aspect of the output is virtually completed and it is recommended that the next visit by the Expert should be his final one. The remaining 10 months of the project's life should be devoted to extending the use of chemical softening in the industry.

OUTPUT II

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PRODUCT DESIGN AND DEVELOPMENT

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1. Ultrasonic Bonding

Development work carried out by the Fellows at Clemson University, South Carolina, has revealed that this technique is not suited to jute and this work has been terminated.

2. Micro-crimping

At Clemson, the Fellows are working on Micro-crimping, a method whereby yarn or cloth may be given a softer, bulkier appearance. Both these factors could be beneficial for certain diversified products.

3. "Supersod"

This is an American product, which is, in effect, a pre-seeded mat which is rolled out to make an "instant" lawn.

Attempts were made to make this in one of the mills but it was found that no suitable grass seeds were available indigenously.

4. Jute mulch

Jute fabric, basically a DW flour cloth, has been tried as a mulch for high value seeds such as tomatoes and papayas. Germination and early vegetative growth were improved due to moisture retention by the mulch, coupled with protection from



heavy rain splash, bird attack and sun-scorch. Jute mulch is related to geo-jute (see later).

#### 5. Cotton bale covers

A spirally -sewn 7 oz. jute hessian is being looked as a possible way to recapture some of this market which has been lost to polyolefin materials.

#### 6 Yarn blends

Development work on blends of jute with viscose, nylon, polyester etc. has come up against the problem of price.

Technically, blending is quite straightforward but the intersecting gill-box (sited at Birla Jute & Industries) has not brought about the more intimate blend which was hoped for. The quality of the blend is no better than that achieved on a conventional open gill jute drawing frame. It is however a high output machine and is being used to produce all jute yarns for decorative fabrics and floor coverings.

The economics related to the technical properties of these blended yarns are not good. For instance, viscose (the cheapest blending fibre available) costs about Rs.34/- per kg. in top form. Good grade jute in tops cost about Rs.10/- per kg. From drawing to spinning adds Rs.10-15 to the price of a 5 lb yarn (170 tex). The prices of various blends are shown below :

<u>% Jute</u>	<u>% Viscose</u>	<u>Yarn costs, Rs./Kg.</u>
100	-	20-25
90	10	22-27
80	20	25-30
70	30	27-32

In blends with up to 20 or 30% of "other fibre" the yarns have no great technical or aesthetic superiority over all jute yarns despite the increase in cost.

When one is trying to enter a market held by cotton yarn, selling at about Rs.25-30/- per kg. unless there is some special merit in the blended yarn, the chance of success is slim.

It is interesting to note that the same conclusion was reached in the UNIDO- executed IJO blended carpet yarn project GLO/87/003. One must have a very high percentage of "other fibre" before one sees a real improvement over all jute yarn and then the cost becomes prohibitive.

#### 7. Union Fabric (curtains, upholstery, luggage )

Work has continued to promote the use of all jute yarns in handlooms, chiefly as weft. The National Handloom Development Corporation, with the Jute Manufacturers Development Corporation and IJIRA has organised workshops in different parts of India, with live demonstrations of weaving and dyeing and bleaching by IJIRA staff to popularise jute as a yarn offering good properties at an interesting price of 15%

cheaper than cotton. At retail levels a jute/cotton fabric comes in at Rs. 27-35/- per m compared to Rs.30-40/- per m for all cotton.

The volume of yarn which this end use may ultimately consume is not large. For example, 100,000 m of curtain fabric needs in the region of 24 tonnes of jute weft. In jute terms this is not a lot; a small fine yarn unit with, say 12 modern spinning frames will produce this quality in 4-5 days. The writer's view is that development in this direction will only benefit those mills which are technically sound, have good quality concepts and commercial flair.

#### 8. Denim fabric

Some work has been done with jute weft in leisurewear (jean) fabric. The cloth is a 3/1 warp-faced twill in which the jute weft is well hidden. The fabric comes out some Rs.10 per m cheaper than all-cotton. Samples of this cloth were available and had a very good appearance and handle.

#### 9. Floor Coverings

1000 tex (30 lb) yarn has been tried as pile in hand-tufted floor-coverings for the home market. Alternate tufts of jute and coarse wool are used.

#### 10. Jute reinforced plastics

As studies continue of the technical and economic parameters

of jute tea-chests as alternatives to plywood chests it is emerging that cost-wise the picture is not too good. Unless the Government intervene in some way to discourage the use of plywood so as to reduce deforestation, it would appear that jute reinforced plastic tea chests will hold few attractions to the user because of price.

