

**BANGLADESH AGRICULTURAL RESEARCH PROJECT  
US-AID PHASE-II**

**ANALYTICAL EQUIPMENT AND INSTRUMENTATION**

**A CONSULTANCY REPORT  
BY  
W. RONALD CLAYTON  
CORNELL UNIVERSITY  
JULY 1982**



**BANGLADESH AGRICULTURAL RESEARCH COUNCIL**

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ANALYTICAL EQUIPMENT AND INSTRUMENTATION

Consultancy Report

by

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Cornell University

CONTRACT AID/388-0051  
(IADS/BARC)

**THE AUTHOR :**

Ron Clayton has worked 20 years in the area of instrumentation and equipment design with the Agronomy Department of Cornell University. At the same time, he has been busy designing and repairing equipment for other departments and programs in the University.

He has also offered a course for faculty and students on instrumentation selection and maintenance with emphasis for those individuals from developing countries.

The recent visit to Bangladesh reported herein was his first overseas assignment.

## ACKNOWLEDGEMENTS

Many people provided a great amount of assistance in my consultancy; not only in Bangladesh, but also in the office of International Agricultural Development at Cornell.

While in Bangladesh, Dr. Sam Portch was a most valuable resource not only for arranging and coordinating my visits, but also on many other levels. Of special value was his suggestion to hire Mr. Abdur Rajjak, a local consultant; to work with me. Mr. Rajjak is a Bangladeshi, trained in Budapest as an electronic engineer, and has a M.Sc. in Instrumentation. Mr. Rajjak is highly qualified and can continue to be a valuable asset to BARC, if they will contract him. He can act as a professional contact between BARC and their affiliated institutes, and myself.

At the same time, I wish to express my gratitude to a host of other scientists at the many government institutes who coordinated or worked with me during my consultancy.

Dr. David Daugherty, his IADS staff, and IPSU, are to be thanked for their logistic support.

## INTRODUCTION

The consultancy was set up for a six week period in order to visit most of the agriculture institutes to repair equipment, to evaluate status of other equipment, to make a list of part needs, and to initiate training on instrumentation.

This mission was largely completed. Details of the laboratories visited and status of the equipment are found in the appendix to this report.

Analytical instruments are often the backbone of an agricultural research project. However, care must be taken in their purchasing (to fit the actual need), installation, maintenance, and repair. Some recommendations are made in this report. These are considered essential to the operation of an analytical instrumentation facility at any institute. It is hoped by the author, that this report will receive widespread distribution. It is of particular importance that these recommendations be pointed out and their importance understood by institute directors and administrators so that financing can be obtained to implement them.

## 2.0 SCOPE OF WORK

The consultancy had five major phases:

- a. Repair of laboratory equipment.
- b. Evaluation of equipment from the point of view of replacement of items no longer worth repairing from an economical or obsolescence view point.
- c. Preparation of a list of needed components or parts and follow-up on the purchasing of these upon return to the USA.
- d. Instruction in equipment purchasing and installation, analytical techniques, diagnosis of problems, and repair and maintenance of equipment.

- e. Preparation of consultancy report that contains practical recommendations for improving the situation of analytical instruments in Bangladesh.

The visit was made possible by an arrangement between IADS and Cornell University with special consideration given by Dr. Robert Lucey, Chairman of the Agronomy Department at Cornell; without whose permission this assignment would not have been possible.

### 3.0 OBSERVATIONS

The first day of the consultancy was spent on orientation and organization. Visits were made to BARC, and BRRI at Joydebpur and to Technotrade Company in Dhaka.

The meetings with Dr. Badruddoza (BARI), and Drs. Zaman and Ehuiyan (BRRI) served to focus the expectations that BARC had of the consultancy. It was their opinions that not only should equipment be made operational, but instruction should be given to people at each location so they could understand how the equipment functions, diagnose problems, and make repairs where possible.

The visit to the BARI and BRRI facilities provided insight into the types of problems to be worked on.

The following three days and several subsequent days were spent at BARI (see itinerary Appendix I) where 27 pieces of equipment were worked on, with 22 being repaired. The remaining 5 need parts.

The initial work was done at the Soil Science Division with Dr. Islam and Kh. Majidul Hossain.

