ANNUAL REPORT 1965-66

NATIONAL PHYSICAL LABORATORY,
NEW DELHI-12

NATIONAL PHYSICAL LABORATORY
HILLSIDE ROAD, NEW DELHI-12

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REPORT OF THE DIRECTOR, FOR THE YEAR 1965-66, TO THE EXECUTIVE COUNCIL OF THE NATIONAL PHYSICAL LABORATORY, NEW DELHI - 12

In previous years it had been the practice to submit the Annual Report of the Laboratory to the Executive Council. The technical and the administrative matters of importance were published as a part of the Annual Report of the CSIR. Annual report of the Laboratory has not been published separately so far. During the last two years, the work of the Laboratory has been put on project basis and the report for the year 1965-66 has been drawn accordingly.

At the beginning of the year, Shri G.D. Jogleker was the Scientist-in-Charge of the Laboratory before I had taken over as the Director on the 26th May, 1965.

Report of Estimates Committee

The work of the Laboratory has been scrutinized by the Estimates Committee of the Lok Sabha and Hundred and Third Report of the Committee, gives their findidgs. For a period of over six months, some members of the staff had to devote considerable part of their time to the work of the Committee, as the informotion asked for covered a wide range of the activities of the Laboratory spread over a fairly long period.

On the basis of their investigation, the Committee has made certain recommendations which are being implemented. The Committee strongly recommended that the National Physical Loboratory should regularly and in time, bring out its Annual Report and circulate it amongst industry and other laboratories/institutions and universities who are interested in the subject. In line with the recommendation, this is the first time that the report is being published.

NPL Technical Bulletin

A significant thing that has been undertaken during the current year is the starting of the quarterly publication of the NPL Technical Bulletin from January 1966, and this has been noted by the Estimetes Committee in their Report. This would enable the Laboratory to maintain close liaison with the universities and other research institutions in the country and attract the attention of the public and the industrialist to the work of the Laboratory which is of national importance. With the publication of the bulletin, the lacuna that was so far existing has been removed.

Open Day

The Laboratory observed "Open Day" for the first time in January 1965, to acquaint the public and industry with the work of the Laboratory. The Estimates Committee commended this practice and hoped that this practice would be continued in future also. It is hoped to observe the next "Open Day" in January, 1967. (Figs. 1 and 2).

Work for Defence Department

The Laboratoryi s actively busy in solving a number of problems for the Defence department. During the fiscal year, the country had to face hostilities with Pakistan. Without going into the details, we will only mention that the N.P.L. played its part in helping the defence efforts of the country by its scientific work.

Materials Group

Major effort is being done in advanced countries to develop research in Materials Science and Engineering. The importance of this subject has been increasingly appreciated to meet the needs of the growing technology. The National Physical Laboratory is establishing a Materials Group. This is an interdisciplinary activity, and forms a part of the perspective plan of the Laboratory, and has been noted by the Estimates Committee.

Get Together

A 'Get Together' between Indurstries and Research Laboratories was organised by the C.S.I.R. at the N.P.L. on December 20-21, 1965. Decisions were taken on assignment of Research and Developement projects to various laboratories and research institutions. The projects were classified as high priority and regular. The N.P.L. has been assigned the following eleven projects on a high priority basis :

1. Variable Capacitors.
2. Multicontact Relays.
3. Carbon Composition Resistors.
4. Steatite Water Switches.
5. Ferrites (Raw materials).
6. Ferrite cores for miniature transformers.
7. Carbon tracks for volume controls.
8. Polyester capacitors.
9. Ultrasonics.

   (*a*) Ultrasonic cleaners.

   (*b*) Ultrasonic therapy units.

Fig. 1. Visitors to the National Physical Laboratory on Open Day.

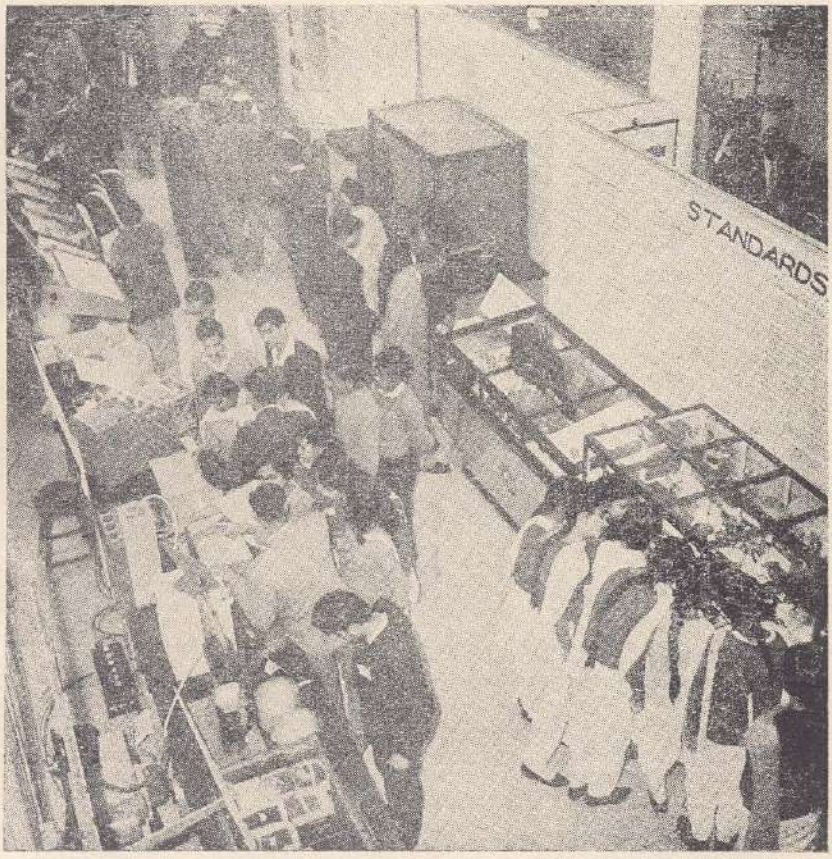

Fig. 2. Visitors to the Exhibition on the Open Day.

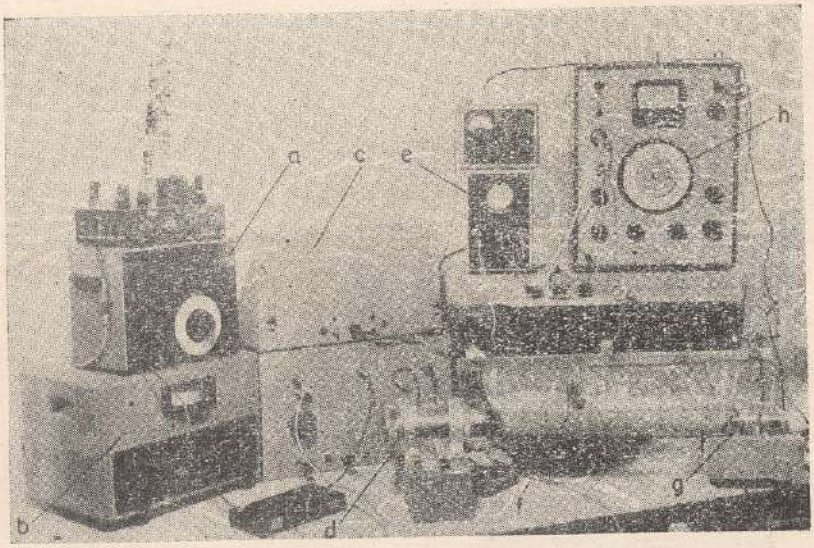

Fig. 3. Set up for Velocity Measurement in Sand Samples.
(a) Oscillator, (b) Amplifier, (c) Pulser, (d) Vibrator, (e) C.R O., (f) Sample Holder, (g) Pick up, (h) Frequency Analyser

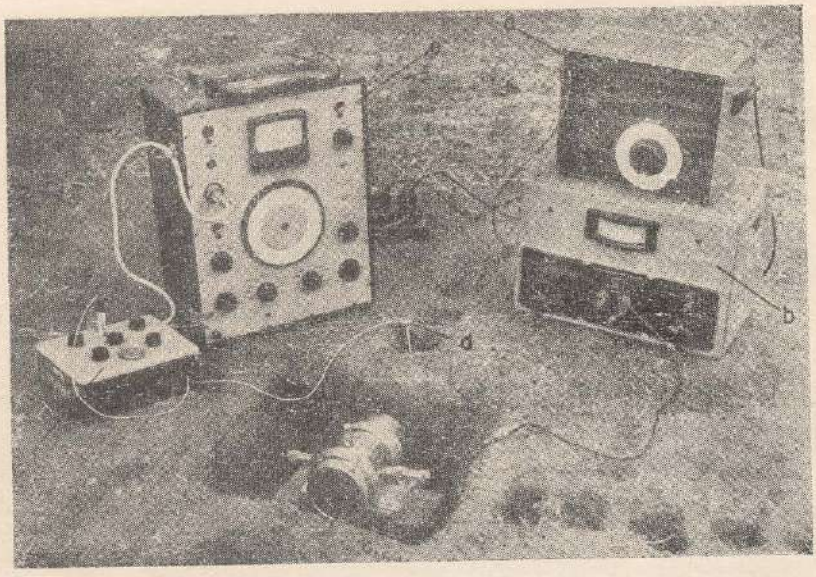

Fig. 4. Sound Attenuation Measurement in Soil *in Situ*.
(a) Oscillator, (b) Amplifier, (c) Vibrator, (d) Pick-up, (e) Frequency Analyser, (f) Vibration pick-up preamplifier.

(c) Ultrasonic surgery units.

(d) Ultrasonic generators.

(e) Echo sounders for fishing industries.

10. Semi-conductor Grade Silicon.

11. Design of Electromagnetic Feeders, Capacity 50 to 600 tons/hr.

These items would form part of the new projects.

We have also been asked to take up the following two projects on high priority by the Electronic Group in the Scientific Advisory Committee to the Cabinet on the recommendations of the Electronics Committee.

(a) Carbon composition resistors required by defence.

(b) Setting up of comprehensive Testing and Standardisation facilities for Electronic Components.

Of the above components, the industry has evinced an interest in three *viz.*, carbon tracks for volume controls, variable capacitors and polyester capacitors.

Organisation

The divisions in the Laboratory are being maintained so that scientists of similar disciplines have a chance to work together. However, the work has been oriented project-wise which often requires inter-division collaboration. This is being encouraged.

In describing the scientific activity of the Laboratory, we have classified the projects under six separate categories, namely ; (1) Research (2) Developement, (3) Standards, (4) Calibration and Testing, (5) Service and (6) Pilot plant. A complete list of the projects under these headings is given in the Appendices. I to VI. In this brief report, it would not be possible to discuss all the projects. However, to give an idea of the entire spectrum of the scientific work and the achievements, we are mentioning only a few selected projects.

1. RESEARCH ACTIVITIES

Propagation of Sound Waves in Granular Media

A study has been made of the propagation of sound waves in granular media with reference to sand and soil. (Figs. 3 and 4). The results show that at high frequencies, the use of earth as a medium of sound propagation for long range transmission is limited. However, the results have shown that sand and soil can be used effectivily for sound insulation. This work formed a part of the thesis for the Ph. D degree of one of the members of the staff.

Chemical Kinetics of Reactive Systems

The determination of chemical kinetics of reactive liquid system of biological and non-biological origins by ultrasonic methods has shown that these methods can be used for the study of chemical kinetics. This work formed a part of the thesis of the Ph.D degree of one of the members of the staff.

Noise Survey

In big cities one of the causes for fatigue is the noise made by transport vehicles, industrial machinery, aeroplanes, etc. A few years back the noise survey was carried out in cities like Delhi and Bombay and during the period under review, a similar study was undertaken for the city of Calcutta. (Fig. 5). Such survey would enable the civic authorities to take effective measures to reduce the noise to the desired level.

Acoustical Requirements of Auditoria

For the past few years the Laboratory has been advising various institutions all over the country with acoutic design features. This advice has been well appreciated by the institutions concerned. During the year under report, field measurement of some of the auditoria had been carried out and the data analyzed. This is forming one of the important features of the work of the Laboratory. (Fig. 6).

Clinical Thermometers

Clinical thermometers are usually marked as "½ mt.", 1 mt. ", etc. One is lead to believe that these indications refer to the time during which the thermometer will certainly acquire the body temperature, when properly applied. As a precaution, some doctors advise that the thermometer should be applied for twice the time marked on it. But it is well known that experimental work on biophysics has shown that this is not quite correct. The time that a thermometer takes to acquire the body temperature depends not only on the physical constants of the thermometer, but also on the environmental conditions, the position of the thermometer in the human body and to a much greater extent on the bio-physical condition of the part of the body where temperature is being measured,

In fact the thermometer should be kept in position till it would not rise any further, and therefore the time required would vary from person to person. Solution to this problem was found after experimenting on a large number of "½ mt." thermometers of different makes, both Indian and imported, supplied by the Indian Standards Institution. The results of these investigations formed the basis of the Time Rating prescribed for the Clinical Thermometers, in the Indian Standard Specification (IS : 3055-1965).

Thermal Conductivity Measurements

The Laboratory is equipped to carry out thermal conductivity measurements on insulating materials, by the 2-specimen, gaurded hot

Fig. 5. Noise Survey of Calcutta.

Fig. 6. Inside view of the Tagore Theatre Chandigarh from stage showing raked seats, resonators in back partition and exposed trusses in the ceiling.

plate method. The design limitations of this apparatus are such that for materials, with aggregates of 5 to 6 cm and large, values of thermal conductivity cannot be tested.

During this year, a steady state, radial heat flow method of finding thermal conductivity was developed for large aggregates, and large conductivity blocks such as those of heavy concrete. The results of the tests have been used for designs being made by the Atomic Power Project.

Battery Separators

Battery separators play a vital role in the life and performance of batteries. It has been found that the influence of the separators depends on the physical properties of the separator, such as porosity and permeability. These factors depend on the pore size and pore size distribution in the separator. It was shown earlier by work carried out in the Laboratory that separators with a pore size between 4 and 14 microns give good performance because the passage of antimony ions from the positive grid to the negative plate is not easy and thus the local action at the negative plates gets reduced. Further work was carried out on this aspect and it was found that the efficiency of a separator is better, if the calculated resistance is low, and if the product of porosity function and surface area is high. It has also been found that seperators of high porosity are better but the porosity should not be due to closed pores since closed pores cause an increase in resistance. There seems to be no correlation between permeability or mean pore size and the performance of separators. This work has attracted attention of the battery manufacturers and users throughout the world.

Rheological Properties of Carbon Mixes

In the manufacture of carbon products, two methods of forming are used, *viz.*, moulding and extrusion. In moulding there is little flow of material but in extrusion the final product is formed due to the flow of material through the extruding chamber and nozzle. If the flow is not proper, the extruded articles are defective. To understand the flow characteristics, it is necessary to know the rheological properties of the binder mixed mass at the shear rate obtainable in extrusion. Different types and sizes of rods and tubes are being extruded by the well known firms, but the factors governing the process of extrusion remains a secret with them. To understand the rheological properties of the extruded mass the Laboratory undertook systematic study of this important aspect, and a number of papers have been published on this subject. The Laboratory was the first to show the importance of these studies as far as the extrusion of carbon products is concerned. During the year the parallel plate method for determining the rubberlike modulus and relaxation time has been completed.

Projector Carbons

In the manufacture of projector carbons, carbon tubes are first extruded and baked and then filled with light giving salts and baked again. This is the method at present being used by all the manufacturers af projector carbons. This method requires two operations of baking, and if

the filling of the tubes with light giving salts is not proper and continuous improper burning of the rods takes place. To avoid the two processes required in the manufacture and also to get a continuous core mix for proper burning of the carbons, a new method was developed by the Laboratory in which simultaneous extrusion of the shell and the core mix takes place. Thousands of rods of different sizes have been extruded with this method and have given satisfactory results in Laboratory tests and in actual use in theatres. A few thousand rods made by this process have also been sold. The simultaneous extrusion of the core and the shell is a significant contribution of the Laboratory to the Carbon Technology (Fig. 7).

Platinum Resistance Thermometers

A study of the properties of materials at low temperature is of importance and in this connection, thermometers are required for the measurement of the temperature. Eight platinum resistance thermometers over the range 450°C to −183°C have been constructed. These have been calibrated at several thermal equilibrium stages known as 'fixed points'. The accuracy of temperature measurement with these standard platinum resistance thermometers is 0·001°C. It is proposed to extend the range of platinum resistance thermometry down to the liquid hydrogen point, *i.e.*, −253°C. It is necessary to keep on recalibrating these thermometers occasionally for checking their reliability. The N.P.L. is now in a position to make available the technical know how to other laboratories and industrial institutions in the country who may be interested in the construction and calibration of platinum resistance thermometers. (Fig. 8).

Daylight Studies

The colour of objects under different lights differ depending on their absorbing and reflecting properties. They are also affected by the distribution of energy in the different spectral colours in the light sources in which they are viewed.

Daylight influences man's visual activities, as a human eye is able to distinguish such shades in colour more easily under natural daylight than under artifical daylight, and feels that the real appearance of an object is the one seen in natural daylight. The need for a standard lamp of a definite spectral distribution is felt. But as the quality of daylight itself varies with different hours of the day and for different days of the year depending on the weather conditions, it is necessary to make a systematic study of the colour and spectral distribution of the daylight, and then select a few ideal daylight colours, and adopt them as standards for the daylight for use in industry and for general purposes. This data, alongwith the data from other countries, will be useful for the Commission Internationale de l'Eclairage which is meeting next year to choose the International Artificial Standards for daylight which can be used (1) in Industrial inspections, (2) for visual and photoelectric colorimeter, and (3) for the reduction of spectro-photometric data for colour specification for new materials and manufactured goods.

It is also necessary to note the luminance of the sky in this connection, and therefore work has been undertaken in the Laboratory, and a recording

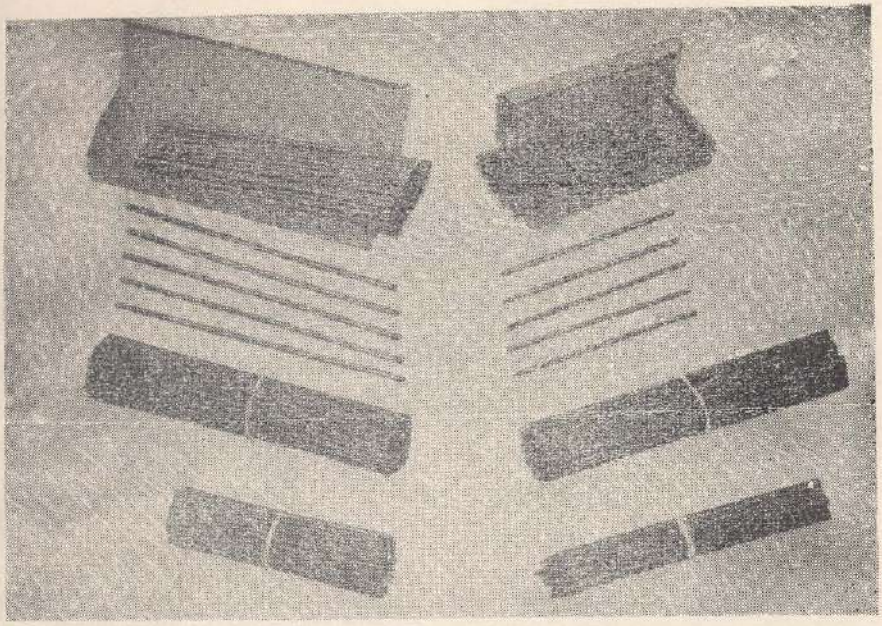

Fig. 7. Projector carbons of different sizes made by the new method.

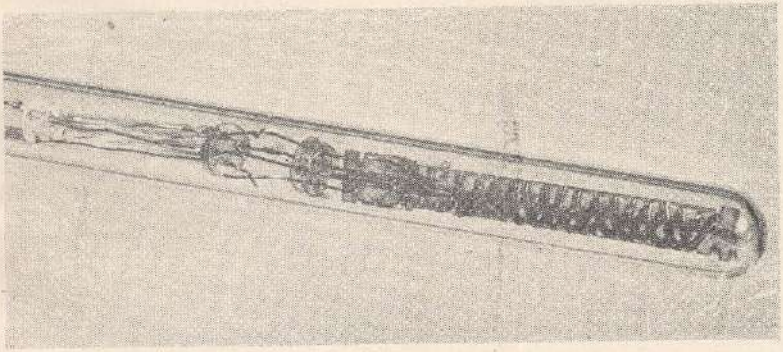

Fig. 8. Coiled-Coil Sensor of the Platinum Resistance Thermometer.

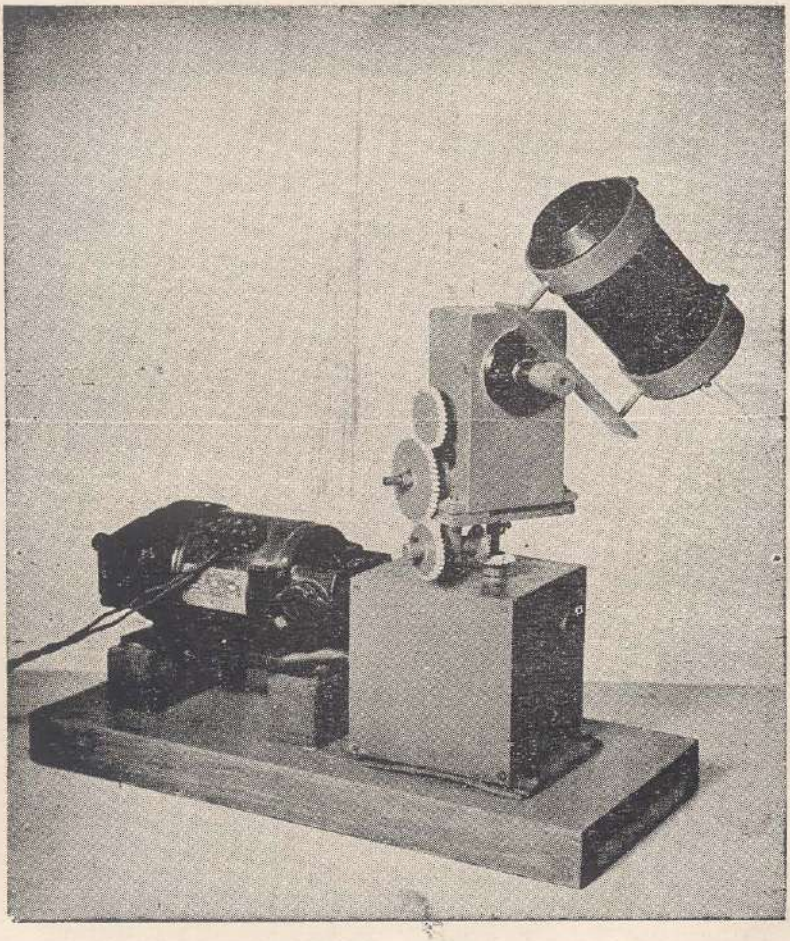

Fig. 9. Sky Scanner.

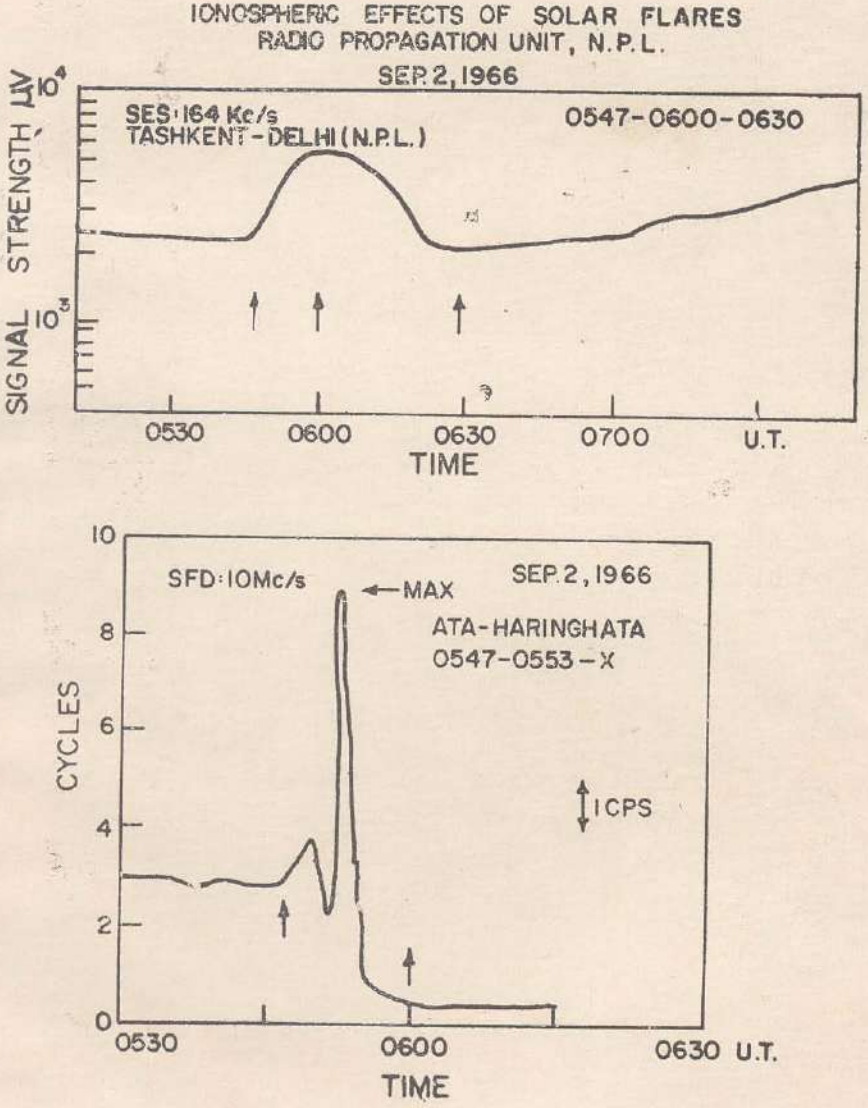
IONOSPHERIC EFFECTS OF SOLAR FLARES
RADIO PROPAGATION UNIT, N.P.L.
SEP. 2, 1966
SES: 164 Kc/s
TASHKENT - DELHI (N.P.L.)
0547-0600-0630
SIGNAL STRENGTH, μV
10^4
10^3
0530
0600
0630
0700
U.T.
TIME
SFD: 10Mc/s
MAX
SEP. 2, 1966
ATA-HARINGHATA
0547-0553-X
1 CPS
CYCLES
10
8
6
4
2
0
0530
0600
0630 U.T.
TIME

Fig. 10.