The ongoing programme for developing and field testing of several thousand reinforced jute fruit boxes is to be extended into 1991 in co-operation with JMDC and the local authorities in fruit growing areas. A workshop will be organised to popularise these products in Uttar Pradesh.

As an off-shoot, the use of jute/plastic materials in garment and footwear boxes is being examined.

The development work is now centred on using thermoplastics, mainly polyethylene, to produce "mouldable" products. The impending research contract at Harwell Laboratories UK will enhance these developments by optimising processing methods, producing corrugated sheets and the conversion of mouldable jute into various containers.

Earlier work with thermosetting resins has attracted the attention of some Indian laminators who are now trying jute in full-scale production of decorative panels. Jute offers a good price advantage coupled with adequate technical properties.

Most of the work done so far has been with jute cloth as the

basis for these composite materials. Jute felt, however, seems to offer benefits in price as well as ease of moulding.

The Phase II research contract with Harwell Laboratories UK is in course of finalisation. It lasts 9 months, so to derive benefit from it, an extension to the project will be needed.

#### 11. Geo textiles

The project has prepared three sites using jute as geotextiles for combating soil erosion and in June of 1990 an Expert's visit was made by Mr. James Thomson. He made a tour of several sites in India and held discussions with engineers and government officials. The crux of his report with which the writer agrees, is that there could be a substantial market in India for jute geotextiles of various kinds. However, the opinion of the project staff, which the writer endorses, is that the recommendations of the Thomson report are too general and do not take due account of the local conditions and the needs of this development.

Within the confines of cost and time of the present project there is little possibility of a significant attack on this market and it would seem logical to extend the project in this field. To this end it is planned to have a visit from an Expert, not to go over the same ground as Thomson, but to devise a work plan with the required inputs, for geojute.

The desired candidate is Dr. Ramaswamy of Singapore University (His description and CV are given in the Appendix to this report).

OUTPUT III

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INSTRUMENTATION

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The Project Workshop for on-line control instruments has now supplied 13 autolevellers to the Mills and has orders in hand for 21 more. The staff welcomed the useful comments made by the Expert Mr. A Campbell, and wish him to return for 2 months from 1st January 1991.

The two Fellowships have been fruitful. Campbell, in his mission report, noted that Mr. R.K.Mukherjee had the potential for overseas study for a high degree. It was explained that neither the Project nor UNDP could help but British Council (or the equivalent in some other country) may be of some assistance but the decision would lie with the Director of Research.

The Expert has completed two missions and his third mission is being organised.

OUTPUT IV

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PRODUCTIVITY AND CONSULTANCY SERVICES

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The preliminary studies which were recommended by the Expert , Mr. G Haines, have been made at Birla Jute and Industries Ltd., Union North (National Jute Mills Corporation) and India Jute Mills Ltd. and a report was sent to each mill. Birla took the matter further by way of a deeper investigation of the production techniques in their mill. Two local experts (Sahoo and Chowdhury) are working in the mill and their findings are expected shortly. After Birla they move on to Union North.

These activities are taking longer to complete than was expected because of the volume of work required in the mills.

IJIRA's Inter-Firm Comparison (I.F.C.) of spinning productivity levels has been operating for a considerable time now and, under this Project activity the I.F.C. is to be extended to cover weaving.

Unfortunately, work has yet to start. A Systems Analyst is on site, an assistant is to be recruited but the hold up has been the decision not to start work until a special room is ready for the computers, printers and ancillaries. September is the estimated date for completion of the room. It is hoped that, with the experience of the spinning I.F.C. behind them, the

staff will be able to produce worthwhile output by the end of June 1991.

The Expert, Haines, should return in 1991 when at least 2 in-depth mill studies are completed and the I.F.C. for weaving is well on its way. The project should notify UNDP/UNIDO when Haines is required.



OUTPUT V

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MARKET RESEARCH AND INFORMATION UNIT

Throughout the Project this output has come up for discussion and the decision about its implementation has always been deferred. Now a decision had to be made.

After consultation the NPD and Technical Coordinator agreed that the need for this activity has disappeared.