The model and serial number of each instrument was noted along with any required items described (Appendix II). This information will enable the ordering of necessary manuals, parts and supplies upon return to the USA. The necessary

items will be sent, and then installed by Mr. Rajjak or someone else.

On 10/3/83, a visit was made to BARI to Dr. Bhuiyan's laboratories. He suggested that Mr. Hossain assist so he could be instructed in the maintenance of the BARI instruments. Twenty-two pieces of equipment were worked on.

Again, a list of equipment including condition and required parts, was made for subsequent procurement and installation.

It was evident that rodents had done a great deal of damage to equipment. Some equipment, particularly those items with insulation material suitable for rodent nest building, were completely ruined.

It should be possible to have biological control in the form of cats since attempts at poisoning don't appear effective. It was not sure if zinc phosphide bait had been tried.

In some other laboratories such as at Mymensingh and Nathalari, electronic components on printed circuit boards were damaged by rats, necessitating replacement at a cost of hundreds of dollars.

In the library at BARI, a micro fiche reader was repaired and put into operation. Three individuals were instructed in the operation, adjustment and maintenance of the equipment.

As each instrument was serviced in the various institutes, people were encouraged to become familiar with the maintenance procedures so the equipment could be kept operational.

On March 14, 1983, a trip was made to Chittagong with Dr. Portch. Mr. Mallick of IADS did the local coordination and accompanied us to Hathazari.

Twelve pieces of equipment were serviced. Eight were repaired and the S.O. in charge of the laboratory was instructed in the operation and maintenance of these instruments.

The P.S.O. was interested in getting some refrigeration problems resolved and was going to ship the unit to Chittagong for repair. However, it was suggested that the repairmen bring the necessary equipment to Hathazari from Chittagong because of the high probability of developing a leak in shipment due to shock and vibration; particularly on the primitive road to the station.

For the Steinlite Moisture Tester, charts for oil seeds and pulses are needed. These will be obtained in the US and forwarded.

A microscope was assembled, and the S.O. instructed in its use.

During the visit to Hathazari it was noted that the laboratory environment was dusty and dirty. It is important that all

Cont'd-P/5.

instruments, if they are going to perform reliably, be kept in a location where they are not subjected to dirt, humidity, and abuse.

One other item worth noting at Hathazari was that an improper method was being used to weigh plant materials. The optical zero control was being used to tare weigh the bags, instead of the tare weight control. This introduced an error equal to two bag weights. This error is then multiplied by a factor to obtain a yield per hectare, giving erroneous information. The S.O. was shown how to properly operate the balance and was very pleased to receive the instruction. Wherever such a situation existed, attempts were made to speak to the S.O. on a one-to-one basis to avoid embarrassment. This technique seemed to work well because the S.O. was more receptive to suggestions, and did not lose the respect of subordinates.

Various days were spent at BJRI. Dr. Khan Majlis coordinated the work. A total of 18 pieces of equipment were worked on. Eight were repaired.

The laboratory under the direction of Dr. Khan Majlis and S.O. Mr. Phani Mondal was impressive from the point of view of cleanliness and orderliness; essential requirements of any analytical laboratory. Also, there was a very good understanding of the instruments and their functions. Other laboratories should observe the BJRI soils laboratory and use it as a model for cleanliness and orderliness.

Work was done in the Physics department where a Goodbrand Tensile Strength Meter was observed that had been received in damaged condition in 1981, and never worked. The control module was removed for shipment to the manufacturer in England.

A high vacuum system, used to dry jute to determine its true weight after all moisture has been removed, was checked. This instrument requires a new gauge that will be obtained from the manufacturer.

A Phillips oscilloscope showed a need for some transistors and a special transformer. An attempt will be made to locate and send these.

A Goodbrand Wrap Reel Model BG-18535 has a circuit problem that will require obtaining the manual to solve.

Also, an order for a Mettler UM 6. Microbalance manual will be made since it cannot be used until the operation is explained by the manual.

In the Botany Division, an Olympus Microscope Camera unit was put into operation. The device had not worked since it had arrived. They were pleased to have it operating.