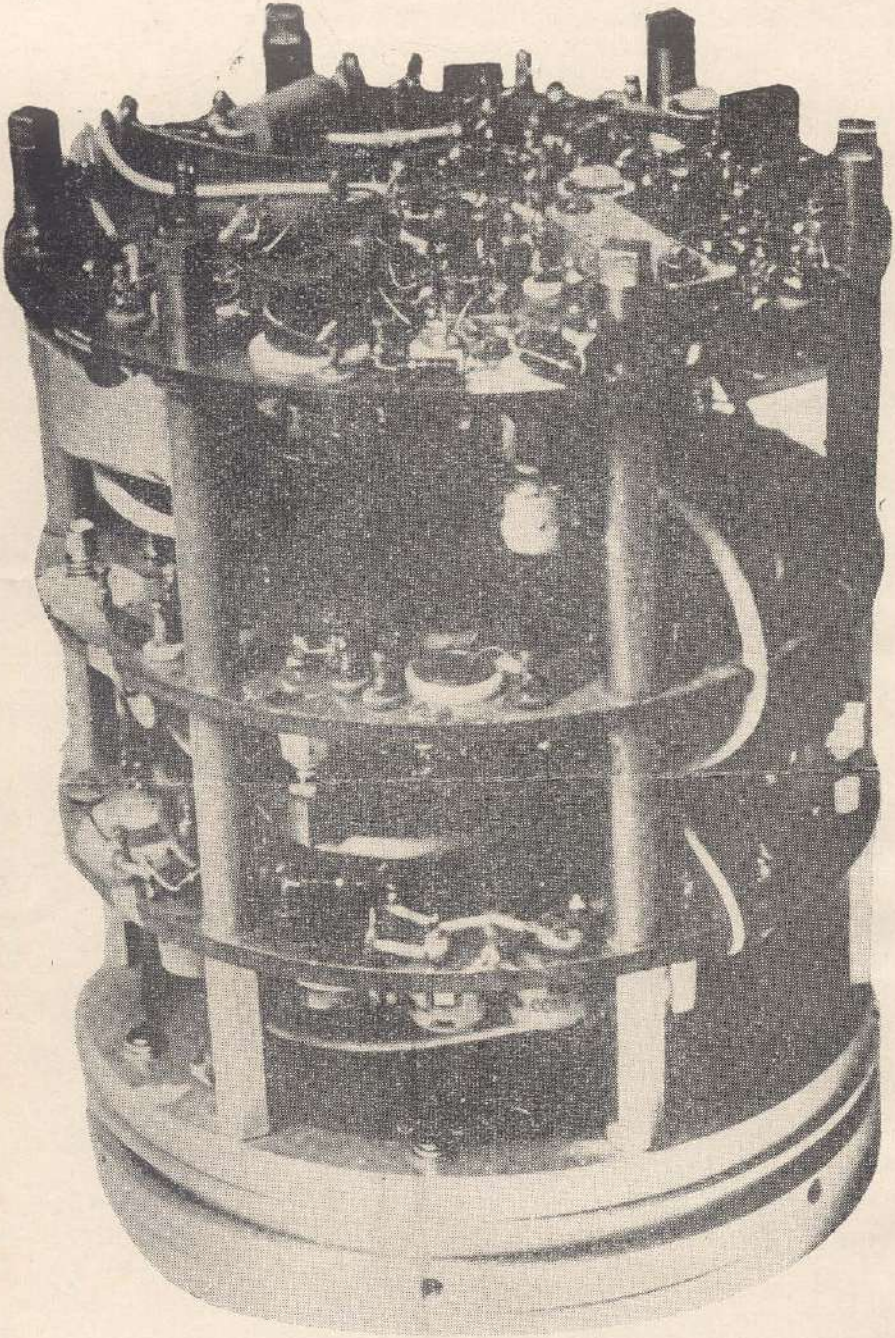

Fig. 11. Rocket Payload.

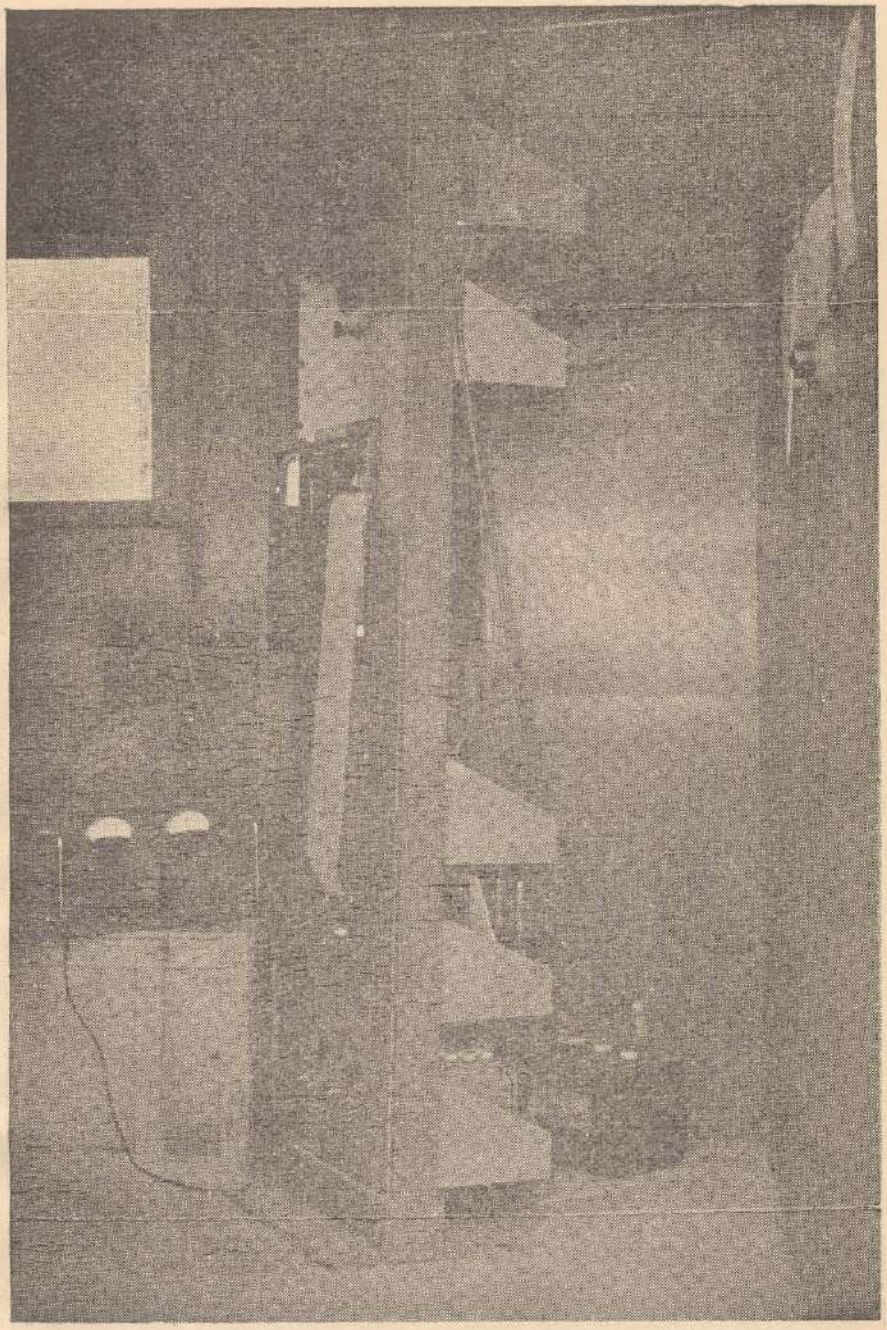

Fig. 12. Solar Radiometer

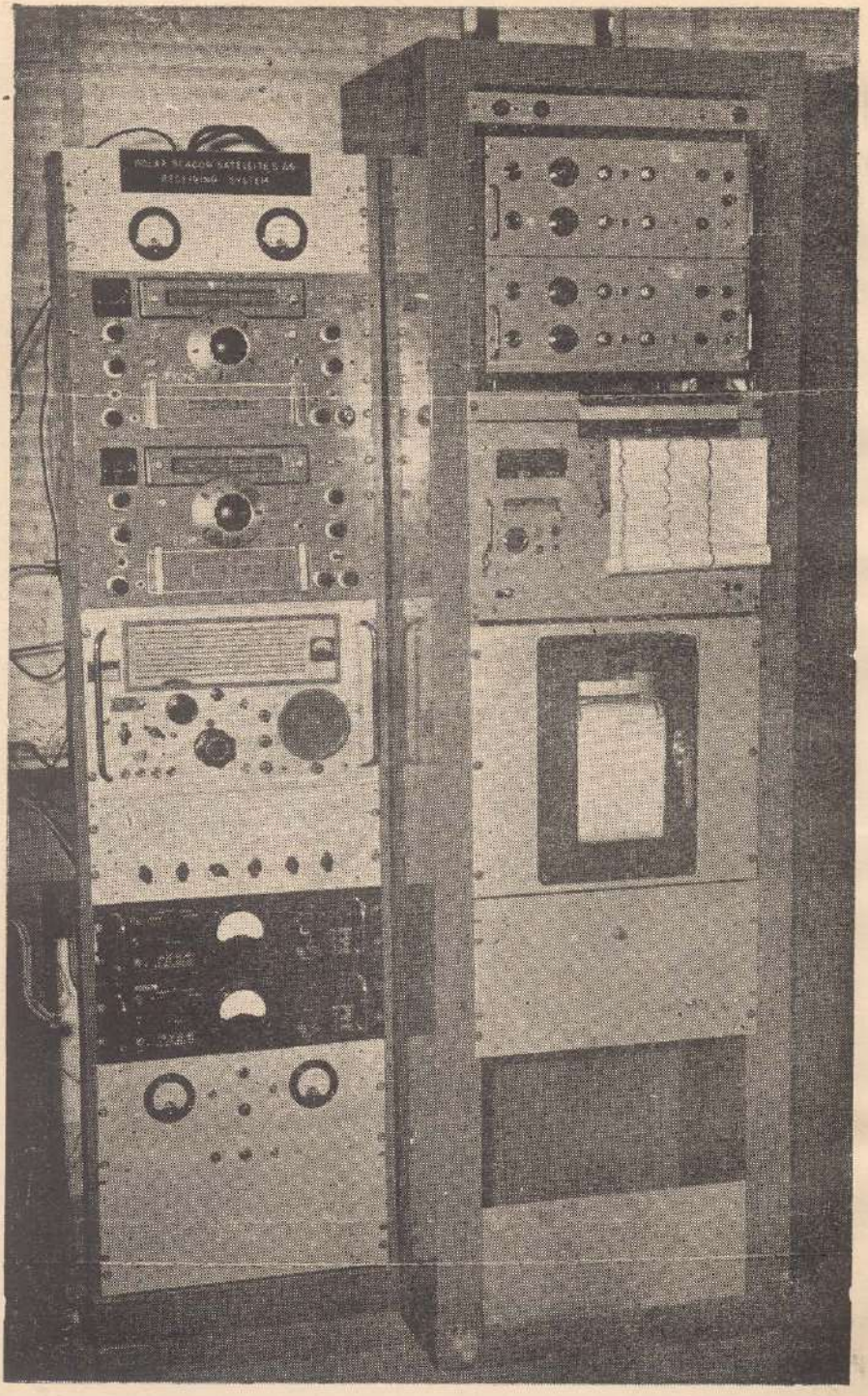

Fig. 13. Satellite Signal Receiving System.

sky scanner which continuously scans the entire sky has been developed for the measurement of the luminance of the sky. (Fig. 9). It is proposed to collect data of the luminance distribution of sky at Delhi and other places in India for different sky conditions.

Radio and Space Physics

The Laboratory participated in the programme of the International Quiet Sun Year which were internationally planned for the period of minimum solar activity, 1964-65, and carried out important work in the fields of (*i*) ionosphere, (*ii*) solar-terrestrial relationships and (*iii*) space research.

One of the most extensive radio patrol of solar flares involving eight equipments covering a frequency of 27 Kc/s to 30 Mc/s was maintained. (Fig. 10). Special service to manned space flights, especially Gemini 6 and 7 rendezvous was provided.

The aeromony of the ionosphere, where a great number of reactions occur, is still inadequately known. An entirely new and comprehensive approach to ion kinetics was made in the light of the recent space measurements of solar X.U.V. radiation, ion composition and electron density profiles and new laboratory measurements of rate co-efficients.

New work on the combined use of sudden Ionospheric Disturbances and satellite X-ray measurements was done for the determination for the effective recombination coefficient in the lower ionosphere.

A new project involving the measurement of sudden frequency deviations in the reception of a standard frequency signal was started for patrolling the solar flares and for studying the physics of the ionosphere.

Rocket payload for the new experiment proposed by this unit for the study of D region was constructed and tested. (Fig. 11). The main equipment is the riometer which measures the changes in cosmic noise absorption as the rocket goes up.

A new multi-frequency analysis technique was developed for the determination of the F region contribution to normal cosmic noise absorption. Another technique was developed to estimate the F region effects on sudden cosmic noise absorption events.

A solar radiometer was constructed and installed and regular measurements were made of solar radio flux at 2000 Mc/s which is a good index of solar activity. (Flg. 12).

An atmospheric model for solar minimum condition was developed using the satellite drag measurements. In this model, the height variation of the concentration of atmospheric constituents like N_2, O_2, O, He and H together with atmospheric scale height (H), mean molecular mass (m) and atmospheric temperature (T) in the height range 100-700 km was given for diurnal minimum, average and maximum conditions.

The Laboratory is participating in the programme of S-66 polar beacon satellite observations, internationally planned for ionospheric research, since its launch in October, 1964. (Flg. 13 and 14). Special study was made of the outer ionosphere and its relation with solar activity and magnetic activity.

Thin Films

The study of matter in the form of thin films has become a new tool for investigating the fundamental properties of solids. The structure of films influences their physical properties. It is important to study the effect of the nature and temperature of the substrate, the rate of evaporation, the pressure and the residual atmosphere in the chamber during the process of deposition of films on the nucleation and growth phenomena of thin films.

Such studies are helpful in the development of thin film optical, electrical, electronic and magntic devices.

The work carried out in the Laboratory on thin films has been in different directions. The optical properties of thin films of metals and dielectrics are being studied for the determination of N and K values. To understand the structure of thin films of vanadium and titanium, the measurements of electrical conductivity and optical reflections are being carried out.

The work on the preparation of thin films interference filters has been undertaken. For the first time in the country a thin film tellurium type transistor has been fabricated and cadmium sulphide transistor is under fabrication. One of the members of the staff has submitted a thesis for the Ph. D. degree on the study of phase transformation of thin films by electron diffraction.

Work on thin films will be one of the important projects to be handled by the Materials Group that is being established.

Growing of Single Crystals

Considerable work is being carried out on growing of single crystals and studying their properties. Last year a Zone Refining Furnace was obtained and is now being commissioned. With the Zone Refining Furnace it would be possible to have highly pure crystals which could be used for the study of their characteristics as well as for making solid state devices.

This work will also form an important part of the work to be carried out by the Materials Group.

2. DEVELOPMENTAL ACTIVITIES

A 3000 kg. Dead-Load Testing Machine

With the industrial development of the country a large number of manufacturing firms are installing testing machines for determining the

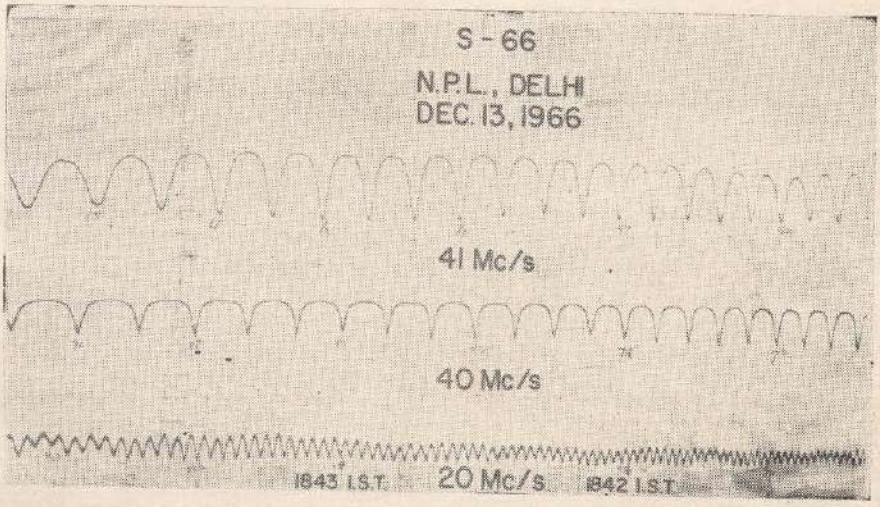

Fig. 14. Faraday Fading Record of Satellite Transmissions.

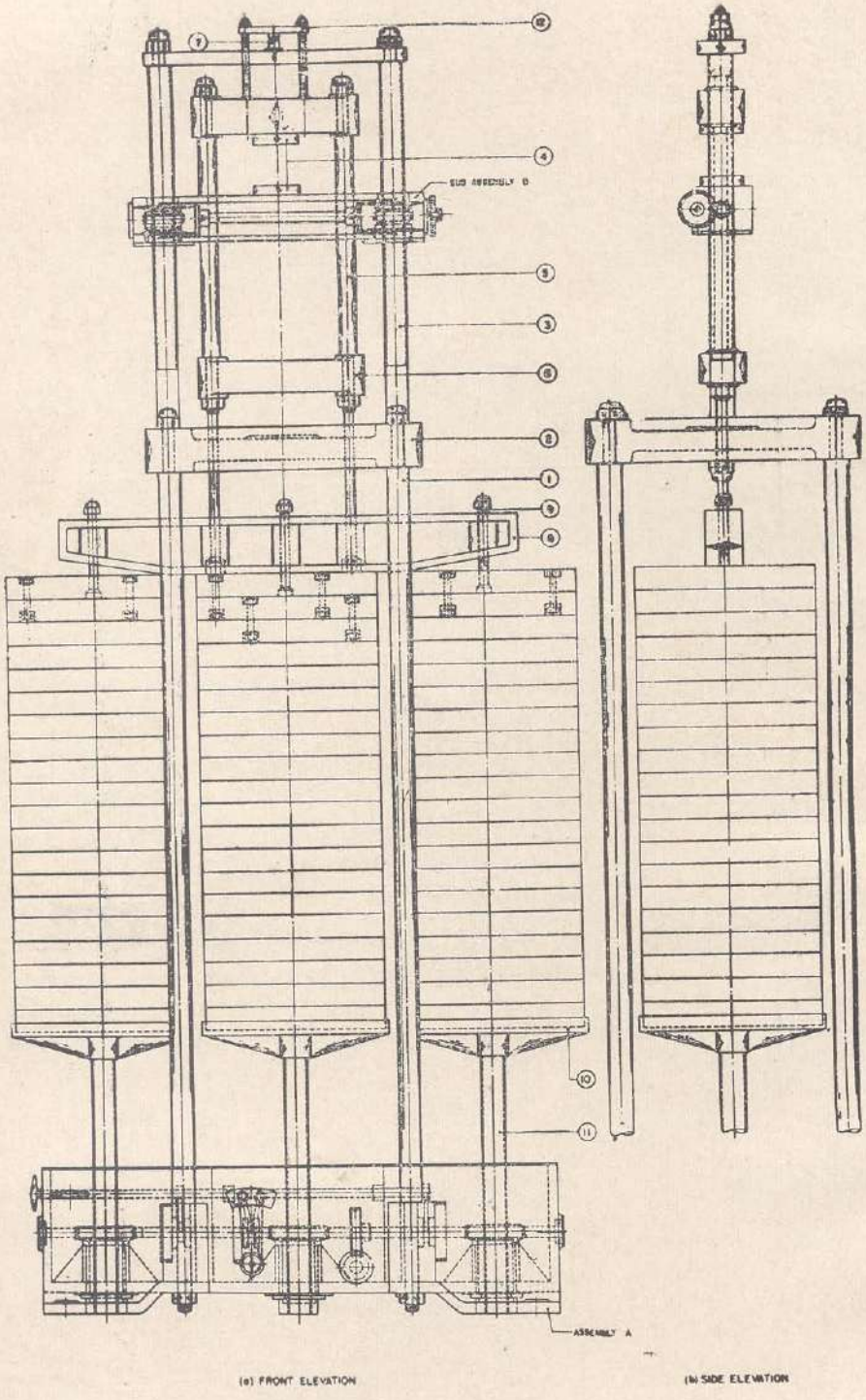

Fig. 15. 3,000 kg. Dead Weight Machine.
(1) Columns, (2) Base block, (3) Threaded columns, (4) Circular plates, (5) Tie rod, (6) Upper & lower platens, (7) Ball & socket arrangement, (8) Small beam, (9) Links, (10) Pan, (11) Loading screw.

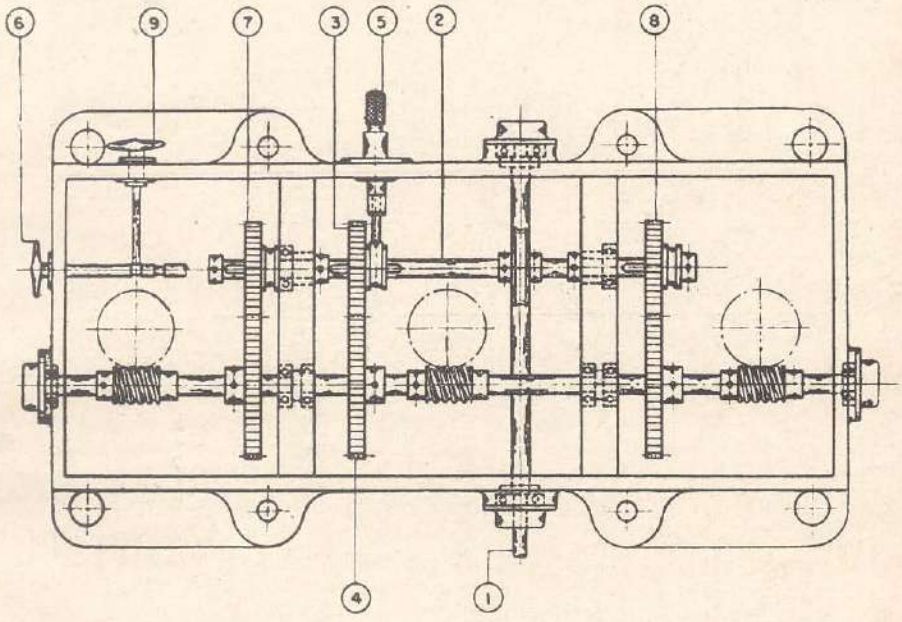

Fig. 16. 3,000 kg. Dead Weight Machine.

(1) Shaft (2) Shaft (3) Sliding gear (4) Gear
(5) Shifting lever (6) Shifting lever (7, 8) Gears.

Fig. 17. Centrifuge for Shake-Down Test.