Originally, it was felt that to derive the most commercial gain from diversified products it would be beneficial to have some expertise of marketing. However during the last year IJIRA's development work, chiefly in the hand-loom sector, has attracted considerable interest in Government circles. As a result several national agencies are now promoting jute in new markets by means of trade shows, seminars and practical demonstrations. These efforts have eliminated the need for IJIRA to develop a marketing cell. This activity/output will, it is recommended, be dropped.

FELLOWSHIPS

The last two fellows finish at Clemson in December. One 6-month fellowship is held in case it is required in geotextile uses of jute. The decision on this will be taken after the Expert's visit in Oct/Nov.

It has been agreed that no fellowship in Industrial Engineering is required since the national consultant in this discipline is able to give all the training required.

The Harwell Contract includes 2 x 3 months Fellowships.

**EQUIPMENT**

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Order 15-0-0778Y has been placed for the Padding Mangle and Vertical Dryer with delivery by June 1991.

Requisition 90/1 (Stork Calender is under negotiation with PAC.

EXPERTS

After lengthy discussions it was agreed that the man-months for Experts should be changed. The recommendations are shown below:

POST 11-03 CHEMICAL SOFTENING

Since work on this activity is nearing completion, the visit of Dr. PK Chatterjee for 1 month December/January should be the concluding one. This releases 2 man-months from Budget 'H'

POST 11-06 MARKETING

This post was included in the project so that marketing expertise could be used to promote the use of jute in high value products, especially decorative materials. The Government of India has recently taken a great interest in promoting jute/cotton fabrics through seminars, exhibitions, and demonstrations under the auspices of the Jute Manufacturers Development Council, Ministries of Textiles, Handloom and Urban Development, Ministry of Social Welfare and Rural Industries and others. In the light of this interest it is felt that the marketing post is no longer an essential part of the project. The post should be deleted. This releases 4 m/m.

POST 11-09 JUTE REINFORCED PLASTICS

This post will now be absorbed into the Harwell Contract.

**POST 11-10 INDUSTRIAL ENGINEERING**

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The allocation of 2 m/m for this post has already been used up but another man month is required to complete the work which has been started.

**POST 11-12 TEXTILE TECHNOLOGY**

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This post is being jointly held with Post 11-05, Fabric Engineering, Dr. Goswami being the selected candidate. He has only been to IJIRA for 1.5 months, with a further 1 month planned for Dec/Jan. There are therefore 3.5 months still available and it is clear that these will not all be used. 1 m/m may be transferred to Post 11-10 (see above).

**POST 11-13 TEXTILE CHEMISTRY**

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The next visit should be the concluding one releasing 0.5 m/m.

**POST 11-14 PACKAGING**

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Discussions have been held with the Indian Institute of Packaging but they are unable to provide an Expert under arrangements suitable to the project. It is therefore desired that UNIDO try to assist in identifying a suitable person. The Job Description will be found in the Appendix to this report.

To summarise, these changes are now shown against the previous plan.

POST	BUDGET 'H'	REVISION	USED AND PLANNED TO 31/12/90	BALANCE FOR 1991
---	-----	-----	-----	-----
	(1)	(2)	(3)	(2-3)
11-01 Tech.Coord	12.0	12.0	9.0	3.0
11-02 Enzymes	3.7	3.7	2.5	1.2
11-03 Chem soft	5.0	3.0	3.0	-
11-04 Inst.design	4.0	3.5	3.5	-
11-05 Fabric Engg.	3.0	3.0	1.5	1.5
11-06 Marketing	4.0	-	-	-
11-09 Jute/Plastics	2.7	-	-	-
11-10 Ind.Eng	3.5	4.5	3.5	1.0
11-12 Tex.Techn	3.0	2.0	-	2.0
11-13 Tex.Chem	3.5	3.0	3.0	-
11-14 Packaging	2.0	2.0	2.0	-
11-50 Geotex/Misc	4.0	4.0	1.5	2.5
	-----	-----	-----	-----
	50.4	40.7	29.5	11.2

These recommendations release 9.7 man months (50.4-40.7) valued at about \$97,000 at today's rates which may be transferred to other budget lines as explained later.

**PERSONNEL**

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**POST 11-13 TEXTILE CHEMISTRY (BLEACHING & DYEING).**

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To have a wider exposure to expertise in dyeing and bleaching, the project staff will shortly identify a new Expert for one visit of one month. The Head of Division should make his selection as soon as possible and supply UNIDO with CV and dates of appointment.

**POST 11-14 PACKAGING**

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IJIRA have no candidate in mind and hope that PPRB may have an Expert's name in their files. The Job Description will be found in the Appendix.