On Sunday, March 20 a trip was made to INA at Mymensingh. The visit was coordinated by Drs. Habibullah and Luftar Rahman. The Jarrell - Ash Atomic Absorption Spectrophotometer in Dr. Habibullah's laboratory had been worked on by another group but was still not functioning. There were multiple problems. The only one not repaired at the time was the damage done by rodents to the printed circuit board. The board will be taken to the US, along with a LI-COR Leaf Area meter that is still under warranty and has never functioned.

Dr. Luftar Rahman was very anxious to have his Ortec Gamma counter repaired. A new photomultiplier was installed and the necessary adjustments made. The background level was checked. Dr. Rahman was pleased with the instrument's performance. He is now planning to submit a grant proposal which was not possible prior to the instrument being repaired.

Dr. Habibullah was also interested in having a new Laminar flow hood installed so the tissue culture work could be started. The necessary equipment was fitted and the hood's operation proved satisfactory.

A total of fifteen instruments were checked and appropriate information noted. Eight were repaired. Any parts or manuals needed will be ordered and shipped upon return to Cornell.

The visit to INA was followed by work for Dr. Syed Gheyasuddin in the Biochemistry Department of BAU. A centrifuge was put in service, a Mettler balance adjusted for accurate weighing, and the proper operation of a LabCon freeze dryer explained. Also examined were a pH meter, a colorimeter, an oven, and an IEC centrifuge. Necessary parts for these instruments will be ordered and shipped to BARC so Mr. Rajjak can make the repairs.

At both INA and BAU, people were assigned to observe the work being done so they could gain some insights and perform required maintenance in the future.

At least two days were spent at BARI in the Soil Science Division working on the Perkin-Elmer Atomic Absorption Spectrophotometer. This instrument had been delivered two years ago, and had not been put into operation. The necessary gases (acetylene and air) and pressure regulators were installed. The S.O. Mr. Majidul Hossain, was instructed on how to set up the instrument and run samples. Unfortunately, there continues to be some problems with sensitivity. A new tank of acetylene was ordered because the original was yielding acetone causing a reducing flame. Also, the methods manual was not available so that will have to be sent.

Also at BARI, a visit was made to P.S.O. Jahiruddin's laboratory in Agronomy to work on three Burrows ovens and a Yamato incubator. Also, a Mettler digital balance was checked in the laboratory next door. It had been damaged by connecting it to 220 volts rather than 110 volts. It will have to be taken to the US and repaired.

On March 29, 1983, a trip was made to Ishurdi to visit SRI and BARI. Mr. Ashraful Islam, P.S.O. (BARI), asked to have

all the equipment in the instrument room checked. The following items were put into operation and the S.O. Mr. Baduruddin, and Shahfiqur Rahman were instructed in their operation and maintenance. a) (2) Ainsworth balances, b) (2) Fisher pH meters, c) (2) Fisher Isotemp ovens, d) (1) Fisher hot plate, e) (1) Fisher centrifuge, and f) (1) Barnstead Still.

A Precision Scientific Co. Autoclave was delivered without a manual and some parts. These will be obtained and forwarded.

At SRI Md. Akber Ali Sarkar showed the instruments to be repaired. Parts are needed for the TOA pH meter, and these will be sent.

Md. Khaleduzzaman Chowdhury asked to get help with a Hach pH meter. He was shown how to isolate the problem. The electrode he needs will be ordered. For the Gallenkamp Muffle Furnace a manual and the necessary parts will be obtained.

A meeting at BARI (Ishardi) was held at 4 P.M., with the P.S.O. He wanted to extend the consultancy, but this was impossible because of the tight schedule. Furthermore, work was completed on all the laboratory instruments.

A two day practical training course was held at BARI on laboratory instrumentation. Topics covered and the course outline are in Appendix III. A list of participants and the institutes they represent are found in Appendix IV.

The remainder of the consultancy was spent in briefing and in report and documentation preparation.

#### 4.0 GENERAL OBSERVATIONS

In going from laboratory to laboratory at the different

institutes, certain observations were made as follows:

1. The enthusiasm and quality of the scientists is impressive.
2. The electrical outlets are so limited and in such poor condition, the instrumentation cannot be located where sample handling and flow would suggest.
3. Falling paint and dusty conditions make impossible the task of keeping the laboratory as clean and tidy as a hospital operating room. Sample contamination and instrument damage is the result.
4. Much of the electrical work performed by institute electricians did not meet the special requirements of laboratory instruments.
5. Illumination is below acceptable levels making accurate work impossible at times.
6. High humidity has caused severe damage to very expensive instruments.
7. Eye protection and eye wash stations are not available.
8. Laboratory coats are not available to prevent accidents caused by loose clothing while working around chemicals, flames and glassware.
9. Rodent have damaged much of the instrumentation to some extent.