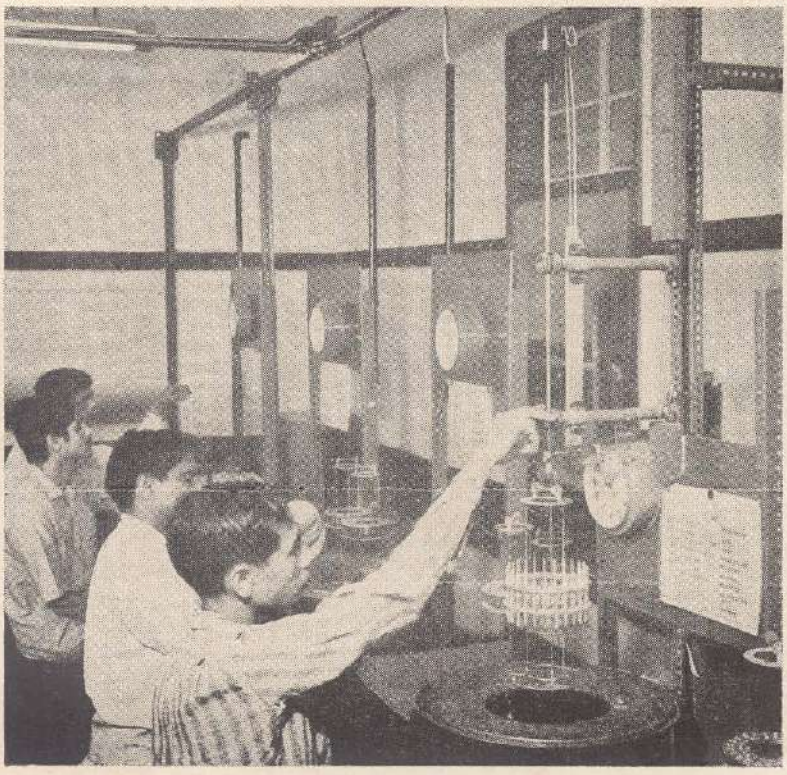

Fig. 18. Accuracy Test at 42°C.

strength of materials. These machines are generally calibrated with proving rings, the manufacture of which has now started in the country. A number of proving rings are received in the Laboratory for calibration. During the year under review, 122 proving rings were calibrated. The calibration is done against an imported standard. In other countries it is the practice to use dead-load machines for the calibration of proving rings. The necessity for having such a machine was greatly felt and a three thousand kg dead-load testing mechine has been designed and built in the N.P.L. workshop and is shown in Figs. 15 and 16. The fabrication of this machine completes the first stage of the programme of developing primary standards within the country for the calibration of load measuring devices like proving rings, dynamometers and standardising boxes.

The machine can be used for calibration of load measuring devices, both in compression and in tension. The accuracy is better than 1 part in 25,000. It is proposed to publish details of the machine separately as a Technical Report of the Laboratory.

Equipment for Large Scale Testing of Clinical Thermometers

Clinical thermometers were being imported until a few years back, but now with the industrial development of the country, manufacture of these has been taken up by a number of firms. Some of them are also manufacturing other types of glass thermometers. The importance of testing the clinical thermometers need not be emphasised and to help the industry, the NPL has done considerable amount of work in the selection of methods and procedures for the testing of thermometers. Several suggestions have been made in order to make clinical thermometers suitable for Indian climates, conditions and resources of manufacture. They have since been incorporated in IS : 3055-1965.

On a special request by the Indian Standards Institution, complete and uptodate testing facilities for carrying out all this work on a production basis have been developed. The installation is completely indigenous and is capable of inspecting 5000 clinical thermometers per shift of 8 hours. It is proposed to carry out operational research on the installation, as a second step. (Fig. 17 and 18).

The facilities have been made available to public on payment of fees. Some manufatcurers have already started improving their products in order to satisfy these tests.

The public can ensure reliability of doctor's thermometers by insisting on thermometers tested according to the Indian specifications.

Infrared Spectrometer

The development of sophisticated instruments, apparatus and equipment, required for research is of primary importance, and has become much more so due to the restrictions put, on account of the difficulties of acute foreign exchange. Mention has already been made of the design and fabrication of 3000 kg dead-load testing machine. An instrument which

is being developed is a cheap automatic recording grating spectrometer for the region 1-3 microns. The instrument in the development stage is shown in Fig. 19. The instrument consisting of the optical layout, the chopper, grating and the lead sulphide detector, is enclosed in a box of of suitable dimensions. The grating can be set in any position from drive through a gearing arrangement (ratio 25 : 1). The grating is driven by a motor which makes one rotation in 24 hours. The chopper disc contains 32 slots and is mounted on a 1500 r.p.m., a.c. motor and gives a chopping frequency of 800 cycles per second. The electronic arrangement uses a phase sensitive homodyne detector system at zero frequency. At present the grating and lead sulphide detector are imported articles but the lead sulphide cell of suitable sensitivity is being developed. The wave length limit could be extended to 7 microns with the help of a lead selenide detector. The optical arrangement, the electronic layout and the atmospheric water vapour bands between 2·5 and 2·8 microns mapped with this equipment on an Easterline Angus Recorder are shown in Figs. 20, 21 and 22. The instrument can prove useful to the industry for detecting traces of water, the CO_2 content in a room and for continuous analysis of heavy water.

Ferrites

The development and Production Unit for Electronic Components has been running the pilot plant for ferrites for the entertainment industry on a commercial basis. The annual turnover is 18 tonnes.

It was the opinion of many that the manufacture of ferrities used in the Telecommunication Industry is so specialised that it cannot be developed in the country. The Laboratory has been able to successfully make compositions having permeability of very high order and other characteristics such as temperature co-efficient similar to those made by the foremost manufacturers abroad. Pot cores suitable for the telecommunication industry are being fabricated. (Fig. 23).

Piezo-electric Compositions

A piezo-electric composition which has good temperature stability suitable for use in IF filters has been developed and Intermediate Frequency Transformers have been made suitable for use in valve and transistor sets. Tests are now being conducted and if these prove successful it will be possible to save foreign exchange spent in importing litz wire and ferrite cores.

Thermistors

Railway Research Organization had posed a problem for development of a Thermistor having stipulated characteristics which can operate at 400°C. These have been developed successfully and plans are being prepared for making them in quantities.

High Voltage High Wattage Resistors

During the recent emergency an urgent problem was given by the Defence authorities to develop a high voltage high wattage resistor for

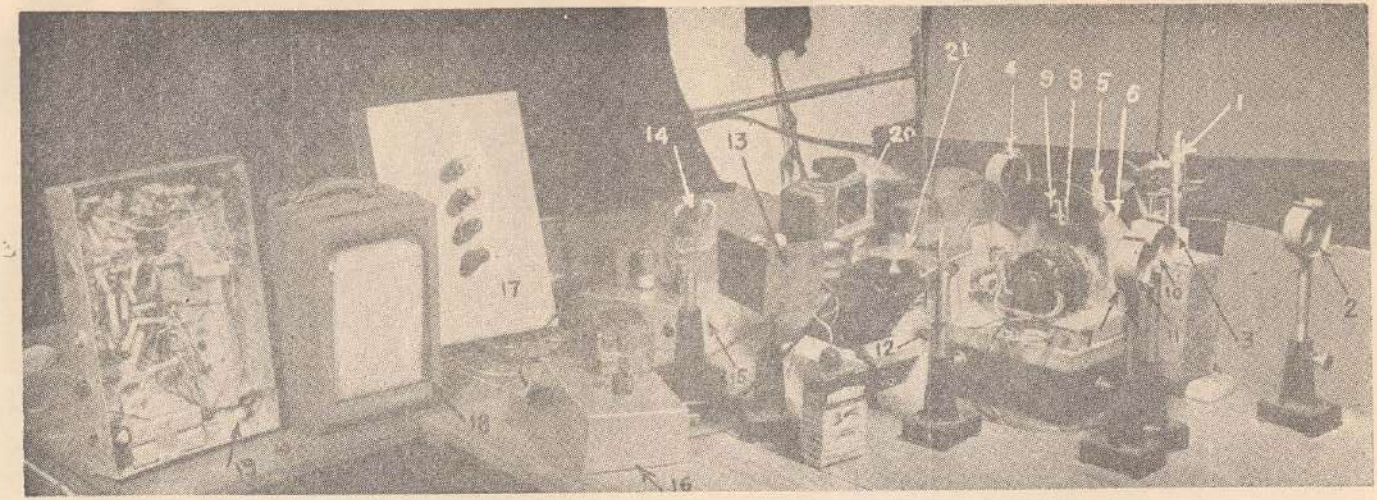

Fig. 19 PARTS OF THE INFRARED SPECTROPHOTOMETER

1. Source (g lobar) of infrared radiation
2. Concave mirror radius of curvature 25 cms
3. Stand for keeping the sample
4. Concave mirror radius of curvature 25 cms
5. Plane mirror to focus light on the entrance slit
6. Chopper plate of fibre carrying 32 slots and mounted on the axle of of the 1500 r.p.m. motor shown in the figure
7. Chopper plate containing the entrance slit just behind the filter plate 8. This plate contains a horizontal narrow slit which allows light from a tungsten lamp (24 volt) in front of the plate to fall on the photocell assembly at 22 behind the plate.
8. F center doped NaCI filter.
9. Plane mirror moving about a vertical axis and throwing light on mirror 10
10. Concave mirror of curvature 50 cms illuminating the grating
11. Concave mirror of curvature 50 cms focussing the image on the exit slit 12. The two mirrors and the grating 20 are in Czerny-Turner mounting. The entrance slit is at the focus of mirror 10 so that the emerging beam is parallel
12. Exit slit
13. Lead sulphide assembly
14. Concave mirror to focus light fro m exit slit on PbS cell
15. Preamplifier for photocell
16. Preamplifier for PbS cell
17. Phase sensitive detector
18. Esterline Angus recorder
19. Stabilished power supply of 300 volts
20. Grating mount
21. Disc to move the grating by hand and to note its rotation magnified 25 times.
22. Photocell assembly
23. Motor to turn the grating below the table.

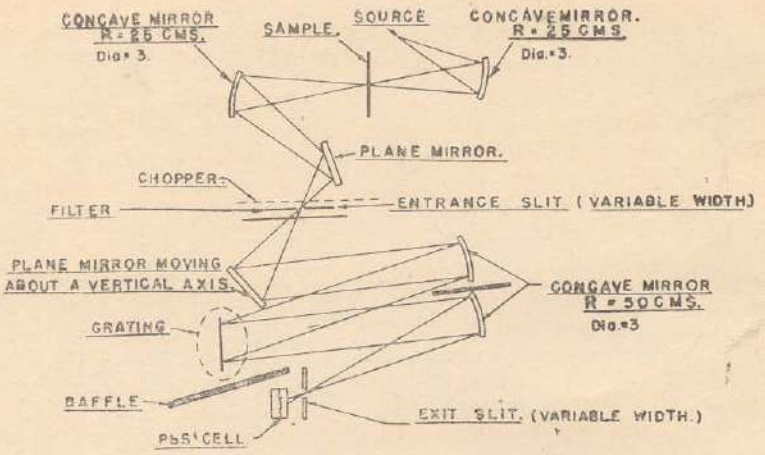

Fig. 20. Optical Layout.

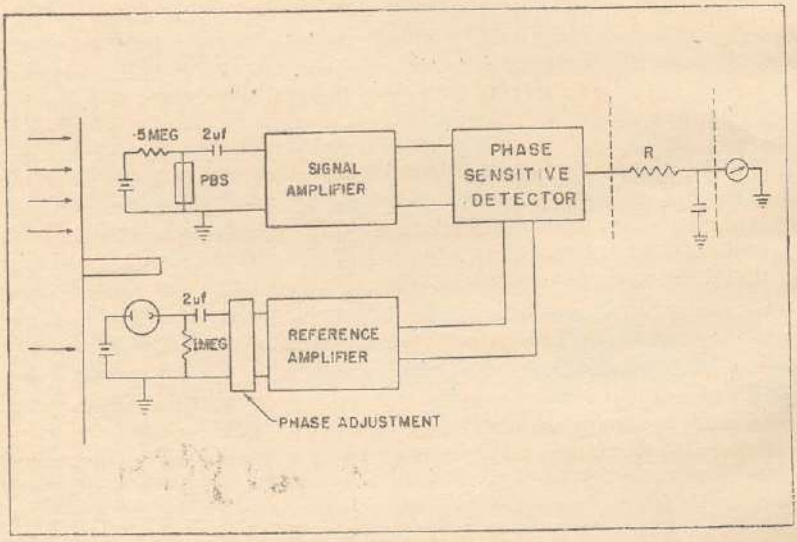

Fig. 21. Electronic Circuit.

use in a very strategic equipment. The problem was solved in a matter of few days and a number of resistors were fabricated which have been used in the strategic equipments.

3. STANDARDS

The Laboratory is the custodian of Primary and Derived standards, Research on and Maintenance of standards are being given high priority. This has been designated as one of the foremost obligations of the Laboratory to the country.

The Laboratory maintains the following Primary and Derived Standards against which Sub-Standards, Working Standards and Instruments are calibrated for the industry, and other laboratories :

Length, Mass, Time and Frequency, Area, Volume, Density, Speed, Acceleration, Force, Atmospheric. Pressure, Sound pressure (Sound Intensity), Vibration Amplitude, Mechanical Power, Viscosity.

Current, Resistance, EMF, Power, Inductance, Capacitance, (for all frequencies).

Practical Temperature Scale from—183 to all temperatures above it (Celsius Temp. Scale).

Luminous Intensity, Secondary Standards of Colour, Temperature of Luminous Intensity and Flux ranges.

4. CALIBRATION AND TESTING

Calibration of Differential Thermometers

Copper resistance thermometers have been made and calibrated in the range 0°C to 100°C. They have been used to calibrate differential (*e.g.*, Beckmann) thermometers graduated upto 0·001 deg.

Thermometer Comparator

Improvements were made in all types of thermometers, but a comparator for temperature range 5°C to 95°C has been specially developed to do large scale testing in test houses and manufacturing centres.

Testing of Sirens

The effective range of a siren depends upon the background noise prevailling at the point of listening. Apart from the noise at the listening point, other factors determining the audibility of a siren are (*a*) height and location of the siren, (*b*) obstacles between the siren and the listening point, (*c*) nature and density of the built up area around the listening point

and (*d*) the nature of terrain between the siren and the listening point and overgrowth of trees and shrubberies on the path.

It is also found that the radiation of sound from a siren is not uniform in all directions. The complex directionality patterns of one type of machine is as shown in (Fig. 24).

This study would enable the civic security authorities to locate the sirens at proper places in important cities and towns so that the sirens could be heard by all people when the signals are given during periods of emergency.

Tests on Pandrol Clips

A pandrol clip is an elastic fastener used to hold the rail and the sleeper together on a rail track. This represents an improvement which the Indian Railways now plan to introduce over the conventional rigid fastener now in use. The pandrol clips have been found to provide better fastening for rail tracks meant for heavy duty traffic (*i.e.*, large accelerations, high speeds and bigger loads). Such clips are being used on the British railways. It has been estimated that for heavy duty traffic the force with which the clip must hold the rail and the sleeper together (also called the toe load), is approximately 1500 lbs. The test scheme described here was devised by the National Physical Laboratory at the request of the Engineer-in-Chief, Northern Railway to measure this toe load.

The scheme envisages the introduction of two pieces of paper, one on either side, between the rail piece (6" long) and the rail seat before the clips are driven. The sleeper is fitted upside down (it can be fitted right side up also with equal facility) with suitable clamps to the movable crosshead in an 'Amsler' Universal Testing Machine. Similar clamps are fitted to the web of the rail and fixed to the fixed cross-head of the testing machine. Load is now applied which, in effect, means that the rail piece is pulled vertically from the rail seat. The load indicated at the time when it is possible to pull out the two pieces of paper is the toe load exerted by the two clips together.

Tests on Steering Wheels : Design of the Conditioning Chamber

A small scale ancilliary unit for the manufacture of steering wheels has come up near Delhi. The wheels will be supplied to vehicle manufacturers in the private and public sectors. One of the reliability tests for the wheels is the hot and cold test in which the steering wheel is taken through a temperature cycle from 175°F to −40°F to determine its resistance to cracking, breaking, warping, discolouring, etc. The conditioning chamber was designed and fabricated to condition the specimen at the lower temperature of −40°F.

5. SERVICE

The broadcast of standard frequency and time signals are carried out from the station 'ATA' located at Kalkaji, South of Delhi. The

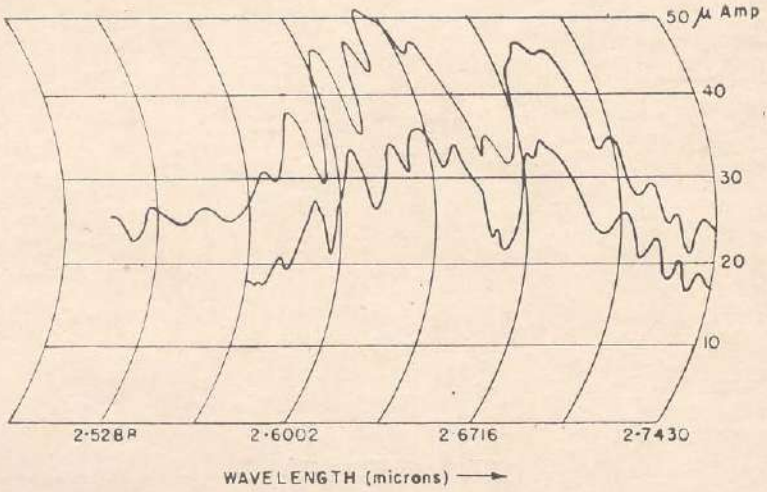

Fig. 22. Atmospheric water vapour bands between 2.52 and 2.74 microns taken with the instrument on an Esterline Angus Recorder. Two curves represent two repititions.

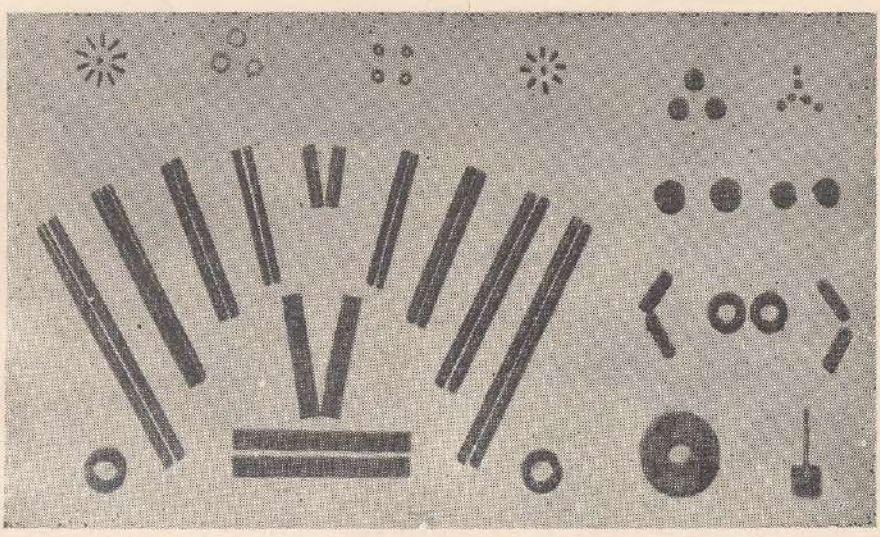

Fig. 23. Hard and Soft Ferrite Products used by the Electronic Industry.

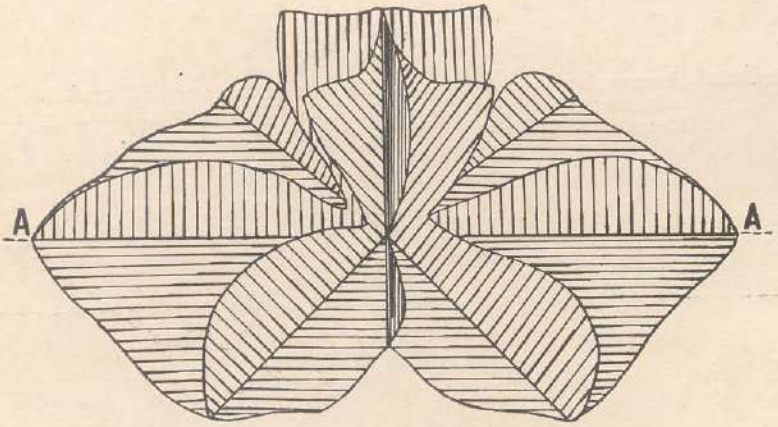

Fig. 24. Directionality Patterns of Sound Radiation from a Siren (AA—Axis of Siren).

standard carrier frequency is of ten megacycles, modulated with signal consisting of seconds pulse, minutes pulse and thousand cycles tone. An announcement is made through an automatic mechanism in morse code giving the station call sign and the time in universal pips. A voice announcement is also made to give the location and the call sign of the station and maintenance and broacast of time standards at ATA, the Indian Standard Time from a speaking clock system in conjunction with the automatic mechanism. The broadcast is carried out on all working days during 11·00 hrs to 13·00 hrs IST. The high precision required for such broadcast is achieved by the inter-comparison of the standard oscillators among themselves and by continuous recording of the beat frequency between them in a beat modulator counter. Also every day checks of the broadcast are made against similar broadcast stations established in other countries.

A.R. VERMA.

DIRECTOR

APPENDIX I

RESEARCH PROJECTS

Code No.	*Project*	*Progress*	*Project Team*	*Reference**
A/R/1	Propagation of Sound Waves in Granular Media.	A comprehensive study has been carried out on the propagation of sound waves through sand and soil. Measurements on the determination of porosity, density, flow resistance, propagation constant, characteristic impedance, transmission loss, absorption and reflection coefficient, structure factor and velocity in a large number of sand and soil samples of different grain size in the frequency range 1 to 30 kc/s were analysed. The dispersion in velocity is attributed to the viscous effects of the filling fluid and the grain size of the aggregate. Transmission loss measurements show an increase with frequency according to the "mass law". Effect of grain size on transmission loss is of type T.L. $\simeq$20 log K/r. The results can be used for estimating attenuation of sound in such media and for purposes of sound insulation.	Pancholy M & Bindal V.N.	A : 1, 9
A/R/2	Study of Kinetics by Ultrasonic Methods	From measurements carried out in a number of different types of chemically reactive systems of non-biological origin, the activation energy and enthalpy changes have been calculated and the data obtained by this	Pancholy M. & Saxena T.K & Singal S.P	A : 3, 4, 6 & 8

*References are to Appendix XI.

Code No.	Project	Progress	Project Team	Reference
		method correlated with those from other methods. Ionisation of indicator phenophthalein and dimirisation reactions have been studied and measurements have also been made in enzyme systems. For enzyme urease, ultrasonic relaxation was observed and rate of formation of enzyme complex was studied. The results show that using ultrasonic technique kinetics of fast chemical reactions can be studied and physico-chemical constants such as the rate of reaction, volume change, activation, energy, heat of reaction and equilibrium constant can be determined.		
A/R/3	Response of Loudspeakers to warble Tones	Measurements have been made on several loudspeakers of different qualities. Overall frequency response, frequency response in a limited region and transient response has been taken. Damping coefficients have also been measured. The results show that amplitude modulation occurs in regions where the frequency response changes rapidly.	Chhapgar A.F. Pancholy M. Sharwan Kumar	
A/R/4	Absorption of Sound by Indigenous Wedge Structures.	In a 16″×16″ impedance duct, samples of foamed polyurethene were measured to determine optimum dimensions of base depth, overall length and air gap. Other materials examined were foamed polyurethene shreds, mineral wool and fibre glass enclosed in wire mesh cages. Fibre glass with a density of 9 lb./c. ft. packed in a cage of 100 cm.		

Code No.	Project	Progress	Project Team	Reference
		length and 20 cm. base depth, coupled with a resonator in the base, is found to give an absorption of 99% at 105 c/s.		
A/R/5	Phyical Aspects of Architectural Acoustics.	Field measurements on two more halls have been taken and the data analysed. Model studies on two halls which had been measured earlier were completed as regards sound distribution. For this purpose, a logarithmic amplifier has been assembled.	Pancholy M. Chhapgar A.F. & Davinder Singh	A : 2
A/R/6	Noise Survey	A noise survey of Calcutta city, including day - time traffic noise, night - time noise, noise due to offensive trades, etc., has been completed and results are being analysed. Equipment for measurement of noise given out by individual automobiles has been standardised and some pilot observations undertaken.	Pancholy M. Chhapgar A.F. and Singal S.P.	
A/R/7	Study of Steels by Ultrasonics.	Equipment required for measurements on ultrasonic velocity and absorption in different varieties of indigenous steel samples subjected to different heat treatments has been designed and assembled. These include pulsed radio frequency generators in the range 4 to 44 Mc/s, positive and negative pulse outputs of duration 0·5 μ sec. to a few m. sec. and repitition of one in 0.3 sec. to 100000 sec., necessary regulated power supplies, radio frequency receivers and demodulators, mixer units and matching	Pancholy M. and Sharwan Kumar.	

Code No.	Project	Progress	Projcet Team	Reference
		circuits and ancillary equipment like furnace upto 800°C., crystal holders and cooling unit.		
AC/R/1	Use of Cinnamic Acid Derivatives in Inorganic Analysis.	Cinnamic acid alone has been used for the precipitation of titanium and estimation therefrom by ignition. In an extended investigation from this laboratory methoxy, hydroxy and nitroderivative of cinnamic acid have been used as precipitants for thorium. The same has now been extended to Titanium Zirconium, and Uranium (vi). pH conditions for the complcte precipitation of these ions have been worked out. Precipitation in each case is effected at pH value lower than with the conventional reagents, thus making it possible to affect the separations of the aforementioned ions from Cobalt, Zinc, Copper, Rare earths and Iron etc., This has application in the analysis of certain types of alloys in which titanium is present in small quantities.	Gupta, P.K. Verma M.R. and Agarwal K.C.	
AC/R/2	Nitroso Derivatives of Substituted Diaryl Amines.	Nitroso diphenylamine has been used as a colorimetric reagent for palladium. The method is not applicable to larger quantities of palladium, as a flocculent material starts separating out at higher concentration of the metal.	Gupta P.K. and Verma M.R.	