**POST 11-50 GEOTEXTILES**

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Dr. Ramaswamy is the preferred candidate. His Job Description and CV follow in the Appendix.





CONTRACTS

The only contract in the Project is at Harwell Laboratories, U.K. on jute reinforced plastics. This is the second contract on the subject to be done at Harwell. Terms of reference are ready and the decision has been taken to include the Expert's visit in the contract itself. In the same way the bench fees for the Fellowship are included in the contract. The project will bear the cost of travel and DSA for the Fellow.

Harwell Contract

The financial situation is as follows:

Budget "H", Line 29-99, Contracts		\$ 132000
Expenditure to 31/05/90		\$ 60000
Balnace		<u>\$ 72000</u>
<u>Contract</u>		
Institutional fee	\$ 88700	
Expert's fee	\$ 22600	
Air fare	\$ 3000	
DSA	\$ 2000	
	<u>\$ 116300</u>	
Deficit		<u>\$ 44300</u>

This deficit can be countered by Budget Line transfers (see later).

**PROGRESS OF BUILDING PROGRAMME**

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All along, the project has been dogged by late inputs of premises for equipment at IJIRA itself and at the mill pilot plants.

Despite continued pressure by the NPD the lengthy time needed to get permission to build has seriously held back progress. Equally, contractors have been slower than anticipated and have repeatedly fallen behind schedule.

The position at the various sites is :

- |   |   |
|---|---|
| (a) Labs at IJIRA.                              | All permits now obtained; tenders received; work expected to start shortly. Hopefully these labs will be ready for use in six months. |
| (b) Site for Enzyme Plant at Kinnison.          | Still under construction; expected to be finished in Oct/Nov.   |
| (c) Site for Bleaching and Dyeing, India Jute.  | Shell of building available; no internal work started; completion date?   |
| (d) Site for Bleaching and Dyeing, Birla Jute.  | Completed and operational; Slippage of some 3 months.   |
| (e) Site for intersecting gill box, Birla Jute. | Completed and operational; Slippage of some 3 months.   |
| (f) Site for Bleaching and Dyeing, Anglo India. | Complete, partially operational.  |
| (g) Site for reinforced plastics, BJEL.         | Complete and operational.   |

BUDGETS

The implications of those proposed changes on Budget "H" are as follows:

011-019	Personnel	: \$ 538636 x 40.7 =	\$ 434970	Note 1
		-----		
		50.4		
011-029	Contracts	: \$ 13200 + 43800 =	\$ 175800	Note 2
011-039	Training	: \$ 310600 x 78 =	\$ 336483	Note 3
011-049	Equipment	: \$1547823	\$ 1547823	Note 4
011-059	Misc	: \$ 17275	\$ 172775	Note 5
		-----	-----	
		\$2546334	\$ 2512351	

Note 1

The m/m of experts to be redced from 50.4 to 40.7 Expenditure taken in proportion.

Note 2

The additional cost is explained in Contracts.

Note 3

An extra 6 m/m has been allowed for a Fellowship in geo technical studies for geo jute.

Note 4 and 5 No change

The new budget arising from these changes is within 1.5% of the original and, in fact, some \$ 34000 are still available for any contingencies.

APPENDIX

DP/IND/86/037 - POST 11-14

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PACKAGING DESIGN  
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POST TITLE : Packaging Consultant  
DURATION : 2 Months (One Mission)  
DATE REQUIRED : As soon as possible  
DUTY STATION : Calcutta with the possibility of travel within India and U.K.

PURPOSE OF THE PROJECT : To strengthen the Indian Jute Industries Research Association (IJIRA) so that it may encourage diversification and product development in the Indian jute industry. This post refers specifically to the use of jute reinforced plastic materials as the raw material for box and carton fabrications, especially where wood and plywood are currently used.

DUTIES : The Expert will

- a) study the properties of jute reinforced plastic sheet made with thermosetting resins and thermoplastics materials by IJIRA technologists with reference to their use in box manufacture.
- b) meet the scientists of Harwell Laboratories (UK) who have carried out a research contract for IJIRA on jute reinforced materials and discuss the implications of their work as far as box making is concerned. This meeting will be held in India or in the UK depending upon timings.
- c) design boxes for various commodities to take account of the properties of the base material, the load to be carried and the manufacturing capabilities available in India.
- d) arrange for tests and field trials on such boxes
- e) prepare a Report on his work

QUALIFICATIONS : Degree/Diploma in science or technology coupled with practical development experience. Experience of working in developing countries would be an advantage.