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## 5.0 RECOMMENDATIONS

The following recommendations are made relative to the consultancy.

- 5.1 Interinstitutional training sessions should be held to teach scientific officers and other laboratory personnel new techniques as well as established procedures for doing analytical work. Sending scientists abroad is very costly and limited in scope. Perhaps this money would be better spent having a consultant or manufacturer's representative visit Bangladesh to teach dozens of people in a classroom/laboratory situation.
- 5.2 Monies made available through USAID for short term consultancies should be used to provide properly trained and qualified engineers for the installation and maintenance of laboratory instruments. It will take at least five years to develop this capability within the participating institutes and, in the interim, national and expatriates should be hired to fulfill this very important function.
- 5.3 Instruments must be located in an environment where humidity and dust are minimized. This could be achieved by an airconditioner and frequent cleaning (daily) of floors and work/storage areas.
- 5.4 Where possible, consolidate equipment to minimize duplication and the greater number of problems resulting from many instruments getting infrequent use and maintenance.
- 5.5 Encourage each laboratory supervisor to instill a sense of pride in his subordinates so they will take an active role in keeping their laboratory and its equipment clean and orderly.

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- 5.6 As additional scientific equipment is added to a laboratory, ensure that necessary electrical, water, gas, air and venting requirements are met.
- 5.7 Foster greater cooperation between laboratories and institutes by showing a willingness to share equipment and information.
- 5.8 Raise the level of awareness with regard to safety and health hazards in the laboratory through training and posters.
- 5.9 Develop a central purchasing unit coordinated by BAFC. This will facilitate ordering and expedite procurement of goods and services.
- 6.0 Enlist the services of nationals and expatriats to act as liaison between scientists and equipment suppliers. This would help fit the equipment to the application and avoid problems associated with having sophisticated specialized equipment that is not tailored to the necessities of the job. This would involve people in Bangladesh and the US, with frequent visits by the US based specialist to interface the application and the design and manufacture.

## APPENDIX-I.

ITINERARY: Mr. R. Clayton  
1983

<u>Date</u>	<u>Location</u>	<u>Description</u>	<u>Local Coordinator</u>
March 4	Dhaka	Noon Arrival	Drs. Daugherty and Portch
<u>5</u>	Gulshan Guest House	Briefing by Dr. Portch	Dr. Portch
6	Dhaka-Joydebpur	BARI-BRRI-Directors	Dr. Portch
7*	Joydebpur	BARI	Dr. Islam
8*	"	"	"
9*	"	"	"
10*	"	BRRI	Dr. Bhuiyan
11*	"	BARI	Dr. Islam
<u>12</u>	Dhaka	Weekend	Dr. Portch
13*	Joydebpur	BRRI	Dr. Bhuiyan
14	Hathazari	BARI	Mr. Mallick
15	"	"	"
16*	Dhaka	BJRI	Dr. Khan Majlis
17*	"	"	"
18*	Joydebpur	BARI	Dr. Islam
<u>19</u>	Dhaka	Weekend	Dr. Portch
20*	Mymensingh	INA	Dr. Habibullah
21*	"	"	"
22*	"	"	"
23*	"	BAU	Dr. Eaquab
24*	"	"	"
25*	"	"	"
<u>26*</u>	Dhaka	Weekend	Dr. Portch
27*	"	BJRI	Dr. Khan Majlis
28*	Joydebpur	BARI	Dr. Islam
29	Ishurdi	SRI	Dr. Shahjahan
30	"	BARI	Mr. Drew
31*	Ishurdi-Dhaka	BJRI	Dr. Khan Majlis
April 1	Joydebpur	BARI	Dr. Islam
<u>2</u>	Dhaka	Weekend	Dr. Portch
3*	Joydebpur	Course-BARI	Portch-Islam

<u>Date</u>	<u>Location</u>	<u>Description</u>	<u>Local Coordinator</u>
4*	Joydebpur	Course-BARI	Portch-Islam
5	"	BARI	Dr. Islam
6	Dhaka	Report Preparation	Dr. Portch
7	"	Report Preparation	"
8	"	Departure	"

\* Dates Mr. Abdur Rajjak will accompany Mr. Clayton.