Code No.	Project	Progress	Project Team	Reference
		Sulphonic derivatives are generally water soluble. In order to test this, nitroso derivative of diphenylamine-sulphonic acid was prepared. As a first step, absorption spectra of this palladium salt at various pH values were plotted and optimum conditions for this estimation of palladium worked out. Preliminary experiments indicated that by using the above reagent, larger quantities of palladium can be estimated. Nitroso derivative of Phenyl β— naphthyl amine have also been prepared; a preliminary study of its possible use as the reagent for palladium has also been carried out.		
AC/R/3	Estimation of Phenyl β-naphthylamine.	Above compound (PBNA for short) is an important antioxidant used in rubber compounding. In the conventional procedures its estimation is carried out by measuring the absorption of its solution at 310 mμ. Coloured product, however, is obtained by condensing this with diazotised derivative of nitroaniline, sulphanilic acid or other amine sulphonic acids. Absorption spectra of these have been taken and optimum conditions for the estimation of PBNA worked out. A paper on this subject was presented at the annual	Guppta P.K. and Verma M.R.	

Code No.	Project	Progress	Project Team	Reference
		meeting of Rubber Research Association held in Delhi.		
AC/R/4	Thin Layer Chromatography of Dyes used in Tablets and Fluids and other speciality Inks.	Red, blue, violet, green and black dyes which are normally used in the preparation of writing inks, fluids and tablets were collected and their chromatographic behaviour on silica gel coated glass was studied using various eluents. Ink blue showed several spots showing that the dye normally available contains several isomers. This method was applied to the identification of dyes present in commercially marketted inks. Of the 20 samples of the inks examined dyes used in 19 of these could be identified. Several speciality inks particulary imported recorder inks were analysed and the dye used in these was identified.	Rai J. and Verma M.R.	AC: 1
AC/R/5	Studies in Thin Layer Chromatography of Inorganic ions Part I, Separation and Identification of Co, Ni, Cu, Zn and Cd.	Several metal ions, particullarly, copper, zinc, cadmium, nickel and cobalt form metal complexes which thiocyanate, In the presence of Pyridine, these became soluble in organic solvents due to a formation of Me (SCN) nPym. Chromatographic behaviour of the above mentioned ions has been studied on silica gel coated glass plate using several eluents. Gener-	Rai J. and Verma M.R.	AC : 2

Code No.	Project	Progress	Project Team	Reference
		al composition of eluents was alkalithiocyanate alcohol-tetra-methylamonium hydroxide and pyridine α-picoline/methyl ethyl ketone etc. Well defined spots are obtained. This technique can be extended to the separation of the above ions from a mixture		
AC/R/6	Complexometric Determination of Thorium and Chromium in the presence of one another	Methods have been developed for the estimation of thorium and chromium from a mixture by complexometric titration. The reaction between thorium and a typical complexone is instantaneous while that between chromium and complexone is slow, and can be completed only on boiling. The former complex is colourless and latter is highly coloured and has an absorption band at 540mμ. A combination of volumetric & spectrophotometric method has been used for the estimation of these two metal ions in the presence of one another. This has applicatication in the analysis of thorium-chromium alloys, the available method of analysis for which is very complicated. Paper is ready for publication.	Amar V.K. Agarwal K.C. and Verma M.R.	
AC/R/7	Studies on Metal oxalate Complexes Part I.	Copper, nickel and iron form with oxalate ions respectively blue, green and yellow complexes, each one of these is stable over a fair	(Mrs.) Padma Narayan and Bhuchar V.M.	

Code No.	Project	Progress	Project Team	Reference
	Spectrophotometric Determination of Iron, Nickel and Copper in the presence of each other.	range of pH values. Equations have been developed for the determination of the above mentioned metal ions from a mixture by taking the absorption (Optical density) of the oxalate complex at 730, 390, and 370 mu. Satisfactory results have been obtained. In particular this method is of special value for the analysis of Cupro-nickel alloys. Considerable amount of economy of time and chemicals is affected by adopting the above mentioned method.		
AC/R/8	Studies in Metal Oxalate Complexes Part II. Determination of Traces of Iron in some pure Metals.	As an extension of the above it was noted that iron oxalate complex has a particularly high absorption in the ultra-violet region. Measurement of absorption at 320 mμ and application of principles of differential spectrophotometry have been applied for the determination of iron content of pure metals like nickel, aluminium zinc and copper. Several samples were analysed using thiocyanate (ASTM) and Nitroso-Resalt (BSS) and the results compared with the oxalate method. Satisfactory concordance was obtained. The method is being examined at the Mint, Govt. of India, for its applicability to the analysis of coins of various denominations.	Kukreja V.P. and Bhuchar V.M.	
H/R/1	Gold Point by	In gots, at least three each, weighing 1500 g of gold of	Bansal T.D. Wasan V.P.	

Code No.	Project	Progress	Project Team	Reference
	Wire Method.	high purity (99·9999%) are required for precisely realising the Gold Point of the IPTS. These were not available. The wire method for this purpose which is ordinarily considered to have a reproducibility of 1 deg, has been improvised to give a reproducibility of 0·1 deg. at 1063°C.	and Kukerja H.R.	
H/R/2	Time of Response of Oral Type/-Rectal Type Clinical Thermometers.	As a result of this research the ISI has adopted a response time of 7·5 s to 8 s during 1964-65. Mathematical analysis showed that the wall of thermometer bulb can probably be thickened several fold without appreciably increasing the time of response. The work has been sent for publication. Investigations on rectal type clinical Thermometers show that similar considerations hold good in this case also.	Bansal T.D. Sastry K.S. Sharma M.M. and Tolani M.H.	
H/R/3	Copper Resistance Thermometers.	Resistance thermometers using enamelled copper wire were made and calibrated. They were found suitable for measuring temperature differentials in the 0°C to 100°C range. They have been utilised for calibrating Glass Type Differential Thermometers (Beckmann) graduated to 0·01 deg. The work showed that they can be safely used for even least counts of 0·001 deg.	Bansal T.D. and Wasan V.P.	
H/R/4	Radial Flow	It is well known that the usual methods of determin-	Bansal T.D. Sastry K.S.	

Code No.	Project	Progress	Project Team	Reference
	Method of Determining Thermal Conductivity of Blocks of Large Aggregates.	ing thermal conductivity cannot be used for cement concretes which are used in Engineering, because the aggregates are very large. This determination has been done abroad after making the actual structures or by using semi-arbitrary and indirect methods using complicated equipments. These methods again put limitations on size of aggregates. The steady state radial flow method of finding conductivity, using guard cylinders, has been developed to a stage where it could be precisely used for concretes having aggregates of any size. The reproducibility is of the order of 1 to 2% and accuracy of 5%. The method does not involve any special equipment and can be applied to test blocks so that the results can be used for design of large masonary structures much before actual construction. The effect of age of concrete on the k-value has also been studied in a particular type of heavy concrete. The work has been utilised by the Rajasthan Atomic Power Project.		
H/R/5	Bulk Density of Indian Mineral Wools.	Density of an insulating fluffy material under specified load is known as Bulk Density in Insulation Engineering Practice. This property was determined, according to a method proposed by ISI, for 8 types of	Wasan V.P. Kukreja H.R.	

Code No.	Project	Progress	Project Team	Reference
		mineral wools (*i.e.* glass wool, slag wool, rock wool) at 10 different loads using 15 samples in each case. This involved 1200 determinations. The results were analysed statistically and suitable values of this property for different materials were suggested to ISI. The results have been adopted by ISI in two specifications, at the Jan. 1966 meeting.		
IP/R/1	*Particle size distribution and permeability studies.*			
IP/R/1.1	Battery Separators	Effieiency of a battery separator is better if the calculated resistance is low and if the product of porosity function and surface area is high. It has also been found that separators of high porosity are better, but the porosity should not be due to closed pores since closed pores cause an increase in resistance. There is an optimum pore size distribution which gives better performance.	John P.T.	IP : 3
IP/R/1.2	P.V.C. Powders for Battery Separators	Particle size distribution of industrial PVC powders have been determined. A successful method of sintering the PVC powders has	John P.T.	

Code No.	Project	Progress	Project Team	Reference
		been developed, which enabled open porosity to be equal to the theoretical porosity.		
IP/R/1.3	Adsorption studies.	Adsorption of water vapour, CCl_4, oil. etc. by carbon brushes, battery separators, timber, etc. was determined. Two papers have been published. A,B. E.T. apparatus is being set up.	John P.Ts	IP : 4 & 5
IP/R/2	Study of Rheological Properlies.	The parallel plate method of determining rubberlike modulus and relaxation time for shell and core mixes has been completed.	Chari S.S.	
LT/R/1	Study of of Torsional and Young's Modulii of Thin Metallic Rods at Low Temperatures.	A cryostat has been fabricated to measure torsional and Young's modulii of thin metallic rods at liquid air temperatures. Preliminary measurements are being made to check the cryostat. This work is based on the methods developed earlier. Jr. of Sc. Inst., *39*, 145 (1962) ibid *41*, 662 (1964).	Baveja K.D.	
LT/R/2	Specific Heat Measurement of Alloys and Magnetic Materials	The main cryostat along with its components was constructed and tested. To improve the accuracy of measurements a feed-back type d.c. galvanometer amplifier has been put to use. The whole apparatus has been under trial runs. The arrangement for automatic switching on and off the electric heating current has been designed. In order to prepare specimens of metals and alloys for the specific heat measurements, a high	Dhillon J.S. and Sharma R.G.	

Code No.	Project	Progress	Project Team	Reference
		vacuum furnace was designed and fabricated. The high vacuum system is at present under test.		
LT/R/3	De Haas-van Alphen Effect in Dilute Bismuth Alloys.	Most of the parts of the cryostat were made and assembled.	Dhillon J.S. and Reddy Y.S.	
LT/R/4	Theoretical Study of Fermi Surfaces of Metals and Alloys.	The Green's function method of band structure was studied in detail. The phase shifts needed in this method were obtained for copper and their variation for the Hartree Fock Slater and Wakoh potentials was studied.	Sundaram R.	
LT/R/5	Electrical and Thermal Conductivities of Dilute Magnetic Alloys.	Data on dilute magnetic alloys were analysed and a possible explanation of the anomalous behaviour was offered. Proc. Phys. Soc. (Lond), *78*, 1361 (1961); ibid *79*, 1216 (1962); Nature, *194*, 955 (1962); and Phys. Stat. Sol. *7*, 53 (1964). The cryostat has been improved and some measurements made at liquid Nitrogen and liquid Helium temperatures on an alloy of silver containing 0·095 atoms per cent of manganese in solid solution.	Chari M.S.R and Shankaranatatajan N.	LT : 1
OPT/R/1	Colorimetric Studies.	The comparative study of difference matching functions in use for spectrophotometric evalution of colour has been completed.	Das S.R.	OPT : 1
OPT/R/2	Gas Discharge Studies.	The residual intensities of spectral lines in high pressure mercury lamps	Das S.R. Dandawate V.D.	OPT : 2, 3 & 4

Code No.	Project	Progress	Project Team	Reference
		have been studied and correlated with the excitation potentials of the respective lines. An apparatus has been set up for the probe measurement of the collision phenomenon in gaseous discharges, under controlled conditions.		
OPT/R/3	Signal Colour Recognition.	Data on signal colour recognition have been collected and analysed for the purpose of specifying the limiting boundaries of signal colours under Indian conditions.	Das S.R. Partha- S. sarathi Manamohanan B.	OPT : 5
OPT/R/4	Daylight Studies.	The spectral distribution of north skylight in Delhi has been measured under varied conditions over a period of one year. Part of the data has been analysed and fitted to the normalising factors proposed by others, to evaluate the typical daylight distribution for Delhi.	Das S.R. Sastri P.V.D. Manamohnan B.	OPT : 6
OPT/R/5	Irradiance Distribution in Fringes of Superposition.	Theoretical calculations have been made on the effect of coupling between the etalons on interference fringes of superposition for dielectric as well as metal mirrors and experimental measurements have been started.	Sen D. Pumtambekar P.N.	OPT : 7
OPT/R/6	Study of Excitation Conditions in Spectroscopic Sources.	A detailed study has been made of the transition probabilities, oscillator strengths and electron transition moments in different sources for molecules like N_2, CO, A, O, CN, NS and OH, which have astrophysical and aeronomical interest.	Joshi K.C. Sastri P.V.D. Parthasarathi S.	OPT : 1/0/5

Code No.	Project	Progress	Project Team	Reference
OPT/R/7	Optical Properties of Thin Films.	The work on colorimetric properties of thin metal and dielectric films has been completed. An apparatus has been set up and work started for the measurement of spectral reflectance of thin films at normal incidence for the determination of n and k values. A method has been developed for the preparation of thin films without substrate.	Singh R.G. Shanta Mrs. Bai M. Mrs. Marwah R.	OPT : 16 to 18
RPU/ R/1	Ionospheric True Heights	IQSY project IARIIBM computer 1620 is being regularly used for the reduction of the ionograms to true height profiles.	Saha A.K. Mahajan K.K.	RPU : 6
RPU/ R/2	Use of Satellite Drag Observations for the Atmospheric Density Determinations.	A new atmospheric model for solar minimum conditions has been developed and is being published in the Journal of Atmospheric Sciences, USA.	Mitra A.P. Bhatnagar V.P. Saha A.K.	
RPU/ R/3	Satellite Studies of the Outer Ionosphere.	Regular trackings of satellite S-66 and BE.C being made under IQSY and COSPAR cooperative programmes. Results were presented at the Second International Symposium on Radio Astronomical and Satellite Studies of the Atmosphere held at Boston U.S.A, in October, 1965.	Somayajulu Y.V. Tuli Ram Tyagi Bhatnagar V.P.	RPU : 10 and 11
RPU/ R/4	Rocket Sounding of the Ionosphere.	Prototype payload of a new experiment conceived by Somayajulu and Mitra was constructed by Somayajulu at Goddard and has been kept at Goddard Space Flight	Somayajulu Y.V. Rao M.N.M.	

Code No.	Project	Progress	Project Team	Reference
		Centre, NASA for integrated flight from Wallops Island, USA. Two more playloads are being built for flights from Thumba. Concept of new experiment presented at the Second International Conference on Aeronomy, Illinois, USA in Sept :, 1965.		
RPU/ R/5	Ionosperic Effects of Nuclear Explosions.	All recorded explosion effects have been analysed. Results published in RPU Report Nos. 18 and 20 being published in Ind. Jour· Appl. Phys. The project is completed.	Saha A.K. Mitra A.P. Mahajan K.K. Mitra N.R.	RPU : 8 and 9
RPU/ R/6	Multi Frequency Riometers.	IQSY Project. All 3 Riometers are working well. A new multifrequency analysis technique has been developed and presented at Second International Symposium on Radio Astronomical and Satellite Studies of the atmosphere at Boston, USA in Oct.'65.	Somayajulu Y.V. Mitra A.P. Srivastava R.N. Ranganathan T.N.	
RPU/ R/7	Solar Riometer.	IQSY project. Working well and regular observations of solar radio flux are available. Equipment was calibrated with a horn built in NPL in January, 1966·	Rao M.N. Mukerjee A.K.	RPU : 12
RPU/ R/8	Equatorial Ionosphere.	Plasma Diffusion in the ionosphere was studied and the results are published in the Journal of Atmospheric and Terrestrial Physics U.K. A new work on close relationship between exospheric tempratures and F region ionization has been completed.	Mitra A.P. Chandra S. Narasinga Rao B.C. Rangswamy S.	RPU ; 27
RPU/ R/9	Physics of the D region :	An entirely new and comprehensive approach to ion kinetics has been made. This	Mitra A.P. Somayajulu Y.V.	

Code No.	Project	Progress	Project Team	Reference
		is considered to be a major break through.	Srivastava R.N.	
RPU/ R/10	Studdy of F layer Effects with Doppler Fading Technique. A. PL-480 project.	Equipment is working well at Calcutta. Two flare events were recorded.	Mitra A.P. Saha A.K. Subramaniyam C.V.	
SSP/ R/1	Purification, Doping and Processing Solid Materials.	Experimental set up to grow crystals has been improved and larger crystals of better quality have been obtained. Equipment for cutting wafers of crystals and polishing them has now been set up and is working satisfactorily.	Parashar D.C. Sootha G.D. Narendra Kumar Mahadevan J. Singh C.P. Sharda G.D. Seth G.L.	
SSP/ R/2	Study of High Temperature Properties of Metals	The measurements of the conductivity are made in the temperature range 1200°K to to 1400°K by ' the self heating' method (Worthing and Holliday 1948, Krishnan and and Jain 1954). Possible sources of error in the method are discussed and methods to improve the accuracy are suggested. The results show a large discrepancy with the values reported by Angell (1911). However in the lower temperature range, Angell's results do not agree with the measurements of Schofield (1925) and others. The results obtained agree with measurements of Schofield and others below 1200°K extrapolated to higher temprratures.	Goel T.C. Jain S.C. Verma N.S. Narendra Kumar	

Code No.	Project	Progress	Project Team	Reference
SSP/R/3	Study of Colour Centres in Ionic Crystals	(a) *Electronic Conduction in Additivity Coloured KCI crystals* Measurements of the electrical conductivity of additively coloured crystals heated in dark are made for temperature ranges between 100° to 500°C. It is found that the ratio of the conductivity of the coloured crystal to the conductivity of the normal crystal remains practically 1 upto about 300°C. Above 300°C the ratio increases. It attains a maximum value much larger than unity between 400°—450°C and then decreases at higher temperatures. Contribution to the electrical conductivity by the ionized F centres is found to be negligible in this temperature range. An intimate correlation is found between this increase in the ratio and the metallic colloid absorption band peaking at 7300A. The results are interpreted in terms of electronic conductivity due to thermionic emission from the colloid particles into the conduction band of the KCI crystals. The observed temperature variation of the electronic conductivity yields of value of 0·32 *e*V for the electron affinity of KCI crystals. The temperature at which the maximum of σ occurs vary from 400° to 450°C when the excess metal concentration in the crystal changes from $3{\cdot}8 \times 10^{17}$ per cm^3 to $1{\cdot}0 \times 10^{18}$ per cm^3. The observed variation of the peak position on the excess metal concentration supports the view that	Jain S.C. Mehendru P.C. Parashar D.C. Sootha G.D. Mahadevan J Jain R.K.	

heterogenous equilibrium exists between the F centres and the colloids, and yields a value of 0·8 *eV* for the energy of formation of an F center from the colloid center.

(*b*) *Ionic conductivity of Cobalt-activated sodium chloride crystals*

The results of ionic conductivity measurements on sodium chloride crystals doped with cobalt are obtained in the impurity range. For the same temperature and concentration of the impurity, σ the conductivity is higher for the cobalt than for the nickel impurity. Unlike in the case of nickel-doped crystals, the value of σ for cobalt-doped crystals does not show any decrease for even larger concentrations of cobalt impurity. The energy of association for cobalt ion with positive ion vacancy is found to be 0·3 *eV*., a value close to that obtained for the nickel impurity.

(*c*) *Evidence of Different Types of F centers from Thermoluminescence Studies in X-irradiated Alkali Halides I Highly Pure KCl crystals*

Two thermoluminescence peaks are observed at 135 and 190°C in highly pure KCl crystals (divalent impurity concentration $\leqslant 1$ ppm) *x*-irradiated at room temperature and heated at 40°C per min. Utmost care was taken to avoid exposure of the crystals to light and

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the concentration of M and other aggregate centers remained negligible in these experiments. The growths of the area δ_i and δ_g under the first and the second peaks with the time of x-irradiation, are found to obey the equations given by Mitchell, Wiegand, and Smoluchowski for the growth of the concentration f_i and f_g of the first stage and the second stage F centers, respectively. From this result and from the observation that the ratio $\delta_i/f_i = \delta_g/f_g$ remains constant in a variety of crystals (irradiated for different times or with different X-ray intensities, quenched, slowly cooled or partially bleached), it is concluded that all the thermoluminescence is due to F centers and that the 135° and 190°C peaks correspond separately to the bleaching of the first stage and the second stage F centers, respectively. The values of the parameters in the equations given by Mitchell et al., are derived from the observed growths of δ_i and δ_g and are found to be in agreement with the values obtained by Mitchell et al. The reduction in the area under the thermoluminescence curve on partial optical or thermal bleaching is found to be proportional to the reduction in the F center density. However, optica bleaching reduces both thermoluminescence peaks, whereas thermal bleaching upto about 100°C reduces mainly the first peak. It is found that complete thermal bleaching does not destroy

Code No.	Project	Progress	Project Team	Referedce

all the vacancies generated during the irradiation but disperses some of them more uniformly. Both thermoluminescence peaks are found to correspond to a first order process ; therefore, it is concluded that the retrapping of the electrons released from the F centers is negligible. The activation energies of the two peaks are 1·05—0·05 and 1·15—0·05 eV, respectively. This indicates that thermal bleaching of the second stage F centers at higher temperatures is not due to the retrapping of the electrons by anion vacancies, as concluded by some earlier workers, but to differences in the energies of thermal ionization of the two types of F centers. Possible mechanisms which can give rise to differences in thermal ionization energies are tentatively suggested. These rerults are not inconsistent with the view that the first stage F centers are formed by the vacancies present in the crystal prior to irradiation and are distributed uniformly in the crystal, and that the second stage F centers are formed by the vacancies generated in the crystal during the irradiation process, perhaps near a defect, and are present in small regions of high local concentrations. Result of preliminary experiments indicate that the calcium impurity introduces a new thermoluminescence peak at 85°C, enhances the 135°C peak, and suppresses considerably the 190°C peak. Deformation introduces an additional peak

Code No.	Project	Progress	Project Team	Reference
		at 270°C and reduces the rate of growth of the second peak at 190°C. The parameter 'a' defining the observed rate of generation of new vacancies varies approximately as the square of the intensity of x-irradiation in agreement with the observation of Mitchell et al. and the more recent observation of Abramson and Caspari.		
SSP/R/4	Study of Optical Electrical and other Properiics of Thin Films	Electrical conductivity of thin vanadium and titanium films has been measured under different experimental conditions. The optical reflection measurements are being made and the results are being consolidated to evaluate the structure of thin films.	Jain S.C. Jain V.K. Devindra Singh Ramesh Chander	
SSP/R/5	Physical Properties of and Irradiation Effect on Ionic Crystals and Semi-conductors	Measurement of electrical conductivity of 4 LiF crystals (3 pure crystals of different origins and one doped with 0·01 mole % of Ti) has been obtained. The results suggest that Ti is present as a doubly positively charged ion in LiF. The following energy values are derived: 2·74 eV for the energy of formation of a separated pair of Schottky vacancies, 0·70 eV for the energy of activation for the migration of a cation vacancy and 0·48 eV for the energy of activation for the migration of a cation vacancy and 0·48 eV for the energy of association of Ti with a cation vacancy.	Jain S.C. Jain V.K. Kishan Lal	
SSP/R/6	Ultrasonic Attenuation, In-	A timing unit to interpolate-time-delay between quartz controlled time markers 3μ	Dayal C.R.	

Code No.	Project	Progress	Project Team	Reference
	ternal Friction and Elastic Constants of Metal and Alloy Crystals	sec. apart was fabricated and performance tests were conducted. A liquid-air-liquid-nitrogen cryostat for ultrasonic attenuation and elastic constant measurements at these temperatures was modified and performance studies are being continued. A liquid-air, liquid-nitrogen cryostat for internal friction and elastic constants (at low frequencies) measurements was designed, fabricated and modified and is under test. The work on the following theoretical aspects was continued. (*i*) Electronic contributions to the temperature variations of elastic constant of normal metals of hexagonal crystal symmetry. (*ii*) Electronic contribution to the temperature variation of elastic constant of superconducting metals having hexagonal crystal symmetry. (*iii*) Electronic contributions to the thermal expansion coefficients of metals having hexagonal crystal symmetry. (*iv*) Thermo-elastic internal friction in metal having hexagonal crystal symmetry.		