LANGUAGE : English

DP/IND/86/037 Post 11-50

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GEOTECHNICAL ENGINEER  
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- POST TITLE** : Geotechnical Engineer
- DURATION** : 4 weeks
- DATE REQUIRED** : As soon as possible
- DUTY STATION** : Calcutta with some travel within India
- PURPOSE OF PROJECT** : To strengthen the R&D activities of the Indian Jute Industries Research Association (IJIRA) so that it may encourage diversification and product development in the Indian Jute industry. This post refers specifically to the development of jute materials as geotextiles to be used in India with particular attention to the material's use in areas of soil erosion.
- DUTIES** : The Expert shall:
- a) review the work IJIRA has begun, making site visits and having discussions with engineers as required.
  - b) make an assessment of the role which jute materials may play in this market.
  - c) in the light of (b), suggest a programme of development with a work plan, timetable and necessary inputs.
- QUALIFICATIONS** : Academic qualifications in Civil Engineering are required with extensive research experience coupled with evidence of successful field work. Experience of operating in developing countries is essential.
- LANGUAGE** : English

1. Name : SALEM DORESAMIEN RAMASWAMY

2. Date of Birth : 30 July 1933

3. Marital Status: Married with 4 Children

4. Status : Permanent Resident of Singapore  
(Resident in Singapore since June 1970)  
Non Resident Indian citizen

5. Qualifications: B.Sc (Mysore University 1954)  
B.E. (Civil Engineering, Mysore Univ 1958)  
M.E. (Soils & Foundations, Indian Institute  
of Science, 1960)  
Ph.D (Soil Mechanics, Czechoslovak Academy  
of Sciences, Prague 1965)

Honorary Degrees: Doctor of Technical Sc.  
Doctor of Science

6. Fellowships & Memberships :

Fellow : Institution of Engineers of India  
----- Indian Geotechnical Society  
Institution of Engineers of Singapore  
American Society of Civil Engineers

Member : International Rock Mechanics Society  
----- International Geotextile Society  
International Society of Soil Mechanics and  
Foundation Engineering  
International Association of Engineering Geologist  
Southeast Asian Geotechnical Society

Professional: Registered Professional Engineer (Singapore)  
----- Chartered Civil Engineer (India)

7. Publications: Over 150 publications in International Journals  
and International Conference Proceedings in the  
areas of Geotechnical Engineering, Geotextiles,  
engineering Geology, Pavement Materials, Waste  
Materials etc. (a full list of publications is  
enclosed)

8. Awards: American Society of Civil Engineers Construct-  
ion Prize 1982  
International Contractors Association  
Foundation Research Awards 1979 and 1982  
Indian Geotechnical Society Best Paper Award  
1982

- PATENTS :** Holding UK Patent and Singapore Patent on Jute Fibre Drain. Patent pending in Japan. Negotiations are underway for patenting in India.
- CONFERENCES:** Attended about 30 conferences all over the world either as a speaker to present paper, invited panelist, chairman or keynote speaker.
- Organised several regional and international Conferences as Chairman of Organising Committee
- Currently, Chairman of Organising Committee of 5th International Conference on Geotextiles, Member of Technical Committee of 7th Road Engineering Conference of Asia and Australia
- CONSULTANCY:** Acted as consultant in the areas of Foundation Geotechnics, Geotextiles, Material etc in India, Singapore, Malaysia and Indonesia. Several projects have been tackled since 1970.
- EXPERIENCE:** 1960-1970 - Lecturer/Assistant Professor at Coimbatore Institute of Technology, Coimbatore India-Teaching, Research and consultancy
- 1970-1990 - Associate professor at the National University of Singapore-Teaching, Research and Consultancy.
- PRESENT INVOLVEMENTS:** Council Member, International Geotextile Society, Corresponding Member, Indian Roads Congress, Corresponding Member, International Navigation Congress, Belgium, Committee on Natural Geotextiles, Chairman, Organising Committee, 7th International Conference on Geotextiles, Member, Technical Committee, 7th Road Engineering Conference of Asia and Australasia, Deputy Chairman, Committee on Code of Practice of Earth Works, Singapore Institution of Scientific and Industrial Research, Etc.etc,...