Note : Institutes  
 BARI : Bangladesh Agricultural Research Institute  
 BRRI : Bangladesh Rice Research Institute  
 BJRI : Bangladesh Jute Research Institute  
 INA : Institute of Nuclear Agriculture  
 BAU : Bangladesh Agricultural University  
 SRI : Sugar Research Institute

## APPENDIX-II.

## BARI-Joydebpur-Soil Science

- B & L Spec. 20 S/N 0617456 E  
Repaired
- Corning Colorimeter 252 S/N 5752  
Operation checked
- B & L Spec. 20 S/N 1215068  
Repaired
- Tokyo Photo-Electric Flame Photometer ana-10 AL  
Replaced ignition coil
- Mettler balance  
Tightened 10 gm knob and adjusted optics
- Ainsworth balance S/N 86-2255 Model 300  
Taken to U.S. for repair
- Ainsworth balance S/N 86-2587 Model 300  
Repaired
- Corning 7 pH meter S/N 007/3398  
Repaired function switch
- Marvel refrigerator S/N 001469  
Repaired fan mount
- Memmert Oven Model TV 10 560112  
Repaired wiring
- Fisher Muffle Furnace S/N 453  
Wired for operation
- Fisher Muffle Furnace S/N 457  
Wired for operation
- Turner Flame Photometer 510 S/N 21153  
Need manuals
- Fisher Accumet pH Meter S/N 220  
Prepared for use
- P-E AA Spec. Model 2280  
Need methods manual, compressor, Lamp holders
- IEC Centrifuge Model CL S/N 42 900972  
Repaired
- Blue M Hydrometer Jar Bath Model HBJ-10C S/N No. 1017  
Repaired
- Gallenkamp Furnace Model FR 565  
Needs 25 amp line in laboratory

Still - Chinese made  
Repaired heater

GCA Precision Digester Cat No. 65500  
Installed cord and transformer

Gallenkamp Cat. No. SA 850  
Plug installed

Burrows Model 1875 S/N 1469220 (3 pcs)  
Repaired

YAMATO Sci. Incubator  
Cord repaired

BRRI - Dr. Bhuiyan

Mettler Balance H20T S/N 373807  
Needs gears for gram indicating dials

Ainsworth Balance FHM S/N 56336  
Works - needs #87 lamp

P-E Coleman 124 DE Spec. 124-0072 S/N 4830-29  
Works - need schematic

IEC Centrifuge Model HT S/N 34050485  
Repaired - need manual

Thelco Oven Cat. No. 31481 S/N 21-AE-6  
Wiring repaired

Thelco Oven Cat. No. 31517 S/N 22-AE-8  
Repaired

Thermolyne Hot Plate HPA224CM S/N 138  
Needs new insulation

Sears Compressor 102.17061 S/N 609658  
Need manual

Vortex Genie Model K-550 GE S/N 6279  
Needs parts

Boekel Oven  
Needs switch

Lab-line Instr 3550 S/N 032  
Compressor Not connected - Parts missing

YAMATO Incubator  
Repaired

GCA Chromatographic Drying Oven Model 31492 S/N 13AE5  
Rodent damage

Bendix Hygrothermograph Model 594 S/N 14516  
Needs sensor and charts

KODAK Micro Fiche Reader  
Repaired and cleaned

YSI Model 33 S-C-T Meter S/N 3445  
Needs function switch

A.OTT Water Level Tester  
Cleaned - works now

PAKO Photo Dryer Cat. No. S2 Model 26 S/N 031025  
Needs manual

Kindermann Pamulus 800 Overhead projector  
Need manual

Hathazari

Torsion Balance Model DLM2 S/N 162747  
Adjusted

Mettler Balance E2000 S/N 830018  
Installed level

Kent pH Meter S/N 7020/4277  
Needs electrode

Steinlite Moisture tester 400 S/N 27136 G  
Order charts for relevant crops

Seedburc germinator S/N 7982  
Need temperature information

Torsion Balance Model DLM5 No. 168805 500 gm  
Need parts

Thermolyne Hotplate Model HPA1910N  
Installed

OLYMPUS Microscope CHC 001  
Set up and demonstrated

BJRI

Pye Unicam AA Spec. Model SP 2900  
Installed new nebulizer

Mettler Balance PL200 No. 747201 ES-43702  
Sent to U.S. for repair

Cont'd-P/4.