Code No.	Project	Progress	Project Team	Reference
		(v) Thermal stress distribution in metallic solids with hexagonal crystal symmetry.		
TP/R/1	Dynamics of the Y (1815 MeV)$^{-05}$ KN Resonance.	A KN resonance at 1815 MeV has been established by an exact N/D calculation with spin parity assignment 5/2.	Aggarwal B.C.	TP : 7
TP/R/1	Analysis of KN Scattering by Exact N/D Method.	Phase shifts in satisfactory agreement with the experimental results have been obtained on the basis of a single particle exchange model. The Fermi Yang ambiguity has been removed.	Aggarwal S.C.	TP : 13
TP/R/3	Scattering in Broken SU (3).	Some new sum rules have been obtained on the basis of broken SU (3) models.	Gupta S.N. Pande L.K.	TP : 1
TP/R/4	T-violation and Electromagnetic Interactions.	It has been been shown that a violation of time reversal invariance through electromagnetic interactions can be observed by the study of Compton scattering.	Gyan Mohan Pande L.K. Mani H.S.	TP :6
TP/R/5	Bootstrap Possibilities of 70-plet of SU(6)	The possibility of bootstrap of a 70-plet in an SU (6) invariant static model has been established.	Gyan Mohan Pande L.K. Mani H.S.	TP : 12
TP/R/6	SU (n) Crossing Matrices. (in collaboration with T.I.F.R) Bombay.	A general method is evolved for obtaining any crossing matrices in an SU (n) symmetry.	Gyan Mohaa Pande L.K. Mani H.S. Virender Singh (TIFR)	TP : 10
TP/R/7	Landau Damping of Hydro-	The dispersion relations and damping coefficient for Hydromagnetic waves in a collision-	Bimla Booti	TP : 8

Code No.	Project	Progress	Project Team	Reference
	magnetic Waves.	less plasma are obtained by using the semi-phenomenological model of Winterberg which is modified to include the effects of Hall current. It is shown that the dispersion relation, for the case when the wave propagation is perpendicular to the direction of external uniform magnetic field, is unaffected by the Hall current. However, for the case when the wave propagation is parallel to the magnetic field, the Hall current modifies the expressions for the characteristic frequency and for the Landau damping of the Alfven Waves. It in fact decreases the damping coefficient. In the latter case, besides the Alfven mode there exists another mode but this is damped much more strongly.		
TP/R/8	Collisional Damping of Transverse Plasma Oscillations.	The effect of Coulomb collisions on the transverse electron oscillations in a fully ionised hot plasma is studied by means of the Fokker-Plank equation. The damping coefficient for the electron-ion collisions ri. It turns out to be much greater than the one for the electron-electron collisions *xk*.	Bimla Booti Jain T.K.	TP : 5
TP/R/9	Effect of Coulomb Collisions on Contra Streaming Plasmas (in collaboration with Delhi University	The instability of contrastreaming plasma is investigated taking into account the Coulomb Collisions via the Fokker-Plank co-efficients in the Boltzmann equation. The dispersion relation is obtained on the assumption that the Coulomb collisions are weak and solved on the additional phase velocity of the wave is much larger than	Bimla Booti Trehan S.K.	TP : 9 (D. Univ.)

Code No.	Project	Progress	Project Team	Reference
		the mean thermal velocity particles. It is found that while the temperature has the effect of increasing the maximum wave number rX_c (which for a cold plasma is equal to $(2)^{\frac{1}{2}}$ in units of W_p/U, where W_p is the electron plasma frequency and U is the streaming velocity below which electron plasma is unstable, the collisions have no effect on this wave number. However, the growth rate of maximum instablity decreases (compared to its value for a cold plasma) on taking into account the thermal motions but increases when the collisions are taken into account.		
TP/ R/10	Axial Vector Coupling Constant Renormalization in β-decay.	The renormalization of the axial vector coupling constant in decay has been computed in terms of the off-mass-shell pion nucleon vertex. The computed number agrees with the experimental results.	Gyan Mohan Mani H.S. Pande L.K.	TP : 15
XR/ R/1	X-ray Studies of Bismuth Sulpho-Tellurides.	The crystal structures of phases increasingly rich in sulphur from Bi_2STe_2 to Bi_2S_3 are to be investigated. A composition (rich in Te) $Bi_8S_4Te_{12}$ has been tried as well as one with composition $Bi_8S_5Te_7$. The latter has given an X-ray pattern very similar to tetradymite, Bi_2STe_2, which is rhomobohedral, space group R 3m. Single cryrtal rotation as well as a-axis zero level photographs have shown that $Bi_8S_5Te_7$ is a single phase composition. Accurate cell dimensions are being determined.	Ali S.Z. Kundra K.D.	

Code No.	Project	Progress	Project Team	Reference
		Composition $Bi_5S_3Te_{12}$ gave two phases, one isomorphous with Bi_{12} STe_2 and the other Te. Heating the composition mixture at 1000°C in sealed, evacuated fused silica capsules, quenching, and further heating to about 1100°C again yielded the same results.		
XR/R(2	High and Low-Temperature Phase Transformations in Semi-Conductor Crytals.	Bi_2 Se Te_2 a soft silvery material and of special technical interest in thermo-elec. tric devices. has been studied by the X-ray powder method in a unican high temperature camera. An excessively-ground powder was annealed in vacuum at about 470°C and X-ray photographs at room temperature to about 450°C were taken at successively higher temperatures. The expansion along the a_0 and c_0 axes was found to be non-uniform, with an arrest in the range 250-300°C. A room temperature photograph taken after the above series showed that the lattice parameters, had changed from the original values. Various periods of annealing failed to give constant a_0 and c_0 values at room temperature, and the high angle lines did not give well-resolved doublets. Another sample of the same composition but without excessive cold-work damage was annealed at about 575°C in vacuum and this yielded a much better pattern with sharp and well resolved high angle doublets. Lattice parameters, determined by the Straumanis technique and Cohen's least square method are ;	Ali S.Z. Kundra K.D.	

Code No.	Project	Progress	Project Team	Reference
		$a_0 = 4.303 \quad \cdot 0003°A$ $c_0 = 29.996 \quad \cdot 002°A$ This specimen has been studied at successively higher temperatures upto 525°C. The expansion along both the axes has again shown an arrest in temperature range slightly higher than the cold-worked sample.		
DNPL/R/1	Growing Single Crystals of Germanium and other Semi-Conductors.	The related equipment was completely designed and fabricated in N.P.L. A vacuum of the order of 10^{-6}mm. of mercury and a temperature of 1000°c was achieved in the apparatus, necessary to grow crystals of Ge. The crystal could not be grown so far, for want of suitable material of required purity. However, recently the instrument has been modified and the same is now used for deposition of thin films of metals and dielectrics. The preparation of thin film interference filters is undertaken and this work is in progress.	Shah V.V.	
DNPL/R/2	Growing Single Crystals	A vacuum system was designed and fabricated for use in the study of single crystals. This can be used as a vacuum deposition and vacuum sputtering unit with an arrangement for introducing a gaseous atmosphere. It also has a device for cleaving crystals in vacuum. Experiments are being carried on with the help of this apparatus on crystal made in the laboratory using the apparatus for crystal growth. This	Ved Prakash	

Code No.	Project	Progress	Project Team	Reference
		crystal growing apparatus was fabricated last year and demands some refinements to be made. These changes are now being incorporated in it. Work is in progress on the study of dislocation in single crystals using etch pit technique.		
DNPL/R/3	Study of Polytypism of Silicon Carbide.	'A' axis normal beam Weissenberg photographs for zero layer and equi-inclination photographs for first, second, third and fourth layers were taken for 6H polytype of silicon carbide by integrating Weissenberg camera. The three dimensional intensity data were collected by taking micro-photometer traces of individual spots and integrating their values with the help of intensity scale. These values were corrected for Lorentzpolarization factor and temperature factor. The calculations for the refinement of the atomic parameters and electron densities are under progress by three dimensional Fourier synthesis. It is proposed to study the electron density distribution in the above crystal with special reference to the effect of chemical bonds over electron densities.	Govind Singh	
DNPL/R/4	Study of Structure of Monolayers of Straight and	Several straight chain organic compounds *e.g.*, stearic, palmitic, behenic and margaric acid and branched chain fatty acids were prepared as manolayers by Langanuin Blodgett	Srivastava R.K.	

Code No.	Project	Progress	Project Team	Reference
	Branched Chain Fatty Acids.	method. Monolayer thickness was measured by multiple beam interferometry in the case of stearic and palmitic acids. Preparation of multilayers of some branched chain fatty acids is under progress. A detailed study of the structure of the above monolayers by electron microscopy and electron diffraction methods is to be undertaken in the future course of work.		
DNPL/R/5	Study of Electroluminescence of Phosphors.	Preparation of Macro-activated Strontium-Sulphide phosphors activated with Sodium Sulphate was tried without success.	Bhawalkar R.H.	
		Calcium and Zinc sulphide phosphors activated with copper have been successfully prepared. They are now being tried for electroluminescence. An electroluminescence cell has been prepared and various methods of getting electroluminescence are being tried.		
DNPL/R/6	Study of Surface features of Silicon Carbide Crystals.	Replicas of the silicon carbide crystal have been successfully prepared by three different techniques. After shadow-casting (in order to improve contrast) the prepared replicas are under observation in Electron Microscope, in order to study the surface features of the crystal. In this way replicas of the several different crystals of silicon	Bhalla A.S.	

Code No.	Project	Progress	Project Team	Reference
		carbide have been prepared for study. Due to the poor resolving power of the present Electron Microscope, (in transmission), good results could not be obtained. Thus it is proposed to continue the above study with the Philips EMZ-OO Electron Microscope, which is awaited.		
DNPL/R/7	Transmission Studies on Silicon Carbide Crystal	The experimental set up for the measurement of the optical absorption in visible region was modified. The set up was extended to study the absorption in the Ultra violet region. The photomultiphier tube used to study the intensity was showing a continuous decay in the intensity with time. The possible reasons for this decay were explored and overcome by changing the Mercury lamp with the 6 volt continuous lamp. The voltage of the source battery was kept uniform. The percentage transmission of 5400 A through 6H. Silicon Carbide crystal was determined. The effort is being made to measure the Absorption Coefficient value and there by to calculate the euergy gap value of 6H Silicon carbide Polytype.	Verma S.P.	
DNPL/R/8	High Pressure Studies on Bismuth.	The high pressure assembly was designed and fabricated The pressure was generated in a specially designed high pressure chamber by advancing two anvils on its either side through pyrophyllite gaskets. As the	Kapoor Y.M. and Joginder Singh	

Code No.	Project	Progress	Project Team	Reference
		pressure losses were more than 60%, pyrophyllite gaskets were replaced by polyethylene and teflon gaskets. The pressure so generated was measured by studying the phase transition in bismuth metal which shows a sharp change in its electrical resistance at 25 Kb. as BiI–BiII. The electrical resistance of bismuth metal was studied upto 35 Kb. This limitation of 35 Kb. has been due to the material available for the fabrication of the chamber and the anvils. The high pressure chamber was found to shatter above this pressure. We hope that with the use of chamber and anvils made of Tungsten Carbide it will be possible to generate pressure as high as 100 Kb.		
DNPL/R/9	Study of Single Crystal Films of Noble Metals	The proposed work is to measure Hall effect (including Hall mobility and carrier concentration) and to make topological study of magneto resistance in epitaxial grown single crystal films of noble metals at high magnetic field ($N^{30}KG$) and low temperature (specifically at 4°K). To this end an apparatus has been set up initially to study the phenomena at room and liquid nitrogen temperatures with field values upto 15000 gauss. The nature of films (Ag) has been investigated (epitaxy) through electron diffraction patterns. A special device is under coustruction to cleave substrate	Chatterjee H.K.	

Code No.	Project	Progress	Project Team	Reference
		under vacuum and to obtain oriented films applying electric field inside the coating unit chamber. The above study is supposed to throw light for investigating Fermi surface inside metal and to compare it with its proposed bulk model.		
RC/R/1	Aerosol Measurements.	Measurements made at Delhi, Agra and Jaipur have shown that the content of particulate matter in the atmosphere is minimum at Agra and maximum at Jaipur during the monsoon period. The finding suggests that clouds at Agra could be relatively more unstable than those at Jaipur. Observations have shown that ice-forming aerosols may originate from all the source regions such as, maritime, continental, stratospheric or extra-terrestial. Measurements on chloride, sulphate and ice-forming aerosol have indicated that soluble particles might help ice-nucleation. Millipore filters were used for the study of ice-forming nuclei. Investigations have pointed out that Whatman filter paper No. 42 could be used as next best to millipore.	Kapoor, R.K; Sharma, C.D.	
RC/R/2	Measurements on Board Aircraft.	With the cooperation from the Plant Protection Directorate of the Ministry of Food and Agriculture, flights on board 'BEAVER' aircraft were organized and measure-	Biswas, K.R. Khemani, L.T. Sharma, C.D.	

Code No.	Project	Progress	Project Team	Reference
		ments on day-to-day content of soluble and total particulate matter in the giant size range up-to 10,000' height were made. The concentration of soluble (hygroscopic) aerosols remains nearly steady at higher levels, but its proportion in the total concentration generally increases with height. The finding suggests that air layers near ground are predominantly more of continental type whereas those at higher levels are of maritime type. Marked variations in the aerosol content were usually found reflected in the measurements at all heights. Measurements made on a hail-storm day pointed out marked increase in the proportion of hygroscopic aerosols with height.		
RC/R/3	Identification of Chloride and Sulphate Particles	Efforts have been made in course of test flights to obtain samples of aerosol matter on treated glass slides for detection and measurement of chloride and sulphate components. It was found possible to adopt the silver nitrate technique for identification of chloride aerosols.	Khemani, L.T. Biswas, K.R.	
RC/R/4	Precipitation and air Chemistry	(*1*) *Analysis of rain water samples* : Rain from convective clouds showed higher contents of anions (chlorides and sulphates) and cations (sodium and potassium) than that from layer type clouds. The variation of chloride content with progress of rain shower from the two	Khemani, L.T. Chugh, G.L.	

Code No.	Project	Progress	Project Team	Reference
		types of clouds is found to be different. (2) *Chemical composition of hail conient* : A programme of work of hail/ rain water sample collection has been initiated at the State Observatory, Naini Tal with the collaboration of the Director and Staff of the Observatory. Analysis of samples collected has revealed that hail contains higher concentrations of anions and cations than rain which either preceded or followed- (3) *Estimation of trace gases* : The day-to-day concentration of trace gases in the atmosphere such as NO_2, NH_3 and Cl_2 as would have possible bearing on colloidal stability of clouds was estimated. The study of sulphur dioxide in the atmosphere has been taken up.		
RC/R/5	Measurements on Cloud Forming Nuclei.	Preliminary studies have indicated that the content of the cloud-forming nuclei undergoes marked variation in course of the day and also from one day to another.	Sekhon, R.S.	
RC/R/6	Collection Efficiency of Droplets of nearly the same Size.	Previous measurements have suggested that freely falling pairs of droplets in the drizzle size range tend to undergo collision even when they are separated initially by few tens of diameters in the vertical. Water droplets produced	Bohra, J.N. Paul, S.K.	

Code No.	Project	Progress	Project Team	Reference
		from hypodermic needles in kerosene medium were studied in high electric fields. Preliminary observations show that these droplets coalesce only when brought under the influence of electric field; the frequency of coalescence depending upto the value of applied field.		
RC/R/7	Studies in Atmospheric Electricity	A programme of work on atmospheric electricity has been planned. Preliminary analysis of the data collected on hygroscopic aerosols and atmospheric potential gradient has suggested that these two are related in certain periods of the year.	Ramana Rao, T.	
RC/R/8	Studies With Microwave Radar	(*1*) *Generating Cells* : Study has been made of the first radar echoes from cold layer type clouds known as 'generating cells'. The average height of the cell is about 6 km. during winter and 9 km. during monsoon with its depth varying from 0·5 to 1·5 km. Not all of the generating cells have developed into actual rain situations. Seeding by cold technique would help bring about a more desirable level of precipitation development inside.	Biswas, K.R. Chatterjee, R.N.	
		(*2*) *Estimation of rainfall* : The feasibility of utilizing the microwave radar for estimating total rainfall has been explored.		
		(*3*) *Evaluation of results of seeding trials by radar* :		

Code No.	Project	Progress	Project Team	Reference
		Progressive development of rain cells in the up-wind and down-wind sectors on all seedable days (Seeded and not-seeded) has been studied for evaluation by radar of the result of cloud seeding experiment in progress at Delhi.		
RC/R/9	Cold Cloud Seeding Experiment at Delhi.	Fabrication of silver iodide seed generator was completed. Preliminary tests have shown that the equipment works satisfactorily.	Biswas, K.R. Chatterjee, R.N. Sekhon, R.S.	
RC/R/10	Cloud Seeding Operations	The seeding experiment using warm cloud seeding technique was repeated for the 9th consecutive year at Delhi and 6th consecutive year as Agra. As before, finely powdered common salt mixed with 10 per cent talc has been used for seeding. The operations have been conducted during the 3 months monsoon period, July to September. The following table summarizes the results of all the seeding trials conducted so far at Delhi, Agra and Jaipur.	Biswas, K.R. Paul, S.K. Kapoor, R.K. Kanuga, K.K.	

NUMBER OF TRIALS

Station	*Positive result*	*Negative result*	*Inconclusive result*	*Total*
Delhi	29	10	13	52
Agra	17	11	8	36
Jaipur	14	7	3	24
Total :—	60	28	24	112

APPENDIX II

2. DEVELOPMENTAL PROJECTS

Code No.	*Project*	*Progress*	*Project Team*	*Reference*
AC/D/1	Developing a Suitable Filter for the Ultra violet Region, 320 mμ for use in Filter Photometer.	A thin film 500 A thick of silver has been found to be suitable for maximum transmission at 320 mμ, the transmission sharply drops off on either side. Using a mercury vapour lamps as a source, the transmission band can be thinned out further by the use of a Wood's filter and oxalate solution. The filter would be tested for the determination of minor amount of iron in nickel, and aluminium coins in which oxalate forms a complexing agent.	Sen D. Bhuchar V.M.	AC : 8
AC/D/2	Salaya Balsam-A Substitute for Canada Balsam.	The dispersion, reciprocal dispersive power, absorption spectra of the two Balsams have been examined. These compared very well with each other. It appears that Salaya Balsam, an abundant indigenous material may substitute for Canada Balsam quite satisfactorily. It is an 'Import substitution'.	Bhuchar V.M.	
OPT/D/1	Design and testing method for doublet type	Design of the testing equipment has been made and is being fabricated.	Singh R.G. Sm. Shantabai M.	

Code No.	Project	Progress	Project Team	Reference
	railway signal lenses.			
OPT/D/2	Automatic Sky Scanner.	A new sky scanner has been designed and fabricated for recording continuously the brightness distribution of the sky.	Das S.R. Sastri. V.D.P.	OPT : 19
OPT/D/3	Optical Test Methods based on Interferometry	Two new shearing interferometers have been developed for testing precision corner cubes and right angle prisms. A method of testing equality of thickness of optical plates by use of the fringes of superposition in reflected light is being developed.	Sen D. Puntambekar P.N.	OPT : 20,21
OPT/D/4	Retinoscope	A retinoscope has been designed and made in NPL and tested by the Opthalmologist at the Willington Hospital.	Singh R.G. in collaboration with Srivastava K.N. of Willingdon Hospital.	
OPT/D/5	Cockpit Illumination Studies.	Measurements were carried out on aircrafts. Comparative tests on aircraft dials and dial lamps are in progress.	Sarma K.S. Dandawate. V.D.	
AM/D/1	Design and Fabrication of the 3000 kg Dead Load Testing Machine.	The design and fabrication of the machine has been completed. After the calibration of the weights, the machine will be commissioned.	Das Gupta M.K. Sharma. R.S.	
AM/D/2	Design and Fabrication of	The design and fabrication of the machine has been completed. Minor attachments have to be incorpor-	Das Gupta M.K. Nayyar. R.K.	

Code No.	Project	Progress	Project Team	Reference
	an Abrasion Testing Machine.	ated before the machine is put into operation.		
AM/D/3	Design and Fabrication of a Photoelastic Bench.	The overall lay-out and the design of the bench have been completed, The frame, lens holders and the housings for the polaroids and quarter wave plates have been fabricated. Instrument manufaeturers interested in taking up this line of production, have suggested some modifications. These would be incorporated in the design.	Agarwal B,K. Das Gupta. M.K. Agarwal. A.K.	
AM/D/4	Design and Fabrication of the Carlson Strain Meter.	Preliminary studies with regard to this project have been completed. The design and fabrication of the Strain meter will be taken in hand.	Das Gupta M.K. Bindal M.M. Agarwal A.K. Nayyar. R.K.	
H/D/1	Prototype Calibration Equipment for Glass Thermometers.	The ISI has recently laid down specifications for General Purpose Thermometers. The specifications for all other types have been finalised. The draft specifications for "Methods of Calibration of Thermometers" is being finalised. Some of the thermometers in the ISI specifications are 55 cm long and the ISO is considering the adoption of these specifications. Under these conditions, it was considered necessary to develop some prototype calibrating equipment which could be used by ISI, by test houses and by the in-		

Code No.	Project	Progress	Project Team	Reference
		dustry specially for the long thermometers. The following work has been done in this connection.		
		1. *Thermometer comparator for long Thermometers: 5° to 150°C.*	Bansal T.D. Wasan V.P.	
		An equipment has been developed for calibrating such thermometers in the range 0°C to 150°C with a precision upto 0.02 degree. Although performance tests are still being carried out, yet it appears that five such equipments, kept side by side, are capable of calibrating 700 to 1000 thermometers per shift whereas our present capacity is about ½ to 1/3 per shift.		
		2. *Thermometer Comparators for Temperatures above 150°C.*	Bansal T.D. Wasan V.P.	
		Silicone fluids and salt baths are freely used for this purpose abroad. The silicone fluids are extremely costly and have to be imported. So alternatives had to be found. A mercury bath and a salt bath have been developed for this purpose. Five such equipments are capable of calibrating fifty thermometers per shift with a precision commensurate with the least counts of thermometers used by the industry and research organisations.	Sharma. M.M.	
H/D/2	Clinical Thermometers.	1. *Equipment for Large Scale Testing of Clinical Thermometers as per IS : 3055.*	Bansal T.D.	

Code No.	Project	Progress	Project Team	Reference
		Special Equipments have been developed for this purpose at the request of ISI. The equipments include :		
		Central Control Board Constant Temperature Baths Times of Response Equipment—(Ind. Pat. (Pending) Thermometer Cage——(Ind. Pat (Pending) Gauges for Lengths Bulb and Stem Diameter Equipment Tester for Shaking Down		
H/D/2		The whole process has been arranged like a chain process on factory production basis.		
		The Supervisor sits at the Central Control Board. He can have a direct view of each and every process and can check, adjust and control all the equipments with the help of several banks of switches, meters, Dimmerstats, relays, etc— provided on the Central Control Board. The Board is also provided with storage space, for 5000 thermometers (one day's output) and for records and necessary maintenance spares. The complexity of the equipment could be realised from the fact that about 200 wires from various apparatus emanate from the board and it is fed by two, three phase a. c. circuits, one of them being a stabilised voltage supply.		
		Each Constant Temperature Bath consists of a copper cylinder with a perforated		

Code No.	Project	Progress	Project Team	Reference

tubular spiral at bottom. The cylinder is placed inside another insulated cylinder. Water is pumped into the spiral. The water fills the inner cylinder and overflows into the outer cylinder from where it is collected and pumped back through an electrical heater with adjustable input. A glass thermometer gives the temperature of the bath.

H/D/2

Light cages for holding 25 thermometers each, have been developed so as to have a small thermal capacity. They hold the thermometers by spring loading and are so designed that thermometers can be loaded and unloaded and adjusted for prisma and bulb level, quickly. For testing the accuracy of the thermometers at a certain temperature, the loaded cage is dipped in the bath for 10 seconds and taken out. Reading of every thermometer is then verified against the bath temperature.

Clinical thermometers used to be marked "$\frac{1}{2}$ mt", "1 mt", etc. This is deceptive because time required to take body temperature depends not only on the physical constants of thermometer but very largely on conditions of health and disease. In fact, modern biophysical experiments show that under different health conditions a given $\frac{1}{2}$ – minute thermometer might take 10 s to 15 mts, or more for reaching

Code No.	Project	Progress	Project Team	Refereuce
		the maximum in the same person. The overall physical constants of the thermometer can be checked by measuring its time of response under some standard conditions. A suitable equipment for this purpose has been developed. In this equipment, a thermometer cage is released into a constant temperature bath by pressing a button. As soon as the thermometer bulbs touch the water, a second-clock starts while heating and stirring of bath stops. The cage is taken out after 7·5 to 8 seconds and then each thermometer's reading verified. Details of other equipments are obvious. The main features of development are being patented.		
OPT/D/6	Development of a Cheap Automatic Recording Grating Spectrometer for the Region 1–3 mμ	A recording grating spectrometer has been made. At present the grating and the lead sulphite detectors are imported but the lead sulphide cell of suitable sensitivity is being developed. The instrument would be useful to the industry for detecting traces of water vapour, the $C0_2$, content in a room and for continuous analysis of heavy water besides working as an infrared spectrometer.	Saksena. B.D.	
HP/ D/1	Drying of Coal Fines obtained during	It was agreed that drying of coal fines would be confined only to the duration of sunshine hours, when an air solar heater was to be used to heat	Khanna M.L.	HP : 1

Code No.	Project	Progress	Project Team	Reference
	Coal Washings by Solar Energy Utilisation. (in collaboration with CFRI, Dhanbad.)	air in the initial stages and its temperature further raised subsequently with the use of glass mirror reflectors. The possibilities of storing solar energy in water and its use during the absence of solar energy in a shell-tube heat exchanger looked promising. Solar water heater, developed and perfected in this laboratory, could be used and its heat storage reservoir combined with a shell-tube heat exchanger. (Indian Patent No. 99523, entitled " A method for heat storage and/or heating of fluids, with special references to solar energy utilisation", was filed in January 1966). Calculations of the design data of the heat exchanger involving parameters. such as outlet air temperature, length and diameter of pipe, Reynolds number, etc., are in progress.		
IP/D/I	Development of a Manufacturing Process for Silver Graphite Relay contacts.	A method of making silver graphite relay contacts from indigenous raw materials required by the railways has been developed. The properties of the laboratory-made contacts have been determined. They show comparable performance as shown by life tests carried at 95% humidity and 60°C for a period of 100 hrs with 20 makes and brakes per minute. Further work is in progress.	Sen D. Awasthy B.R. Joglekar G.D.	
Elec/D/1	Microwave Tube	(i) Work was started in making our own matrix cathodes for the klystrons.	Chandra K. Parshad R. Arora T.R.	