**ACTIVITIES IN THE AREA OF GEOTEXTILES**

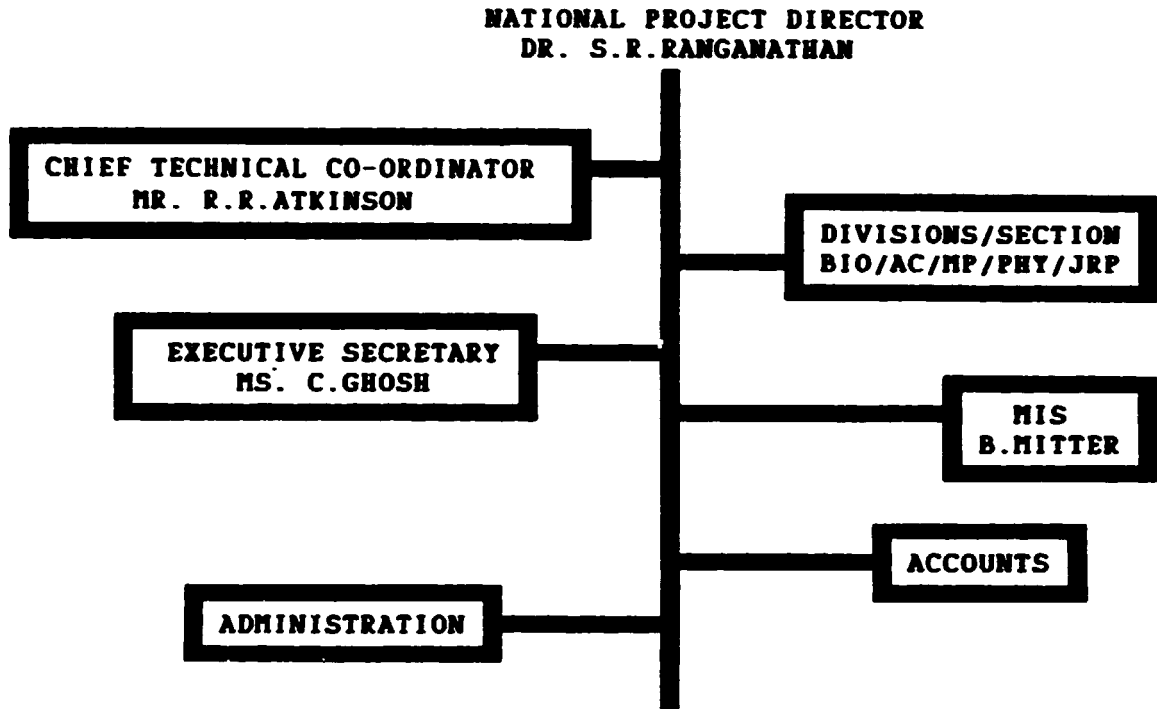
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1. **President, Southeast Asian Chapter of the International Geotextile Society,**
2. **Chairman, Fifth International Conference on Geotextiles, Geomembranes and Related Products, Singapore, 1994**
3. **Council Member, International Geotextile Society,**
4. **Adviser, Editorial Board, Geosynthetics World Journal, International Thomson Publishing, London,**
5. **Chairman, Post-Vienna Conference on Geotextiles, Singapore, 1987**
6. **British Patent : Holder of British Patent on Febredrain- a prefabricated drain made of jute and coir for drainage of soils,**
7. **Singapore Patent : Patent holder in Singapore on the above British Patent,**
8. **Utility Model : Above patent is being registered as an Utility Model in Japan- in Processing stage.**
9. **Chairman : Session on Geotextiles for Roads, 4th International Conference on Geotextiles etc, Vienna, 1984.**
10. **Invited Speaker at Geotextiles Conferences in Singapore, Malaysia, India, Indonesia and United Kingdom.**
11. **Publications : Published several papers on geotextiles including jute geotextiles in several International Conferences. About 10 papers are published in the area of geotextiles out of a total of over 150 plus papers concerning geotechnical engineering, foundations, waste materials, road materials, pavement engineering etc.**



**PROJECT ORGANIZATION CHART**

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**BIO : BIOLOGY**

**AC : APPLIED CHEMISTRY**

**PHY : PHYSICS**

**MP : MECHANICAL PROCESSING**

**JRP : JUTE REINFORCED PLASTICS**

**BIOLOGY DIVISION**

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**FABRIC ENGINEERING/GEOJUTE**