Multilutor Brand 82205  
 Repaired

Burrows Seed Moisture tester Model 700 S/N 16543 B  
 Inoperative - Will send manual

Polymetron pH Meter Type 45D Serie 6614  
 Needs electrode

Gallenkamp Flame Analyser  
 Installer Air Filter/Regulator

Gallenkamp Oven  
 Repaired Temp. Control

Unimatic CL x 4 S/N 33519  
 Needs optical scale

IEC PR2 Centrifuge A6710 x - 1  
 Needs head

Goodbrand Tensile Strength Tester  
 Electronics shipped to England Via Homebound

Olympus Microscope and CAMERA PM-10-A  
 Repaired Shutter release mechanism

General Engineering Vacuum System  
 Needs gauge - ordered from mfr.

INA - Hymensingh

Jarrell - Ash AA Spec. Model 82/760 S/N 21671  
 Circuit Board and Panel Meter Taken to U.S.

Troxler Scales (2) S/N 418 and 421  
 Need battery packs, transformers and schematics

Packard TRI - Card  
 Not Economical to Repair - Discard

LI-COR Leaf Area Meter S/N PAM 993-8203  
 Never worked - taken to U.S.

Ortec Scaler  
 PM tube installed

Gallenkamp Muffle Furnace  
 works

Fisher Recordall S/N R5/6086-72  
 Needs pens and paper

Slee Laminar Flow Hood Type 4HLP S/N L 3249  
Installed and checked .

Oven (Polish) TYP5U-P-4  
Insulation damaged by rodents

Beckman Model 25 S/N 1000500  
Need service manual and source mirror lever

Fisher Isotemp Vacuum Oven Model 201  
Needs door and thermometer

MSE GF-8 Centrifuge S/N GJ-629-A  
Discussed high speed operation

MLW Centrifuge Type S70D  
Installed high speed head

BAU - Biochemistry

IEC Centrifuge S/N 11383 Model UV  
Repaired wiring

LAE Con. Co. Dry Ice Freeze Dryer S/N 37254  
Explained operation and need for dry ice trap

Mettler Balance K15 S/N 263437  
Adjusted

Oven - Polish  
Needs thermoregulator

Fisher 320 pH Meter S/N 164  
Need manual and shorting strap. Unstable

Ishurdi - BARI

Ainsworth Balance S/N 86-4890  
Prepared for operation

Ainsworth Balance S/N 59710 Type 10N  
Repair and put into service

Fisher Hotplate Model 85 S/N 101  
Changed plug

Fisher Centrifuge Model 225 S/N 163  
Installed Head

Fisher Isotemp Ovens (2)  
Plug attached

Fisher Accumet pH Meter Model 600 S/N 255  
Readied for operation

Barnstead Still  
Wired for 220V

Precision Autoclave Cat. No. 67013 S/N 12AM/4  
Needs manual and panel

SRI

TOA Elec. Ltd. pH Meter Model HM-5A  
Needs parts

Hach Portable pH Meter Model 16400  
Need electrode P/N 16044-00

Appendix-III

LABORATORY INSTRUMENTATION TRAINING SESSION

CONDUCTED BY

W.R. CLAYTON, IADS/CORNELL

APRIL 3-4, 1983

AT

BARI, JOYDEBPUR

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## LABORATORY INSTRUMENTATION COURSE

- I. Selection of Equipment
- II. Installation of Equipment
- III. Analytical Techniques
- IV. Recognition and Diagnosis of Problems
- V. Repair and Maintenance
- VI. A Discussion of Problems those Attending the Training Session May Have

## COURSE. OUTLINE

### I. SELECTION OF EQUIPMENT:

- A. What is your requirement
  - 1. Capacity
  - 2. Accuracy
  - 3. Cost
- B. Types of equipment available
  - 1. Colorimeter VS. Spectrophotometer
  - 2. Analog VS. Digital Readout
  - 3. Other Considerations
- C. Which manufacturer
  - 1. What does each offer in services
  - 2. Possible to stay with one manufacturer?
- D. Other Considerations in Selection