Code No.	Project	Progress	Project Team	Reference
	(Klystrons).	Earlier they were imported. The process has been developed sncessfully. (*ii*) Work has been started on fabricating 10-cm klystrons used in radars. The klystrons have limited life and are imported and so to keep our radars operative, it would be highly desirable to fabricate these klystrons. Sufficient progress has been made. (*iii*) High efficiency double gap klystrons : This is a new kind of klystron being developed here. These klytsrons using double gap interaction due to increased beam coupling without the undesirable beam loading, are expected to operate with high efficiencey as compared with the conventional reflex klytsrons already available. Special cavities for the double gap klystrons were made and tested and incorporated in demountable klystrons (using demountable vacuum system), A typical tube gave 200 mw at 3000 mc/s. It is hoped to bring the tube to a finished state soon for its use in radar, communication system and elsewhere.	Chandra K. Arora T.R.	
Elec. D/2	Microwave Components, Materials and Ferrite Devices.	*I. Microwave Components and Materials.* Electroforming of waveguide components has been perfected and the process is in operation for supplying microwave testband components to a number of institutions.	Parshad R. Chandra K. Kumar R.C. Miss Bhagya Laxmi Arora T.R. Bhatnagar H. Kataria P.	Elec : 9

Code No.	Project	Progress	Project Team	Refereuce
		The process has also been referred to N.R.D.C. for industrial exploitation. Other complex components like slotted-section directional couplers, matched loads, attenuators, flexible wave-guides are being made. All the above components are in great demand by outside institutions and their making would be a step in the direction of self-sufficiency and saving of foreign exchange. Microwave absorbing materials and low-loss high dielectric constant materials are being developed. Sufficient progress has been made. *II. Microwave Ferrite Devices.* The object is to develop and make available to the country microwave ferrite devices like isolators circulators, phase shifters, all variable attenuator etc. A broad-band dielectric loaded wave-guided ferrite isolator for x-band and C-band have been made. Work on it has been completed. 3-port Y-circulator is being developed. Initially a narrow-band circulator was successfully made. Attempts are being made to make it broad-banded for increased usefulness. By employing new techniques, a good progress has been made in this direction.	Chandra K. Parshad R. Aggarwal V.K.	Elec : 3,4

Code No.	Project	Progress	Project Team	Reference
		A new type of microwave attenuator-cum-isolator, using Faraday Rotation principles is being developed.		
		Principles of a Ferrite frequency meter for quick determination of frequency over a broad range has been made and will be developed in the coming year.		
Elec/ D/3	I. Microwave Techniques and Measurements and their Applications.	Coupling of two or more klystrons for increased power under frequency locked conditions has been investigated. Techniques were developed, first for coupling under C.W. conditions and later under condition of pulsed, and frequency modulation.	Parshad R. Chandra K. Aggarwal R.K. Kumar R.C.	Elec : 5
		Full success has been achieved. The efficiency of the coupled system being almost 100%. The power under frequency locked conditions is equal to the sum of the power outputs of individual tubes.		
		The work has been completed.		
	II. Measurement of impedance at Microwave Frequencies without using Slotted line.	Slotted lines are difficult to make, are expensive and give errors in measurement particularly for medium and high voltage standing wave radios. The measurement of impedance is a necessity for any kind of microwave measurement and so attempts were made to evolve new means of impedance measurement eliminating the use of the slotted section.		

Code No.	Project	Progress	Project Team	Reference
		A new method for measuring impedance, using a precision attenuator and directional couplers has been developed. Two papers read at I.T.E. conventions and will be published in due course. Another method, for routine measurement and not needing precision attenuator was also devised using a cross-directional coupler and a movable short. The work has been completed.		
	III. Measurement of Dielectric Constant and Loss.	Different methods of accurate measurement of dielectric constant and loss of solids and liquids at x-band have been set up. The object is to devise new instrumentation for the measurement and use in techniques for elucidation fundamental properties of matter. New wave-guide methods have been developed for measurement of dielectric properties of low-loss solids. The methods are more accurate than the existing methods. (Paper under consideration). Investigation on correlation of dielectric properties of powders with those of the corresponding solids has been devised, which yields greater accuracy than any previous formula. The method would be useful for investigating the properties of solids which in bulk cannot be obtained in large enough size for fitting the dimensions of wave-guides.	Parshad R. Chandra K. Dube D.C. Yadav R.S.	Elec : 12

Code No.	Hroject	Progress	Project Team	Reference
		Investigations have been done on dielectric behaviour of liquid air and of liquid mixtures of chloroform-acetone and chloroform-ether. (Paper under consideration).		
Elec/ D/4	Electronic Circuits and Instrumentation.	The object is to develop new kind of electronic circuits particularly those employing counting and switching techniques and to emply the techniques developed here for developing instruments useful to industry, Defence and Government Institutions, to know their needs and help them and to get ideas for new work.		
	I. Electronic circuits	The following circuits have been investigated :	Parshad R Suri S.P. Singh T.	Elec : 8
		(1) Digital readout for transistor decade counter. Different methods like diode matrix and resistance logic has heen achieved to get the in-line readout of decade counting system. The work has been completed.		
		(2) Two new kinds of decade counting techniques have been developed. One technique uses the loading of a transistor of the counting circuit, by an auxiliary circuit at the desired count, and the other uses resistance logic in the newly introduced method of binary-quinary code for decade counting.		Elec : 10, 17
		(3) Operation of transistor free running multivibrator.		

Code No.	Project	Progrese	Project Team	Reference
		The variation of frequencies and wave-shapes as a function of collector resistor, type of transistor, voltage and temperature is being investigated. New results and applications are expected, (4) A constant frequency transistor free running multivibrator. Thermistors and zener diodes have been used in the multivibrate circuit to obtain appreciable frequency constancy over wide range of temperature and voltage. The development circuits can form secondary sources of constant frequencies for many practical applications. The work has been completed. (A paper has been communicated). (5) A constant - amplitude radiofrequency transistor oscillator circuit using negative feedback has been developed. The circuit will have use in transistor radios, signal generators and other electronic instrumentation. The work has been completed. (A paper is under consideration.		
II. Electronic instrumentation.		(1) A general purpose fast (I mc/s) decade counter having digital readout has been developed. The instrument would be given to industry.	Suri S.P. Parshad R. Parminder Singh Singh T, Singh S.K. Inder Bhan	

Code No.	Project	Progress	Project Team	Reference
		(2) Preset counter and its application. A high speed present counter, yielding an output trigger after a predetermined number of input trigger was made. The maximum (200 Kcs) is about ten times that announced so far in litrature. In one form of the counter, in line readout can also be had. A number of industrial firms have expressed interest in making it or usiug it. A mechanical set-up for use of the counter for automatic batching and filling (of bottles) in industry has been under construction. A demonstration unit has almost been completed. It is hoped that maturing of the automatic bottle filling operation, using the present counter will be an important step in obtaining automation and speed in the pharmaceutical and other industries. The counter has been referred to C.S.I.R. for industrial manufacture. At present these machines are only available in foreign countries. The pharmaceutical industries here have shown strong interest in these appliances.	Parbhakar A.C. Surrinder Singh Gautam C.B.L.	
		(3) Transistor curve tracer. A transistor curve tracer exhibiting the family of transister characteristics on a ca-		

Code No.	Project	Progress	Project Team	Reference

thode ray screen is near completion. The instrument would be very useful in testing transistors in a relatively short time.

(4) Instrument for unilateralization of I.F. stages.

The making of this instrument was taken up to help transistor radio industry. It is nearly complete. Use of this instrument would help save time in making I.F. stages and appreciably decrease rejection factors in radio industry.

(5) Reduced voltage protection devices.

A cheap instrument has been made to protect air conditioners, refrigerators and other appliances using electronic motors, from damage when the main voltage fluctuates to low enough values.

The work has been completed.

The device has been referred to C.S.I.R. for industrial manufacture.

(6) A sequential switching timer.

One instrument uses transistors and relays and the other uses transistors only for creating the switching cycle. The timers have uses in industry and general applications.

Code No.	Project	Progress	Project Team	Reference
		The instrument will form a part of process alrrady referred to N.R.D.C. for industrial manufacture of device based on "Sequential switching techniques". (7) Surge detector. An instrument for detecting transients in supply mains has been developed at the instance of a computor industry. Sponsored by industry. (8) A deflection type frequancy meter in the 0-1 mc. range employing counting rate technique is being developed. The instrument is stablised against temperature and voltage variation. The instrumet is near completion.		
Elec/ D/5	Thin film devices.	Thin film technology has in recent years become very use ful for making electronic devices like resistors, capacitors and transistors, for use in integrated circuits and for microminiaturization. For the first time in India, a thin film tellurium type transistor (TFT) has been fabricated. Cadmium sulphide TFT is under fabrication. Thin film capacitor using SiO as the insulator have been made, and its properties investigated. Group III-V (Indium-Antimonide) thin films have been made. This would be used for	Sharma S.K. Parshad R. Verma B.S, Malhotra G.L.	Elec : 14 Elec : 15

Code No.	Project	Progress	Project Team	Reference
		Hall probes and other applications. A Ph.D. thesis on study of phase transformation of thin film by electron diffraction has been completed and submitted.		
DPEC/ D/1	Permanent Magnet Ferrites.	Ceramic composition magnets have been developed. The process is under limited pilot plant trials to assess the process variables. Two firms have been licensed the process.	Ganapathy C.V. Gupta S.C. Aftab Ahmad	
DPEC/ D/2	Short-cum-Medium Wave Ferrites.	These have been sucessfully developed and limited production started in the pilot plant. Samples have been supplied to the Radio Industry for trials.	Ganapathy C.V. Govindaswamy G. Naraynan K.	
DPEC/ D/3	Piezoelectric Ceramics.	Zirconate ceramics have been successfully developed and limited quantities have been supplied to a Defence Estt. Experiments on cylindrical transducers are under way. Ceramic filters for Intermediate frequencies have been made and tests regarding its stability are being conducted.	Ramamurti T.V. Ganapathy C.V. Menon T.R.K. Narayanaswamy N.	
DPEC/ D/4	Technical Ceramics.	Ceramic compositions suitable for trimmer bases have been developed and are under limited production. More than 20000 pieces have been supplied to the Radio Industry and more are to be supplied.	Ramamurti T.V. Shiv Saran Rangarajan S. Bangari N.S.	
DPEC/ D/5	Professional Ferrites.	These are low frequency ferrites used in Telecommunications, by I.T.I. High priority has been given to this project.	Ramamurti T.V. Ganapathy C.V.	

Code No.	Project	Progress	Project Team	Reference
		Compositions with permeability of 2900+20% have been developed and toroids have been made. Pot cores are being developed.	Gupta S.C. Rhanduja R.S. Santokh Singh Ved Singh	
DPEC/ D/6	Microwave Ferrites.	Ferrites suitable for isolators and circulators used in microwave components have been developed and tested by the Electronics Dvn. ITI has evinced an interest in these.	Rammurti T.V. Gupta S.C. Ganapathy C.V.	
DPEC/ D/7	High Temperatures Thermistors.	The RDSO Railway have referred a problem to us to make Thermistors suitable for operation at 400°C for use in Railway safety. These have been successfully developed and we are investigating methods of making them in quantities and to stabilise the process.	Ramamurti T.V. Nair N.K.	
DPEC/ D/8	Volume Control Tracks.	The Radio Industry requires a process to be developed for making carbon composition tracks for volume controls. Preliminary work has been started and trials on pressing moulded tracks are to be commenced.	Ramamurti T.V. Nair R.K.	
DPEC/ D/9	Special Chemical Preparations for electronic Industry	Silver paint (conducting cement) has been developed for use in Resistors, and silver mica capacitors, control tracks etc. and supplied to several parties. A patent has been filed. Similarly magnetic oxide for recording tapes and carbon paint for volume control tracks also have been developed.	Ganapathy C.V. Khullar S.M. Smt. Rama Devi Ramchadran.	

APPENDIX III

3. STANDARDS

Code No.	*Project*	*Progress*	*Project Team*	*Reference*
ECY/ ST/1	Setting up, Maintenance and Improvements of the Electrical Standards of Resistance and Electromotive Force, and Designing and Fabrication of Standard Type of Resistances	The equipments for the maintenance of the Standards of Resistance and Electromotive Force had already been set up. Three new standard resistances and six new standard cells were flown from U.K. after prolonged observation and check at the British NPL and immediately included in the Standards and the value of the standards recalculated after the cross-check. A prolonged intercomparison has been carried out since and work of setting up of these standards has thus been completed. A few standard type resistances of one ohm have been fabricated using manganin wire annealed in an atmosphere of Nitrogen at 550°C. These have been found to be quite stable and compare favourably with imported ones. Some more resistances are being fabricated with a view to making them available to other users.	Batra V.K. Sircar B.	
ECY/ ST/2	Setting up, Maintenance and Improvements of DC/AC Transfer	The Electrostatic voltmeter has been installed together with its 5·3 meters long scale and high intensity lamp. A stabilised D.C. power supply has been assembled to be used for calibration	Pradhan M.M.	

Code No.	Project	Progress	Project Team	Reference
	Standard	purposes. The insulation and the sensitivity of the instruments have been considerably improved. Further improvements are being made after which the instrument will be used, as a transfer standard.		
H/ST/1	Ice Point Cell for TPW :	Triple Point of Water (TPW), cells are used for : (*i*) calibrating the Platinum Resistance Thermometer; (*ii*) Cold Junction of High Precision Thermocouples: and for Fiduciary Point Correction of Very High Precision Glass Thermometers. In cold countries they are 2 to 3 cm dia., about 25 to 30 cm. long and can be maintained round the clock in insulated jars packed with crushed or shaved ice-whenever a precision better than 0·1 deg is desired near the Ice Point. In our climatic conditions, it was found necessary to use much larger TPW cells and the jar method of maintaining them was found to be absolutely inadequate. An ice point cell has been developed which can maintain the temperature all round the TPW cell, at 0°C within 50 mdeg, round the clock. It is thus possible to maintain a constant temperature of 0·01°C (exact) in the TPW cell for several days at a stretch-a necessity in working the IPTS.	Bansal T.D. Wasan V.P.	
H/ST/2	Ice Shaving Machine :	It is well known that the commercial ice, or the ice made by refrigerating dis-	Bansal T.D.	

Code No.	Project	Progress	Project Team	Reference
		tilled water is not uniform in temperature. For thermometry work, crushed ice has been used. But it has been shown in one of our earlier publications that finely Shaved Ice is far more dependable and that in this condition even commercial ice can be made to give the same precision of temperature measurement as specially refrigerated ice-as far as the Ice Point is concerned. The Ice Point Cell for the triple point of water cells, mentioned under item 1, required 400 to 500 kg of finely shaved ice at short notice. Although ice shaving has been done in many ways yet a dependable equipment which would last long and use commercial slabs as well as large crushings of ice, and still give the required quantity of shaving without introducing impurities, does not seem to have been designed. A suitable Ice Shaving Machine satisfying these requirements has been developed. The machine is likely to have commercial applications also.		
H/ST/3	Standard Optical Pyrometer	Disappearing Filament Type Pyrometer using Calibrated Sectors and an Optical Filter of known Characteristics is used in Standardising Laboratories abroad, for realising the IPTS above 1063°C. Such an equipment of	Bansal T.D. Wasan V.P. Kukreja H.R.	

Code No.	Project	Progress	Project Team	Reference
		precision, high enough for a Standards laboratory has always to be developod in the laboratory itself. After several years of sustained efforts, a suitable equipment has now been developed. It has been standardised and with its help, Sub-standard Strip Lamps as well as Optical Pyrometers and Disappearing Filament Lamps have been calibrated. Under favourable conditions, it gives a reproducibility of the order of 0·5 deg at 1800°C.		
H/ST/4	Potentiometer Method for Platinum Resistance Thermometers.	High Precision Platinum Resistance Thermometry, requires a suitable bridge. A bridge worth a Standards Laboratory, suitable for our climates has not been designed anywhere so far. The Potentiometer Method has therefore been utilised for using the high precision platinum resistance thermometers, for realising the IPTS.	Bansal T.D. Wasan V.P.	
LT/ST/1	Precision Platinum Resistance Thermometry	Two more platinum resistance thermometers have been constructed this year (one uncalibrated platinum resistance thermometer, if imported, costs nearly Rs. 2750/-). Zinc point and liquid oxygen point apparatus have been set up. The resistances of the eight platinum resistance thermometers have been measured at the sulphur, zinc, steam and triple point of water.	Baveja K.D. Reddy Y.S. (upto 15.12.65) and Luthra R.K. (from 1.2.66)	

Code No.	Project	Progress	Project Team	Reference
		Measurements have also been made for five thermometers at the liquid oxygen point. Work on the evaluation of the constants of the thermometers in Callendar Van-Dusen equation, from the data collected, is being done.		
OPT/ ST/1	Photometric standardisation of Fluorescent and Gas Discharge Lamps.	A three metre integrator has been designed for the standardisation work.	Sarma K.S. Dandawate V.D.	

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APPENDIX IV

4. CALIBRATION AND TESTING

Code No.	*Materials*	*No. of items*
	Acoustics Division	
A/T/1	Loudspeakers	2
	Vibrating machines	16
	Sirens	12
	Absorption and insulating materials	4
	Microphones	3
	Auto-horns	2
	Audiometer	1
	Sound reinforcement system	1
	Magnetic recording tapes	33
	Miscellaneous	41
	Analytical Chemistry	
AC/T/1	Water	29
	Steel, cast iron, etc.	53
	Non-ferrous alloys	25
	Building materials	45
	Wires, etc.	25
	Fluoride (analysis and preparation)	8
	Sand, quartz, etc.	4
	Miscellaneous chemicals and other products	46
	Applied Mechanics	
AM/T/1	I. **Calibration at factory premises**	
	1. Tensile Universal Testing Machines	5
	2. Compression testing machines	4
AM/T/2	II. **General Testing and Calibration**	
	1. Proving rings	120
	2. Jacks	27

Code No.	Materials	No. of items
	3. Tiles, bricks, cements, concrete cubes etc.	21
	4. Steel rods, wires, plates, sheets, joints, clamps, etc.	96
	5. Hylam tubes	3
	6. Miscellaneous	46
	Development-cum-Production of Electronic Components.	
DPEC/T/1	Transformers	4
	Electricity	
ECY/T/1	Calibration of D.C. and A.C. substandard and precision measuring instruments, viz., voltmeters, ammeters, wattmeters, ohmmeters, potentiometers, bridges, standard cells and resistances, etc.	85
ECY/T/2	Developmental testing of industrial products, viz., electric motors, fluorescent lamp chokes, horns, electric lamps, immersion heaters, cables of different types, transformer oil, impregnating oil, cable compound, transformers, etc.	96
	Electronics	
Elec/T/1	1. Radio and TV sets	25
	2. Signal generator	12
	Heat Standard	
H/T/1	1. Optical pyrometers	2
	2. Thermocouples and pyrometers	5
	3. Thermometers	62
	4. Clinical thermometers	644
	5. Thermal conductivity	14
	6. Fire test	1
	7. Miscellaneous tests	14
	Heat and Power	
HP/T/1	Viscometers	5
HP/T/2	Abel's Flash point apparatus	1

Code No.	*Materials*	*No. of items*
HP/T/3	Greases	12
	Industrial Physics	
IP/T/1	Carbon brushes	10
IP/T/2	Wagner Turbidimeter for testing of cements	7
	Low Tempereture	
LT/T/1	Domestic Refrigerator	5
LT/T/2	Liquid air container	7
	Optics	
OPT/T/1	1. Lenses, mirrors, prisms, plates, etc.	75
	2. Calorimeteric tests, viz. signal glasses, filters, reflectors, lamps, etc.	48
	3. Spectro-chemical analysis of arc carbons, mica, liquid gold, etc.	10
	4. Photometric tests, viz. lamps, etc.	128
	5. Photographic tests, viz. photomicrographs, developer, etc.	101
	Weights and Measure	
	(1) **Calibration**	
WM/T/1	**Mass Section** : Sets of Weights for scientific purposes and the Weights and Measures Enforcement Departments	90
WM/T/2	**Volumetry Section** : Pipettes, Burettes, flasks, etc.	298
WM/T/3	**Hydrometry Section** : Different types of hydrometers	213
WM/T/4	**Length Section** : Slip and precision gauges, sieves, viscometers, length measures, etc.	236
WM/T/5	**Horology Section** : Stop watches and timepieces.	22

Code No.	*Materials*	*No. of items*
	(II) **General Tesing**	
WM/T/6	Balances, pressure gauges, taximeters, autorickshaw faremeters, magnetic tapes, electrical appliances, soil testing equipment, etc.	164
WM/T/7	For other Divisions in the Laboratory	261
	X-ray	
XR/T/1	Oil well cement	83

Testing Fees Realized During The Year 1965-66

Name of the Division	*Amount*
	Rs.
Weights and Measures	36,904.14
Acoustics	3,668.03
Electricity	10,772.53
Optics	4,695.77
Industrial Physics	1,099.00
Heat and Power	4,170.70
Analytical Chemistry	7,018.00
Applied Mechanics	18,100.00
Electronics	450.00
D.P.E.C. Unit	252.00
Low Temperature	900.00
X-ray	345.00
Instrumentation (Repairs)	2,409.00

APPENDIX V

5. SERVICE TO INSTITUTIONS INDUSTRY

Code No.	*Project*	*Progress*	*Project Team*	*Reference*
A/S/1	Acoustics of Auditoria, Elimination of Noise etc.	About 25 cases of technical advice were rendered to various parties reg : acoustics of auditoria and lecture halls, special purpose sound reinforcement and public address systems, elimination of noise and vibrations, etc.		For Govt. Deptts., universities and private parties.
AC/S/1	Estimation of fluorides in Rare Earths.	In order to standardise the material samples of rare earth fluorides recived from various sources these were analysed for their fluorine content. Rare earth fluorides are used as core materials in are carbons. The material was digested with sulphuric acid and the distilling acid was collected under water and the same titrated alkalimetrically. Very consistent results were obtained.	Amar V.K. Verma M.R. Agarwal K.C.	
AC/S/2	Estimation of Mercaptobenzothiazole.	This is an important accelerator in rubber compounding, the manufacture of which has recently been taken up in India. In order to carry out a survey of the quality of the material manufactured, samples were obtained from various sources of manufacture and analysed for their M.B.T. content. The compound was precipitated as copper, silver salt and the estimation carried	Verma M.R. Gupta P.K.	

Code No.	Project	Progress	Project Team	Reference
		out by either igniting the precipitate or direct weighing.		For the Indian Standards Institution.
AC/S/3	Ink for writing permanent record.	A special requirement was to develop an ink which would withstand obliteration from acids, alkalies, solvents, oxidizing and reducing agents and thus guard against fraud. A composition has been prepared which stands upto these tests. However, further improvements have been suggested.	Asha Ram Puri V.D. Verma M.R.	For the Min. of External Affairs. Govt of India.
AC/S/4	Detection of adulterants in asbestos Magnesia composition.	85% magnesia-asbestos compositions are normally specified in ASTM or other standards for thermal insulation. On carrying out a survey of the basic magnesium carbonate available in the country, it was found that the composition does not correspond to $4Mg\ 00_3\ (OH)_2\ 5H_2O$ as envisaged in ASTM Further it had been reported that vegetable fibres are being used as adulterants in place of asbestos. Complete analysis of available samples of basic magnesium carbonate, asbestos-magnesia and other insulating compounds was made. A test was also devised for the detection of vegetable fibres and this is based on a colour developed with the loroglucinol.	Trehan J.C. Verma. M.R.	For the Indian Studards Institution.
Elec/S/1	Maintenance	The standards housed at ATA were maintained and	Ghose T.N. Sood P.C.S.	