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INDST. ENGG.**

**R.S. KRISHNAN  
TEXT. TECH**

**D. ROY  
TEXT. TECH**

**S.M. GHOSH  
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**P.K. CHATTERJEE  
JR. TEXT. TECH.**

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**MRS. C. ROY  
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**MRS. A. BHATTACHARYA  
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**JUTE REINFORCED PLASTICS SECTION**

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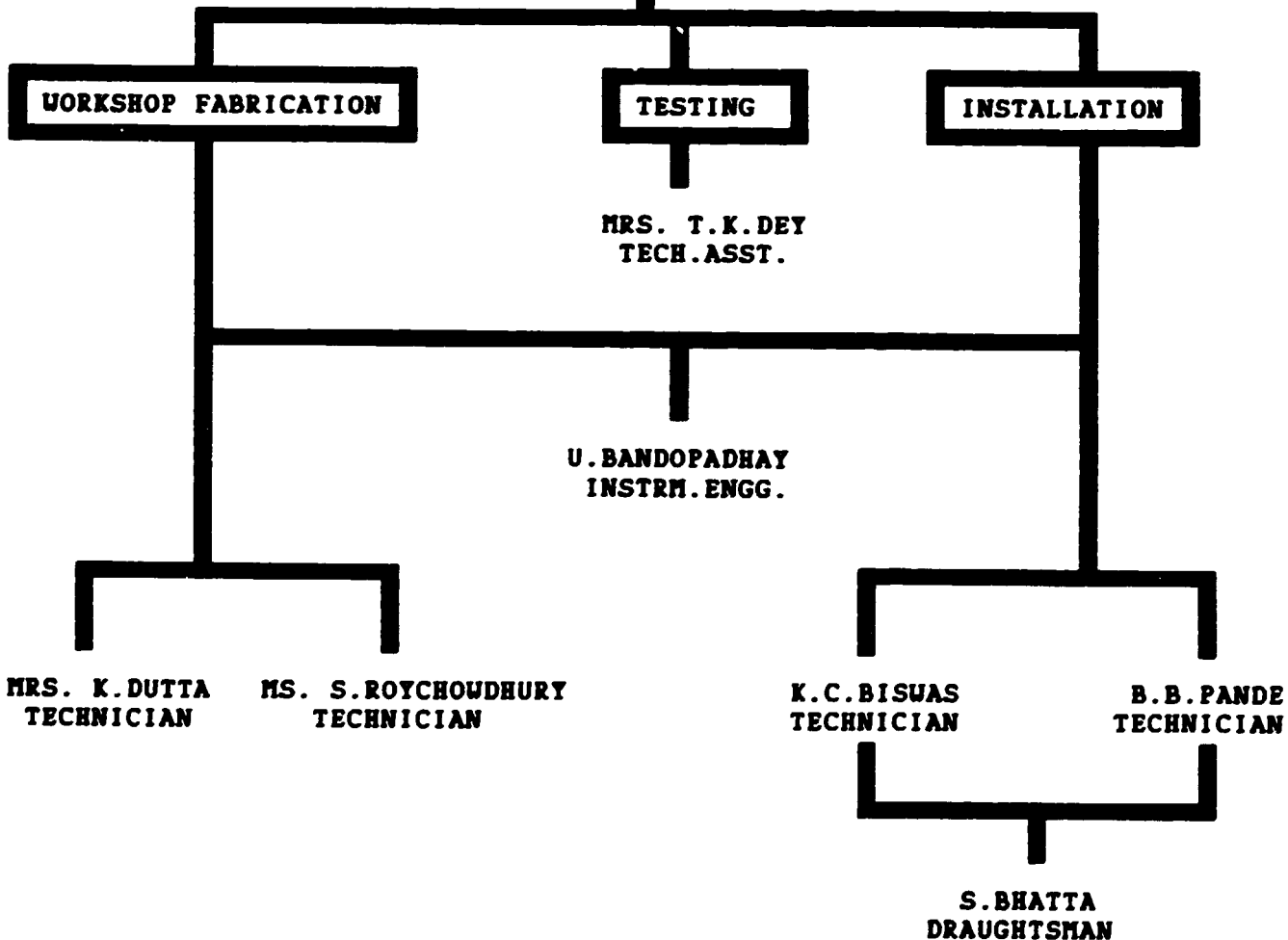
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**ACCOUNTS DEPARTMENT**

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**A.K.MOITRA  
ACCOUNTS ASSIST.**

ADMINISTRATION DEPARTMENT

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