### II. INSTALLATION OF EQUIPMENT:

- A. Services Required
  - 1. Electrical
    - a. Voltage
    - b. Current
    - c. Stabilizers
  - 2. Gases
    - a. Regulators
    - b. Filters
    - c. Purity
  - 3. Ventilation
    - a. Heat
    - b. Corrosive fumes duct
    - c. Fan construction
    - d. Scrubbers

## II. (Cont.)

## A. (Cont.)

## 4. Supplies

- a. Electronic
- b. Chemical

## B. Inspection of Equipment

- 1. Remove all shipping material
- 2. Examine inside of instrument for components loosened in transit
- 3. Consult manual for special consideration

## C. Study the Entire Manual

- 1. Learn what is specific to this instrument

## D. Arrange For Proper Protection

- 1. Humidity
- 2. Dust
- 3. Rodents

## III. ANALYTICAL TECHNIQUES:

## A. Laboratory Environment

- 1. Cleanliness
- 2. Storage of Reagents and Glassware
- 3. Spills and disposal problems

## B. Procedures and Methods

- 1. Pipettes
- 2. Volumetric flasks
- 3. Preparation of standards
  - a. Weighing
  - b. Measuring
  - c. Dilutions
  - d. Storage

## C. Sample Handling Techniques

## D. Instruction of Instrument Users

- 1. Recognition of questionable data
- 2. Maintain a log of operation
- 3. Familiarity with how the instrument does its job

## III. (Cont.)

## E. Safety in the Laboratory

## 1. Organics

- a. Ether fumes being heavy
- b. Explosion in refrigerators

- 2. Heavy metals
- 3. Eye protection
- 4. Pipetting technique

## IV. RECOGNITION AND DIAGNOSIS OF PROBLEMS:

## A. Use a Logical Approach

- 1. If you have a bad lamp don't worry about the switch

## B. Consider the History of the Instrument

## C. What was the Most Recent Thing Done Before the Problem Arose

## D. Troubleshooting Techniques

- 1. Use of continuity tester
- 2. Look for the simplest thing

## V. REPAIR AND MAINTENANCE:

## A. Component Identification

- 1. Lamps, sockets, lenses
- 2. Fuses, switches, plugs
- 3. Thermoregulators
- 4. Resistors, capacitors diodes
- 5. Transformers and variacs

## B. User Serviceable Components

- 1. Lamps
- 2. Electrodes
- 3. Mirrors
- 4. Filters

## C. Frequent Use to Control Humidity and Capacitor Problems

- 1. High impedance circuits

## VI. DISCUSSION OF INDIVIDUAL PROBLEMS:

## Appendix-II

LIST OF PARTICIPANT FOR TRAINING ON INSTRUMENTATION

<u>Sl. No.</u>	<u>Name of Participant</u>	<u>Organization</u>	<u>Signature</u>
1.	Md. Arshad	Deptt. of Soil Survey	
2.	Md. Ebadur Rahman	Deptt. of Soil Survey	
3.	Mihirlal Sarker	Bangladesh Tea Research Institute	
4.	Md. Mosharraf Hossain	Sugarcane Research Training Institute	
5.	Dr. M.A. Sattar	INA, Mymensingh	
6.	Md. Abul Khayer	BAEC, Savar	
7.	Mahmudul Hossain	BAEC, Savar	
8.	Md. Abul Kashem	E/Lab, AECD, Dhaka	
9.	N.I. Bhuiyan	BRRI, Joydebpur, Dhaka	
10.	N.H. Choudhury	BRRI, Joydebpur, Dhaka	
11.	Sultana Razia	BARI, Joydebpur, Dhaka	
12.	Md. Kabir Hossain Talukder	BARI, Joydebpur, Dhaka	
13.	Ohiduzzaman Mazumder	BARI, Joydebpur, Dhaka	
14.	Kn. Hajidul Hossain	BARI, Joydebpur, Dhaka	
15.	Shafiqul Alam	BJRI	
16.	Dr. M.M. Hassen	FRI, Chittagong	
17.	H.B. De	FRI, Chittagong	