Code No.	Project	Progress	Project Team	Reference
	and Broadcast of Time, Frequency Standards at ATA.	broadcast for two hours everyday on working days. New instrumentation was fabricated in the process of switch over to transistorized equipment. New battery chargers were fabricated for providing reliable and troublefree stand-by power supplies.	Krishan Gopal Sachdeva. D.S.	
Elec/S/2	Monitoring of Broadcast Standards of Time and Frequency.	Before the broadcast of station ATA are done, the Time pips are monitored at the NPL with respect to our own Time and Frequency signals from foreign stations. The work was carried out with regularity. Also transistor instrumentation was developed as a stand by and a substitute for vacuum tube instruments. A set-up for measuring frequency accurately, based on the local frequency developed. Frequency calibration service was extended to industry and Defence.	Ghose. T.N. Taneja P.N. Inderjeet. Gulati. K.L.	
HP/S/1	Loss on Evaporation of Greases.	Results of determination of loss on evaporation of the grease samples, for fixing the limits of reproducibility and repeatability of the test method, were reported at the meeting of CDC 29 ISI held in Bombay in September 1965.	Khanna M.L.	For Indian Standards Institution
IP/S/1	Testing of Pressure Sensitive Carbon Discs.	Testing equipment for pressure sensitive carbon discs were designed and built and used for measuring pressure resistance characteristics of carbon discs received from Naval Department.	Dutta K.K. Bulsara A.N. Joglekar. G.D.	Naval Deptt.

Code No.	Project	Progress	Project Team	Reference
IP/S/2	Service to Industry.	Enquiries on particle size and pore size distribution and moisture determination were replied.	John P.T.	
IP/S/2	Help to Industry.	A representative from M/s. Assam Carbon was trained in the manufacture of arrestor carbons for telephones by extrusion method. Dies were designed and made, compositions extruded and processed. Physical properties of the carbons were determined in green condition, and before and after each processing, i.e. baking, immpregnation and re-baking.	Sen. D. Verma C.L. Awasthy. B.R. Joglekar. G.D.	
LT/S/1	Running and Maintenance of Air and Nitrogen Liquefier Plants.	A total of 5344 litres of liquid air and 1108 litres of liquid nitrogen were supplied to Divisions, Delhi University, Defence Science Orgn., and the I.I.T.Kanpur.	Singh N.N. Khandekar, R.S. and others.	
LT/S/2	Advice on Domestic Refrigerators.	A second visit to the Refrigerator Section of Messrs Hyderabad Allwyn Metal Works Ltd. Hyderabad was made in December, 1965. Suggestions for improving the overall performance of the refrigerator were given. A summary of suggestions and technical discussions was sent to the firm.	Singh, N.N.	Messrs. Allwyn Metal Works Ltd., Hyderabad.
RPU/S/1	Vertical Incidence Ionospheric Soundings.	IQSY : Project. The ionosonde is operating according to international schedule and working well. Records are available for 80% of the scheduled time. Special sounding schedules were introduced during world days.	Saha A.K. Mahajan K.K. Narasing Rao B.C. Rangaswamy. S.	

Code No.	Project	Progress	Project Team	Reference
RPU/S/2	Radio Propagation Service.	RRC-A series on the Ionospheric Data and RRC-B series on prediction are being issued regularly. For prediction purposes an additional solar index based on solar radio flux is being used. Special arrangements for supply of weekly Ionospheric Data to Boulder USA and to DIRL, Hyderabad have been introduced.	Mitra. A.P. Saha A.K. Miss. Agarwal, S, Jain, V.C.	
RPU/S/3	Radi Patrol of Solar Flares-	IQSY : Project, Patrol kept for entire period. Provided special service to manned space flights, specially Gemini 6 and 7 rendezvous. New work on combined use of SID and satellite X ray measurements was reported at the COSPAR meeting at Buenos Aires, May 1965.	Mitra A.P. Subramaniyam C.V. Saha. A.K.	
XR/S/1	—	X-ray studies of powders and pastes used in the magnetic crack detection method were carried out.	Ali S.Z. Kundra. K.D. Nagpal K.C. Bhatia H.S. Mrs. Dhawan U.	
XR/S/2	—	Ferrites, prepared in the NPL, were tested.		
XR/S/3		Clays and minerals like stilbite, covellite, chlorites were tested.		
XR/S/4		Grey-black thin coatings on germanium plates were tested.		
Inst/S/I	Servicing of Instruments	There is a small nucleus for servicing instruments; though this is a very small unit, it has rendered vauable help. The instruments listed below which came from outside laboratories and hospitals were put back into service during the last year.	Suri S.K.	

Code No.	Project	Progress	Project Team	Reference
		Audiometer. Opthalmoscope, Slit Torch, Laryngoscope, Twin-Light Carrier, Eye Machine, Torsion Balance, Electric Desalter Electrophoresis, Power Pack, Pace Maker, Flame Photometer, Microscope, Optitherm, pH Meter, Synaptophore, Perimeter, Binocular Microscope, Electrograf, Electrophoresis Apparatus, Colorimeter, Oven, Blood Pressure Instrument, Absorption Metre, Temperature Recorder, Photometer, Universal Bridge, Electric Meter, Controlled Bath Inspissator, Vac. Gauge, Electric Punch, Slide Rotator, Amblyscope, Refractometer, Temp. Controller, Chronometer, etc.		

Code No.	Project	Progress	Project Team	Reference
		Audiometer. Opthalmoscope, Slit Torch, Laryngoscope, Twin-Light Carrier, Eye Machine, Torsion Balance, Electric Desalter Electrophoresis, Power Pack, Pace Maker, Flame Photometer, Microscope, Optitherm, pH Meter, Synaptophore, Perimeter, Binocular Microscope, Electrograf, Electrophoresis Apparatus, Colorimeter, Oven, Blood Pressure Instrument, Absorption Metre, Temperature Recorder, Photometer, Universal Bridge, Electric Meter, Controlled Bath Inspissator, Vac. Gauge, Electric Punch, Slide Rotator, Amblyscope, Refractometer, Temp. Controller, Chronometer, etc.		

APPENDIH VI

6. PILOT PLANTS

Code No.	*Project*	*Progress*	*Project Team*	*Reference*
IP/PP/1	**PROJECTOR CARBONS**			
IP/PP/1.1	Development and Production.	The production was continued from last year. Fifty seven batches were extruded and eighty two backing runs were carried out.	Joglekar G.D. Chari S.S. Kapur S.K, Verma C.L. Awasthy B.R.	
		Production batches were handled. The baking efficiency was improved and the capacity increased by increasing the size and number of furnaces. Economic aspects of production are being continuously reviewed.		
		The carbons produced were tested commercially in the cinema houses at Delhi, Madras, Nagpur, Bhusawal, Jalgaon, Akola and Secundrabad, Bhopal and Chittur.		
		The carbons are being passed on to the industry. 1500 pairs were sold in 1966.		
IP/PP/1.2	Study of Binders	Arrangements have been made for testing physical and chemical properties of coal-tar and pitch. A laboratory mixer capable of being heated to 200°C and of taking 1 kg charge has been designed and fabricated. Modifications have been made to the combustion furnace for eliminating hydrogen from	Iyengar T.R,G.	

Code No.	Hroject	Progress	Project Team	Reference
		the oxygen used for combustion.		
IP/PP /1.3	Study of Raw Materials.	The study of the use of indigenous carbon black was continued. Tar binders were used and studied with respect to mixing, reduction in wastages and the improvement of the quality of the products in the production batches. Rare Earth Fluorides produced at Alwaye Plant are being studied in comparison to the product previously obtained from Trombay Plant. The effect of heat on sintering of rare earth fluorides at various temperatures was investigated.	Kapur S.K. Verma C.L.	
IP/PP/ 1.4	Design and Manufacture of Industrial Equipment.	A new electric furnace of larger capacity for baking was designed, fabricated and used. The capacity of the old furnaces was increased by using larger muffles. This has increased the baking capacity.	Kapur S.K.	
DPEPC/ PP/I.	The Development and Production for Electronic Component.	The Development of the Production Unit for Electronic Components has been running the pilot plant for ferrites for the entertainment industry on a commercial basis. The monthly turn over is 1·5 tonnes of ferrites or 18 tonnes per annum. The total sales for the fiscal year 1966 has been 12 tonnes valued at Rs. 2·72 lakhs. Order for 30 tonnes of antenna rods and coil cores valued at Rupees 5·15 lakhs are onhand. The nett profit	Rammurty T.V. Ganpathy C.V. and Others	

Code No.	Project	Progress	Project Team	Reference
		for year ending 1966 is Rs. 68,000/-.		
		We have been working intensely on the development of suitable composition of high permeability ferrites used in the Telecommunications Industry, and have successfully made high permeability toroids. On the strength of our findings we drew the attention of Government that NPL will be in a position to develop and produce pot cores required by the Indian Telephone Industries. A high level committee of representatives of the Communications Ministry, CSIR. and NPL met on 9th March, 1966 and decided that NPL should make pot cores to International specifications suitable to ITI whose requirements would be to the ture of Rs. 16 lakhs annually and we should stop production of Entertainment grade ferrites in the pilot plant and switch it over to the making of 'professional' ferrities after the samples have been approved by ITI.		
		The Unit has also successfully developed microwave ferrites and high frequency ferrites. An order for 10,000 coil cores operating at 5 and 10 Mc/s has been received from CEERI, Pilani for the television receivers which are being produced there.		
DPEC/ PP/2	Carbon Tracks for Volume	Volume controls have been developed successfully as well as a process for forming tracks on laminates. Two		

Code No.	Project	Progress	Project Team	Reference
	Controls.	firms have shown interest in the process and are prepared to finance it as a project. Negotiations are going on.		
DPEC/ PP/3	High Frequency Ceramics for Trimmers and Carbon film Resistors.	The technical ceramics group is regularly producing on a limited scale, ceramic cores for carbon resistors. So far, we have supplied 2, 75,000 pieces to date. We are continuing to produce them, our present rate of production being 40 to 50,000 pieces a week. Trimmer bases and ceramic washers for trimmers are being supplied regularly to Messrs Murphy India Ltd. So far, 27,100 pieces have been sent and they have been approved. The firm has placed an order for 2 lakhs pieces. We have recently licensed Messrs Chemical Porcelain Factory, Khurja (UP) for Technical Ceramics and their staff is under training in our Pilot Plant.		
DPEC/ PP/4	Thermistors	High temperature thermistors suitable for use at 400°C has been developed at the request of the Railway Development and Standards Organisation. We have asked them to indicate their requirements so that we can undertake manufacture.		
DPEC/ PP/5	Piezoelectric Transducers.	A defence organisation is being supplied regularly disc type Lead zirconate transducers. They have asked for cylindrical transducers which is under development.		

Code No.	Project	Progress	Project Team	Reference
		A piezoelectric filter to resonate at I.F. frequencies has been developed which can replace I.F. transformers. The present I.F. transformers use litz wire and ferrite cores. The litz wire is imported. The ceramic filter will be completely indigenous and will be cheaper with better characteristics. We have also supplied piezoelectric transducers of required shapes and sizes to CEERI, Pilani who are working on various acoustic devices.		

D.P.E.C. UNIT
Manufacturing and Trading Account For The Year Ending 31-3-1966

		(In Rs.)			(In Rs.)
To Raw Material : (13·57 Tonnes)		71,961·32	By Cost of Production		2,05,639·32
To Labour		55,089·00			
To Overheads		78,589·00			
		2,05,639·32			2,05,639·32
To Completed Stock as On 31st March, 1965 :		26,787·00	By Sale		2,71,785·62
			By Stock		* 59,541·79
To Work in Process as On 31st March, 1965 :	29,640·00 37,500·00	67,140·00	**By Work in Process :**		
To Cost of Production		2,05,639·32	IF Cores	5,000·00	
			Antenna Rods	41,176·86	
			Rejected Rods of Last Year :	15,000·00	61,176·86
To Gross Surplus		92,937·95			
		3,92,504·27			3,92,504·27
To Packing		10,306·08	By Gross Surplus		92,937·95
To Freight and Forwarding	3,119·79 1,552·49	4,672·28			
To Nsic Commission		6,124·78			
To Sales Tax		2,976·09			
To Net Surplus		68,858·72			
		92,937·95			92,937·95

N. B :

Rejected rods of the previous years were to the tune of Rs. 37,500/-. 60% of its value has been written off this year manufacturing account as per DPEC Sub-committee decision dated 18th February 1966. Therefore, 40% of its value *i.e.* Rs. 15, 000/- has been carried forward and Rs. 22,500/- has been written off.

GLASS TECHNOLOGY UNIT

During the year under review the unit continued its manifold activities. Besides the usual programme of supply of standard type of scientific glass apparatus such as ground glass joints, various types of standard assemblies, simple and high vacuum stopcoks, distillation bends and distillation heads, the following specialised glass wares were fabricated and supplied to the Universities and research organizations

1. Molecular weight apparatus.
2. Mercury filling equipment for filling clinical thermometers which can fill in 2,000 to 2,500 thermometers in each operation.
3. Quartz discharge tube and other equipment from silica.
4. High vacuum stopacocks upto vacuum of 10^{-6} hg. mm.
5. High vacuum system for the distillation, vacuum evaporation as well as high vacuum system for vacuum valve degassing.
6. McLeod gauges and vacuostats, etc.
7. Oil and mercury diffusion pumps for high vacuum.
8. Oil distillation and fractionating column.
9. Tilting funnel high temperature fractionating column.
10. Ultra high vacuum apparatus for University of Delhi.
11. Special glass assemblies for scientific workers.
12. Oil estimation and chromatography apparatus.
13. Rotating concentric tube.
14. Vacuum jacketed column.
15. Spinning hand rectifying column.
16. Repair of H.T. Kenotran valve.
17. Chromatography equipment.
18. Micro determination apparatus for Alkosyl group.
19. Methoxyl group determination apparatus.
20. Mercury diffusion high vacuum system for mercury filling in thermometers.

New activities :

A large number of 6-phase and 3-phase mercury arc glass rectifier bulbs were reconditioned and put into operation.

We have successfully developed a technique for the fabrication of glass rectifier tube for X-ray equipment.

SALES.

Sales during the year : Rs. 1,58,163·00

Training demonstration.

One UNESCO trainee from Pakistan has undergone training in glass blowing techniques.

One trainee from J & K University is undergoing training in glass technology unit in the field of glass blowing techniques.

Demonstration about the sealing of volatile explosive in the ampoules was given to Dr. Grover of Defence Laboratories, Gwalior and Mr. Mitra, a glass blower from Defence Science Laboratory, Delhi.

Technical advice/consultancy

Following firms were given technical advice :

1. Hicks Thermometers, Mussoorie. The firm has been advised for the manufacture of clinical thermometers, industrial thermometers and chemical thermometers as well as thermometers with standard joints. Glass Technologist is a technical consultant to the firm.

2. **Hi-Tech. Precision Factory, Dholpur** : A Government of Rajasthan enterprise. The firm has been advised for the proper functioning and setting up of machinery.

3. **National Syringes, Ambala**. The firm has been advised in the manufacture of medical syringes.

4. Jain Tube Company, Ghaziabad.

5. **Lakshmi Udyog Mandir, Ambala**. This firm has been advised for the manufacture of syringes.

APPENDIX VII

WORKSHOP

During the year under review the Workshop executed 2410 work orders. The major jobs are listed below.

(*a*) 3,000 kgm. calibrating unit.
(*b*) Ice shaving machine.
(*c*) Variable speed gear.
(*d*) Rocket pay load rack.
(*e*) Parabolic disc. antannae 18'.
(*f*) Optical bench slides.
(*g*) A conditioning unit.
(*h*) Gear box.
(*i*) Cooling plates and guarded hot plates.
(*j*) Photo-elastic bench.
(*k*) Abrasion testing machine.

A number of design jobs were carried out by the Drawing and Design section. The following are the important ones.

(*a*) Lifting arrangement for Desicator.
(*b*) Universal tilting stage.
(*c*) Oil diffusion pump.
(*d*) Hopper for electronic counter.
(*e*) Moss Bauer apparatus.
(*f*) Endless belt conveyer unit.
(*g*) Calibration unit for strainmeter.

The following jobs were carried out for other institutions.

Job	*Institution*
(1) Drying machine	INSDOC (CSIR)
(2) Engraving names of the members of Parliament	A.E.Eng. III CPWD., New Delhi.
(3) Fixing damaged blobe box	IARI, Dept. of Botany, N. Delhi.
(4) Glass breaking device	——do——
(5) Welding of gear box and cover plates	Agricultural Engineering, IARI, New Delhi.

Job	*Institution*
(6) Repair of microscope	Head of Dept. of Entomology, LARI, New Delhi.
(7) Empiler nut etc.	Publication Directorate (CSIR)
(8) Fabrication of 15 feed hole punch	AHQ, Signal Regt. DHW, New Delhi,
(9) Fabrication of thin layer applicator.	Director, National Diary Research Karnal.
(10) Magnet with moving coil	Mr. V.P. Lal, 75 Daryaganj, Delhi.
(11) A deep sea coring bit	Ind. Ocean Expedition Unit (CSIR)
(12) An airflow nozzle	M/s. Asiatic Automotive Engineering Co., New Delhi (Defence)
(10) A crystal holder	Institute of Armament Studies (Defence)
(14) Fabrication of parts of teleprinters	Signal Unit, Army Headquarters.
(15) To cast 43 lead bricks	Atomic Mineral Department.
(16) Fabricate 20 spares tape feed mechanism (teleprinter)	Army Headquarters Signal Unit.
(17) Repairing of relay coil	CSIO, New Delhi (CSIR)
(18) Stainless steel apparatus	Dept. of Chemistry, Gorakhpur University.
(19) Modification of stamp emitting machine	A.D.G. (R&D) P&T) Board, New Delhi.
(20) Repair of the gear boxes of the conveyer belt	Delhi Air Testing Office Safdarjang, New Delhi.
(21) Rotating concentric tube distilling column	RRL, Jorhat (CSIR)

The following old machines were overhauled, repaired and supplied to the Ministry of Rehabilitation for training purposes at Refugee centres :

(*a*) Shaper machine — one.
(*b*) Milling machine — one.

APPENDIX VIII

LIBRARY

The total number of Additions to the Library during the period–1t April 1965 to 31st March 1966 is 1479.

The total number of accessioned publications in the Library upto 31st March 1965 was 53866.

APPENDIX IX

PATENTS FILED

1. Improvements in or relating to adjustable slit system for optical apparatus —Das S.R. and Parthasarathy s.

2. An improved design for recording sky scanner by Das S.R· and V.D.P. Sastri.

3. Complete specifications of the Indian Patent No. 99523 dated 15-5-1965 entitled "A method for heat storage and/or heating of fluids with special reference to solar energy utilization were filed on 3-1-1966.

4. A patent on "Broad-band dielectric loaded E-plane ferrite resonance isolator" for microwave applications has been filed.

5. Time lag testing equipment for clinical thermometers.

6. Thermometer cage.

7. Ice Point Equipment.

8. A process for maunfacture of ink for job printing, stencilling, finger printing or the like compositions. (Ind. Patent No. 93482). Mr. Verma M.R. Rai J. and Puri V.D.

Patent accepted and sealed

1. Hardening Gadget for small tools —Ind. Pat. 95183.

APPENDIX X

SPONSORED SCHEMES

(*i*) The work on Silver Graphite Relay Contacts was undertaken for the Railway Board.

(*ii*) A Scheme for Development of equipment for Large Scale Testing of Clinical Thermometers has been undertaken at the request of I.S.I

(*iii*) Survey of Indian Mineral Wools with regard to densities during use —I.S.I.

(*iv*) New method for finding thermal conductivity of heavy concrete —Rajasthan Atomic Power Project.

(*v*) Cockpit illumination studies —DTD & P (Air).

(*vi*) Determination of photometric characteristics of rough service lamps for use in traffic signals —sponsored by I.S.I.

(*vii*) Study of F-layer effects with doppler fading technique sponsored by National Bureau of Standards, U.S.A. under PL-480 scheme.

(*viii*) Determination of physical properties of and irradiation effects on Ionic Crystals and Semi-Conductors with a view to develop more useful Solid State devices PL-480 scheme.

(*ix*) "Crystal Growth and Imperfections" PL-480 scheme.

APPENDIX XI

PUBLICATIONS

A:1 Pancholy M. and Bindal, V.N. Transmission Loss Studies in Granular Materials. Acustica *17*, 51 (1966).

A:2 Pancholy, M. Chhapgar A.F. and Devinder Singh, Acoustics of Tagore Theatre, Chandigarh, Indian Concrete Journal, *39*, 474, (1965).

A:3 Pancholy, M. Singal S.P. Determination of Physico-Chemical Constants of Electrolytic Solutions from Ultrasonic Measurements, Jour. Sci. and Industr. *3*, 238, (1965).

A:4 Pancholy, M. Singal S.P. Relaxation Phenomenon and Chemical Kinetics in Chemically Reactive Media, Jour. Sci. and Industr. Res. *24*, 462 (1965).

A:5 Pancholy M. and Saksena T.G. Ultrasonic Relaxation in Aqueous Mixture of Urea with Enzyme Urease Journal of Physical Chemistry Communiated.

A:6 Pancholy M. and Saksena T.V. Ultrasonic Study of Esterfication Equilibria Jout. Phy. Soc (Japan)

A:7 Pancholy M. and Bindal V.N. Acoustical Propagation Parameters of Dry Sand. Indian Journal of Pure and Applied Physics, JSIR.

A:8 Pancholy, M. Chhapgar A.F. and Khanna R.K. Performance Characteristics of Warning Bells, I.S.I. Bulletin. *18*, 226 (1966)

AC:1 Verma M.R. and Rai J. Identification of dyes in various types of inks by Thin Layer Chromatography. Submitted American Ink Maker.

AC:2 Verma M.R. and Rai J.—Thin Layer Chromatogryphy of Inorganic ions—Part I. Separation of Copper, Cobalt, Nickel, Zinc and Cadmium as their thiocyanate complexes. Submitted : International Journal of Chromatography.

AC:3 Verma M.R. and Agarwal K.C.—Analytical application of o-Mercapto benzoic acid—Part I. Gravimetric estimation of bismuth and silver. (Submitted : Z. and Chem.)

AC:4 Agrawal K.C. and F.E. Beamish—Fire assay collection of Iridium by copper. Z. and Chem. (1965), 265 *211*.

AC:5 Bhuchar V.M. and Sen. D.—Saleya Balsam as a substitute for Canada Balsam. Submitted J. Sc. Instruments.

AC:6 Safeguarding of consumer's interest (value of mandatory use of certification meeting). Verma. M.R. 9th I.S.I. Convention, Bangalore (1965).

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TP : 11 Gupta S.N. and Pande. L.K.—S-wave Baryon-Baryon Scattering in Broken SU (3), (To be published in Phys. Rev.).

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TP : 16 Sen P.—Origin of SU (3) Symmetry, Am. J. Physics, in course of publication.

APPENDIX XII

ISI MEETINGS

Name of the Scientist	*Meeting Attended*	*Date & Place*
R.K. Tandon	(*i*) Electric Fan Sectional Committee ETDC-5.	26th April 1965 at Delhi.
	(*ii*) Electrical Appliances and Accessories Sectional Committee ETDC : 7 and	From 11th to 17th August,
	(*iii*) Light Electrical Appliances. ETDC 7 : 1.	1965. Madras.
	(*iv*) Standing Working Committee (Electro-Technical) SWCET.	22nd September ISI, New Delhi.
	(*v*) Instruments Sub - committee ETDC 6 : 2	24th and 25th November 1965 at Bombay.
	(*vi*) Electrical Appliances Sectional Committee ETDC 43 and	28th to 31st March, 1965 at
	(*vii*) Panel for revision of IS 302.	Bombay.
T.R. Gopalaswami Iyangar	(*i*) Fountain pens and Ball Point Pens Sectional Committee CDDC : 16.	23rd April 1965 at Bombay.
	(*ii*) Fountain Pens and Ball Point Sectional Committee CPDC 16 and	17th and 12th December 1965 at I.S.I. New
	(*iii*) Its sub-committee.	Delhi.
K.S. Sharma	(*i*) Sectional Committee ETBDC-9.	19th 20th and 21st April 1965 at Bombay.
	(*ii*) Electrical Lamps and Accessories Sectional Committee ETDC 23.	29th November to 3rd December 1965 at Bombay.
	(*iii*) Illuminating Engg. and Lifts Sectional Comm. ETDC 9 and	22nd to 24th Feb., 1966 at

Name of the Scientist	*Meeting Attended*	*Date & Place*
	(*iv*) In Joint Session with 2nd meeting of the Panel.	Calcutta.
Prem Prakash	(*i*) Glass Syringes Sub-Committee CPDC 12 : 1	15th July 1965 at Bombay.
	(*ii*) Medical Glass Instruments and Appliances Sectional Committee and its Sub-Committee.	11th to 18th December 1965
	(*iii*) Engg. Materials Sectional Committee.	at Bangalore.
	(*iv*) Screw Threads and Sectional Committee and its sub-committee.	
	(*v*) Taximeter Sub - committee EDC 41 : 3.	1st February, 1966 at Poona.
	(*vi*) Laboratory Glassware and Related Apparatus Sectional Committee EDC 33.	From 25th to 27th Aug. 1965 at Bombay.
Dr. M. Pancholy	(*i*) Acoustics Sectional Committee-ETDC-27.	December 31'65
	Panel on Acoustic Terminology ETDC. 27-P.3	January 1, 1966 Delhi
	(*ii*) Panel on Acoustics Terminology ETDC. 27-P.3	Feb. 28'65 - Delhi
	(*iii*) Acoustics Sectional Committee ETDC-27	March 1 and 2. 66 - Delhi.
	(*iv*) Acoustic and Heat Insulation Sub - Committee BDC. 12. 5	3 - 6 - 65 and 7 - 12 - 66
M.R. Verma	Meeting of CDC 1	at Delhi in April, 1966.
M.R. Verma and V.M. Bhuchar	The 9th Convention and presented one paper each to the Convention.	Bangalore in December, 1965
V.M. Buchar	Meeting of CDC 1 : 1 and of CDC 1	Delhi in April, 1966.
V.D. Puri	Meeting of CDC 13	Madras in November 1965.

Name of the Scientist	*Meeting Attended*	*Date & Place*
T.D. Bansal	(*i*) Thermometers Sub - Committee CDC 33 : 2 and	On 23rd and 24th August,
	(*ii*) Sectional Committee CDC 33.	1965. 26th and 27th Aug., 1965 at Bombay.
	(*iii*) Thermal Insulating Materials Sectional Committee CDC 37 : 1	17th to 21st Jan., 1966 at Madras.
	(*iv*) CDC 37 : 2	
	(*v*) CDC 37	
G.D. Joglekar	(*i*) Building Material and Components Sectional Committee, BDC-31	23rd September 1965 at Dehradun.
Dr. B.K. Agarwal	(*i*) Method of Physical Tests Sectional Committee DMDC : 3 and	Sept., 27th and 28th at Calcutta
	(*ii*) Non-Destructive testing Sectional Committee.	(1965).
V.D. Puri	(*i*) Inks and Applied Products Sectional Committee CDC : 13.	24th and 25th Sept., 1965 at Madras.
	(*ii*) Inks and Allied Products Sectional Committee CDC-13	25th and 26th Nov., 1965 at Madras.
C.V. Ganapathy	(*i*) Environmental Testing Procedures Sectional Committee ETDC-26.	17th and 18th September 1965 at Bombay.
Dr. M.L. Khanna	(*i*) Lubricants, Hydraulic Fluids,	15th to 16th
	(*ii*) Lubricating Oils and Petroleum Waxes Tests, CDC 29 : 10.	Sept., 1965 at Bombay.
M.K. Das Gupta	(*i*) Bicycles Sectional Committee EDC 26	29th October, 1965 at Bombay.
	(*ii*) Sluice Valves Sub-committee.	28th December, 1965, at Calcutta.
N.N. Singh	(*i*) Building Materials and Components Sampling Sectional Committee. EDC : 31.	33rd December, 1965 at Dehradun.

Name of the Scientist	*Meeting Attended*	*Date & Place*
	MISCELLANEOUS MEETINGS	
Dr. Pancholy (Convener)	(*iii*) Sub-Committee approved by the Ministry of Home Affairs to advise on Sirens.	Nov. and Dec.'65 Three meetings in Delhi.
Dr. Pancholy (Member)	(*iv*) National Committee of the U.S Education Foundation in India for Selection of candidates for scholarships.	
Dr. A.P. Mitra	1. Third General Assembly of the International Quiet Sun Year.	20.3.65 to 3.4.65 Madras.
	2. COSPAR (Committee on Space Research) Assembly.	10-21 May, '65 Buenos, USA
	3. Symposium on Radio Astronomical and Satellite Studies of the Atmosphere.	11-22 Oct., '65 Boston, USA
	4. Cosmic ray symposium at Atomic Energy Commission.	12-15 Dec., '65 Bombay.
	5. Meeting of INCOSPAR (Indian National) Committee on Space Research).	18th Dec., '65 Trivendrum.
	6. Radio Research Committee meeting.	9-10 Feb., '66 New Delhi.
	7. Indian National Committee on IQSY meeting	10th February,' 66 New Delhi.
Dr. Pancholy	(*i*) Advisory Panel of Central Building Research Institute, Roorkee.	10th Nov '66 Roorkee.
(member)	(*ii*) *Conference* All India Workshop on Speech and Hearing	4th April, 1966 to 6th April '66 Vellore.
Prem Prakash	(*i*) Meeting of the Committee to draw up a syllabus for advanced training of Senior Inspector of Weights and Measures (Ministry of Commerce).	11th November, 1965, Poona.
G.D. Joglekar	(*i*) Meeting of the Research Design and Standards Organisation. (Ministry of Railways).	3rd December 1965 - Lucknow.

APPENDIX XIII

FOREIGN DEPUTATIONS

Dr. Y.V. Somayajulu	Visited USA from 27th May to 31st October, 1965 for carrying out tests with the Wallope station scientists on the basis of new techniques developed in the NPL for Rocket Borne experiments and fabrication of pay-loads in connection with the above projects. Local expenses were met by the USA Government
Dr. Bh.V. Ramanamurty,	Visited Japan for attending the International Conference on Cloud Physics in Tokyo and Sappro (Japan) and also the meeting of the International Association of Meteorology and Atmospheric Adhoc Committee for Cloud Physics and Cloud Modifications at the Nagoya University, Japan from 22nd May to 8th June, 1965.
Dr. A.P. Mitra.	Visited Bonn (W. Germany) to attend the 5th Meeting of the Inter-Union Commission on Frequency Allocations for Radio Astronomy from 12th to 13th January 1962. Visited Buenos Aires (S. America) to attend the 8th Planary Assembly of Committee on Space Research and 6th International Space Science Symposium. The entire expenses were met by the International Council of Scientific Union and INCOSPAR.
	For attending the Third General Assembly of International Quiet Sun Year held at Madrid from 20th March to 3rd April 1965, expenditure on travel was incurred out of PL-480 grant and the subsistence abroad met out of International funds.
Dr. S.C. Jain.	Visited USA (Brbana) Illinois from 11th to 13th October, 1965 to participate in the Symposium on Colour centres in Alkali Halides ; also visited NBS, Washington for one week.
	Visited Russia under the Soviet Cultural Exchanges Programme to acquaint himself with

	the recent advances in Physics with emphasis on super-conductivity, etc.
Dr. A.R. Verma	Visited West Germany at the invitation of the German Academic Exchanges service to visit Scientific and Academic Institutes, for 3 Weeks; also visited NPL Teddington, for one week.
Dr. A.P. Mitra	Visited Boston (USA) to attend the symposium on Radio Astronomical and Satellite studies of the Atmosphere October, 1965.
	Visited Pennsylvania State University as a consultant to the University, USA November, 1965.

APPENDIX XIV

APPOINTMENTS AND PROMOTIONS

1. Dr. A.R. Verma took charge as Director, National Physical Laboratory with effect from 26-5-1965.

2. Drs. A.P. Mitra and S.C. Jain were promoted as Scientists 'F' on merit basis with effect from 9-9-1965.

3. Dr. B.K. Agarwala was selected as Scientist 'E' with effect from 5-3-1966.

APPENDIX XV

HONOURS AND AWARDS

1. Shri V.N. Bindal, Scientist 'A' was awarded the degree of Ph.D. by the Delhi University.

2. Dr. A.R. Verma, NPL was awarded the Bhatnagar award for the year 1964.

3. Shri B.C. Narasinga Rao, was awarded the degree of Ph.D by the Andhra University, Waltair.

4. Shri K.K. Mahajan, was awarded the degree of Ph.D. by the Banaras Hindu University, Banaras.

5. Dr. A.P. Mitra was appointed as one of the editors for the

   (1) Journal of Atmospheric and Industrial Research, England ;

   (2) Electronics letters, England ;

   (3) Journal of the Institution of Telecommunication Engineers, India.

APPENDIX XVI

GUEST WORKERS

Institution	*No.*	*Placement-Div.*
Banaras Hindu Universtity, Varanasi.	2	Electricity
—do—	2	Electronics.
Madras Instt. of Techgy. Madras.	5	—do—
Thappar Engineering Instt., Patiala	3	—do—
Delhi College of Engg., Delhi.	2	—do—
J.K. Institute of Applied Physics, Allahabad.	2	—do—
Birla College, Pilani.	2	—do—
Lady Hardinge Medical Hospital, New Delhi.	1	—do—
University of Roorkee.	1	—do—
University of Saugar.	2	Optics.
S.D. College, New Delhi.	1	S.S.P. (Solid State Physics)
Dyal Singh College, New Delhi.	1	—do—
Hindu College, Sonepat.	1	—do—
Central Building and Research Institute, Roorkee.	1	—do—
Osmania University, Hyderabad.	1	—do—
Defence Science Lab., Delhi	2	—do—
Holkar Science College.	1	—do—
D.S.B. Govt. College, Nainital.	1	Electron Microscopy
Agra College, Agra.	1	—do—
Regional Fruit Research Station, Simla.	1	Analytical Chemistry
Central Glass & Ceramic Research Instt., Calcutta.	1	Infrared Spectroscopy
Birla College of Engg., Pilani.	6	Workshop Practice.

APPENDIX XVII

LECTURES BY VISITING SCIENTISTS

S. No.	Name	Institute	Subject	Dat
1.	Dr.G. Gargely	Hungary	Activities of Hungarian Central Inst. for Telecom. and also on Fluctuations Phenomenon in $p-n$ Crystals.	5-3-
2.	Dr. K. Davies	—	Some Ionospheric effects of Solar flares.	5-3-
3.	Prof. W. H. Reid	Univ. of Chicago	Problems in Hydrodynamic Stability.	12-3-
4.	—do—	—do—	The Stability of Parallel Flows	15-3-
5.	Dr. R.P. Wadhwa	—	Microwave Tubes	26-6-
6.	—do—	—	Plasma Physics and Its Application.	—do
7.	Mr. W.K. Clothier	Nat. Standards Lab. of CSIR O., Australia	Basic Electrical Standards at N.S.L.	5-7-
8.	Dr. S. Ranganathan	Cambridge	Field Ion Microscopy	13-7-
9.	Dr. B. Dayal	Banaras Univ.	History of Determination of Structure of NaCl	21-7-
10.	Prof. Haymann	Univ. of Paris	Metallurgical Work and the Electron Microscope	4-8-
11.	—do—	—do—	Cathodic Sputtering and Metallographic Applications	5-8-

Name	Institute	Subject	Date
Prof. Jaistram	Ohio State Univ.	Latest Research on Double Internal Bremstrahlung	23-8-65
Prof, L.S. Kothari	Delhi Univ.	Group Theory	27-8-65
—do—	—do—	—do—	3-9-65
—do—	—do—	—do—	10-9-65
—do—	—do—	—do—	17-9-65
Dr. T.B. Jones		Ionospheric effects of solar s-ray enhancement	8-12-65
Dr. Wein	Budapest	Lecture / Demonstration on Derivatograph	13-12-65
Dr. P.K. Kabir	AEE Harwell	— atoms and — molecules	24-12-65
Academician I. Malecki	Poland	Interaction between acoustic and elastic fields	13-1-66
Academician A,A. Abrikosov	U.S.S.R.	Theory of Semimetals	16-2-66
Prof. Stepanov	U.S.S.R.	Magnetic field at various levels in solar atmosphere	28-2-66
Dr. Roudina	U.S.S.R.	Quasi - Stationary model of the ionosphere.	28-2-66
Prof. W. Wiedlick	Stuttgrat University W. Germany	Theory of Lasers	4-3-66
Mr. W.R. Piggot	Radio Research Station, Slough, England	Collision frequency in the Ionosphere."	16-3-66
Dr. S.K.K. Jatkar	Poona Univ. Poona	Nuclear spin and infrared spectra	25-3-66.

APPENDIX XVIII

LECTURES BY N.P.L. SCIENTISTS

	Name	*Subject and Date*	*Place*
1.	Sh. Joglekar G.D.	New Horizons in Physics on 17-7-65	Broadcast from A.I.R., Delhi.
2.	—do—	Physics in Industry 11-3-66	Physics Teachers Seminar NPL, New Delhi.
3.	Dr. Jain, S.C.	Results of some investigations carried out in NPL—on 14-5-65	Hans Raj College, Delhi University
4.	—do—	4 Lectures : Defects in Crystals—on 21-6-65 to 1-7-65	Inst. of Science, Bombay (Summer Institute)
5.	—do—	4 Lectures : Solid State Physics—on 28-6-65 to 1-7-65	Banaras Hindu University Varanasi (Summer Institute)
6.	—do—	2 Lectures : "Influence of Defects on the properties of Solids—on 31-7-65	I.I.T., Delhi
7.	—do—	Two Types of F-Centers 31-3-65	Leningrad University, Leningrad
8.	—do—	Electronic Conductivity in Coloured Alkali Halides —on 25-4-65	Institute of Crystallography, Moscow
9.	Dr. Pande, K.L.	Symmetries in Particle Physics—March 1965	Physics Deptt., Allahabad University, Allahabad
10.	—do—	SU(n) Crossing Materials on 16th Jnly, 1965	Summer School on Theoretical Physics, Bangalore
11.	Dr. Ramanathan K.G.	6 Lectures : Cryogenic Instrumentation and Tech-	Physics Department, Indian Institute of

	Name	Subject and Date	Place
		niques—on 15-2-65 to 22-2-65	Science, Bangalore
12.	—do—	Superconductivity and some of its Applications —on 24-3-65	The Institution of Electrical Engineers
13.	—do—	Low Temperature Physics : some Applications—on 22-5-65	Shri Ram Institute for Industrial Research Delhi
14.	—do—	Masers—23-7-65	The Institution of Telecommunication Engineers
15.	Sh. Singh, N.N.	Liquefaction of Gasses—on 9-4-65	College of Education, University of Kurukshetra
16.	Dr. Pancholy, M.	Problems in Auditorium Acoustics—May 1965	Institute of Telecommunication Engineers
17.	Dr. Chandra, K.	Research Activities in Microwave Electronics at the NPL—on 8-4-65	Deptt. of Telecommunication Engineers, University of Roorkee, Roorkee
18.	—do—	Microwave Ferrite Devices	Deptt. of Telecommunication Engineers, (at the National Institute of Science, Mathura Road, New Delhi
19.	—do—	Recent Advances in Microwave Tubes—5-5-66	Institution of Telecommunications Engineers, New Delhi
20.	Sh. Vasisth, S.C.	Use of Gyroscope as a Compass—June 1965	Summer School for Servosystems and Automatic Control Engineering at University of Baroda, Baroda.
21.	Dr. Ramanamurty, Bh.V.	Aerosols at Delhi—May 1965	International Cloud Physics Conference, Tokyo
22.	Dr. Singhal, S.P.	Application of Ultrasonics in the study of chemical	Shri Ram Institute for Industrial Research,

	Name	Subject and Date	Place
		reactions and their Kinetics on 16-10-65	Delhi
23.	Dr. Mathur K.N.	Instrument Industry in India—on 19-8-65	National Institute of Sciences, New Delhi
24.	Dr. Mitra, A.P.	A comparative Study of Solar Flare X-ray Measurements from Satellites and Sudden Ionospheric Disturbances—14-5-65	COSPAR Assembly Buenos Aires
25.	—do—	4 Lectures on Space Physics 29-5-65 to 1-6-65	Sri Venkateswara University, Tirupathy
26.	—do—	Solar XVV Radiations Measured by Space Vehicles—29-7-65	Institution of Telecommunication Engineers, Delhi
27.	—do—	Ionospheric Research in India—15-10-65	Air Force Cambridge Research Laboratory, Bedford, Massi, USA
28.	—do—	D-region Processes—18-10-65	Northeastern University Boston, USA
29.	—do—	Multifrequency Riometers and SID Analysis (Paper of A.P. Mitra' C.V. Subramaniym and V.C. Jain)—21-10-65	Symposium on Radio Astronomical and Satellite studies of the atmosphere, Boston, USA
30.	—do—	Ionospheric Electron Content and its variations from Faraday Fading of S-66 Transmissions (Paper of V.V. Somayajulu and Tuhi Ram)— 19-10-65	—do—
31.	—do—	D-region Photochemistry in the light of Rocket and Satellite Measurements of Solar XVV Radiations—28-10-65	Pennsylvania State University, USA
32.	Dr. Somayajulu Y.V	Same results from S-66 Observations and R P U Rocket Programme-9.1.65.	International Seminar on Sounding Rocket Experiments and Techniques, Kodaikanal.

	Name	Subject and Date	Place
33.	—do—	Some Results of Space Research—17.1.65.	Karnataka University, Dharwar.
34.	—do—	Rocket-borne Riometer as a Technique for D-region Studies—29.9.65.	Aeronomy Conference at the University of Illionis, USA.
35.	Dr. Chandra S.	Geomagnetic Control of diffusion in the Ionosphere	International Seminar on Sounding Rocket Experiments and Techniques, Kodaikanal.
36.	—do—	Ionospheric Investigations by Rockets and Satellites 10.1.65.	Indian Institute of Technology, Delhi.
37.	Sh. Verma M.R.	Fun with Periodic Table 24.8.65.	—do—
38.	—do—	Paper and Thinlayer Chromatography of dyes used in Writting inks and Fluids —30.10.65.	Shri Ram Institute for Industrial Research, Delhi.
39.	—do—	Physical Techniques in Chemical Analysis—12.3.66.	Physics Teachers Seminar N.P.L., NewDelhi.
40.	Sh. Chari S.S.	Creep of Green Carbon Mixes at Extrusion Temperatures—20/25.12.65.	Society of Theoretical and Applied Mechnics Conference, 10th Congress Madras.
41.	—do—	Rheology a sPhysics Course for Higher Secondary Students—15.3.66.	Physics Teachers Seminar N.P.L. New Delhi.
42.	Dr. Ram Parshad	Millimeter Waves—6.11.65	Institute of Telecommunication Engineers, New Delhi.
43.	—do—	Electronics, Old and New 12.3.66.	Physics Teachers Seminar, N.P.L., New Delhi.
44.	—do—	Time and Frequency —13.3.66.	—do—
45.	Sh. Bansal T.D.	What is Physics ? Why does matter behave as it does un-	—do—

	Name	Subject and Date	Place
		der various influences ? Heat and Temperature—11.3.66.	
46.	—do—	Fundamental Units of Measurements 12.3.66	—do—
47.	—do—	Improvisation of Instruments for Higher Secondary Classes 13.3.66.	—do—
48.	—do—	Thermometery—15.3.66.	—do—
49.	Dr. Shah V.V.	Properties of thin films and their applications 11.3.66.	Physics Teachers Seminar NPL, New Delhi.
50.	Dr. Saxena B.D.	Maser and Laser 12.3.66	—do—
51.	—do—	Infrared, its detections and applications—15.3.66	—do—
52.	—do—	Production, deduction and uses of infrared radiation 2 lectures. Dec. 26/Jan. 3, 1965	Winter School in Physics, Agra University, Agra.
53.	—do—	Interpretation of 3 bands of—quartz.—12.3.65.	Physics Department University of Allahabad.
54.	—do—	Spectroscopic analysis of Petroleum fractions - a survey of ultraviolet, infrared Raman, X-ray Flourecence and N.M.R. work 27.3.65.	Institute of Patroleum Dehradun.
55.	—do—	General talk 28.3.65.	Physics Society, DAV College, Dehradun.
56.	—do—	Infrared Spectra of Quartz and silicate structures. 11.6.65	Instt. of Physical Chemistry, University of Gottingen (West Germany)
57.	—do—	Infrared Spectra of silicates 25.6.1965.	Instt. of Physical Chemistry, Univ. of Freiburg, West Germany.

	Name	Subject and Date	Place
58.	—do—	Spectra of Crystals with special reference to silicate structures. 6.6.1965.	Optics Department, Schott and Gen. Co. Mainz, West Germany.
59.	—do—	Infrared Spectra of Silicates (Morning) (2) Hydroxyl frequencies of micas (Evening) 16.7.1965.	Department of Physical Chemistry University of Liege, Belgium.
60.	—do—	Scattering of light in Crystals —Survey of work done in India, —July 23, 1965.	Physicalische Institute Technische. Hochechule, Munich, West Germany.
61.	—do—	Interpretation of 3 bands of —quartz, —August 17, 1965.	8th European Congress of Molecular Spectroscopy Copenhagen (Denmark).
62.	—do—	Spectra of Silicates August 24, 1965.	Institute of Physical Chemistry, University of Dresden, East Germany.
63.	Dr. P.T. John	Micromeritics—13.3.66.	Physics Teachers Seminar, NPL N. Delhi.
64.	Bindal V.N.	Applications of Ultrasonics —13.3.66.	—do—
65.	Dr. Ramdas L.A.	Surface Phenomenon and Evaporation Control 13.3.66.	—do—
66.	Dr. Agarwal B.K.	Photo Elasticity, 14.3.66.	—do—
67.	Dr. Ali Z.	X-ray and Crystallography —14.3.66.	—do—
68.	Sh Wasan V.P.	Pyrometry for Higher Secondary Classes. 14.3.66.	—do—
69.	Sh. Ramamurthy	Ferromagnetic and Ferroelectric ceramic materials 13.4.56	—do—
70.	Dr. Pancholy M.	Architectural Acoustics —13.4.66.	College of Architecture Chandigarh.

	Name	*Subject and Date*	*Place*
71.	—do—	Audiometer Calibration —3/4.4.65.	All India Workshop on Speech and Hearing in Vellore, Christian Medical College Hospital, Vellore.
72.	—do—	Problems in Auditoria Designs.—31.5.65.	Institute of Telecommunication Engineers, New Delhi.
73.	Dr. Dhir	Galvanomagnetic Effects in Iron Whiskers.	Indian Institute of Technology, Kanpur.
74.	—do—	Surface impedance of superconductors.	—do—

APPENDIX XIX

BUDGET

Head	*Actual Expenditure (In Lakhs)*
Pay of Officers	7·732
Pay of Establishment	12·933
Allowances and Honoraria	9·527
Contingent	8·166
Maintenance	0·139
Chemical and Apparatus	3·573
Total Recurring	42·070
Capital	5·133
Pilot Plant	12·425
TOTAL	59·628

APPENDIX XX

STAFF

S. No.	*Category*	*Staff in 1.4.65*	*Position on 31.3.66*
1.	Director	—	1
2.	Scientific Officers	57	78
3.	Scientific (JSA/J.T.A. and above)	97	105
4.	Auxiliary Technical	216	234
5.	Administrative and House Keeping	118	116
6.	Class IV	254	274
	Glass Technology Unit		
1.	Glass Technologist	1	1
2.	Scientific Officers	1	1
3.	Scientific Assistants	3	4
4.	Auxiliary Technical	25	26
5.	Cost Accountant	1	1
6.	Class IV	2	2
	Development-cum-Production Unit for Electronic Components and Pilot Plants		
1.	Scientific Officers	4	4
2.	Scientific Staff	18	18
3.	Auxiliary Technical	103	96
4.	Administrative	10	10
5.	Class IV	1	1

APPENDIX XXI

EMMBERSHIP OF COMMITTEES

EXECUTIVE COUNCIL

Chairman

Sir A. Ramaswami Mudaliar,
India Steamship House,
21, Old Court House Street,
Calcutta 1- .

Members

1. Dr. D. S. Kothari
Chairman,
University Grants Commission,
Bahadur Shah Zafar Marg,
New Delhi - 1.
2. Shri G.R.S. Rao
Ewart House,
Bruce Street,
Fort, Bombay.
3. Prof. R.C. Mazumdar,
Head of the Dept. of Physics,
University of Delhi,
Delhi - 7.
4. Dr. S. Chandrashekhar,
Prof. of Physics,
University of Mysore,
Mysore - 2.
5. Dr. A. K. Saha
Saha Institute of Nuclear Physics,
92, Acharya Prafulla Chandra Road,
Calcutta - 9.
6. Shri J. C. Kapoor
President and Chief Executive Officer,
Air Conditioning Corporation Ltd.,
E -2, Gillander House, Calcutta -1.
7. Shri B.V. Baliga
Managing Director,
Bharat Electronics Ltd.,
Jalhalli P.O.,
Bangalore -13.
8. Dr. J. N. Nanda
Director,
Defence Research Laboratory (Material),
Kanpur.

9. Dr. Lal C. Verman
Director,
Indian Standards Institution,
Manak Bhavan,
9, Bahadur Shah Zafar Marg,
New Delhi -1.

10. Director-General,
Scientific and Industrial Research,
Rani Marg,
New Delhi -1.

11. Financial Adviser to CSIR,
New Delhi.

12. Dr. A. R. Verma
Director,
National Physical Laboratory,
Hillside Road, New Delhi -12.

Secretary

Shri Lalit Mohan
Administrative Officer,
National Physical Laboratory,
Hillside Road, New Delhi -12.

Members of the Scientific Subcommittee

Chairman

Dr. A. R. Verma
Director,
National Physical Laboratory,
Hillside Road, New Delhi -12.

Members

1. Dr. S. Chandrashekhar,
Prof. of Physics,
University of Mysore,
Mysore -2.

2. Dr. A. K. Saha
Saha Institute of Nuclear Physics,
92, Acharya Prafulla Chandra Road,
Talcutta -9.

3. Shri J. C. Kapoor,
President and Chief Executive Officer,
Air Conditioning Corporation Ltd.,
E -2 Gillander House, Calcutta -1.

4. Shri B.V. Baliga
Managing Director,
Bharat Electronics Ltd.,
Jalhalli P.O.,
Bangnlore -13.

5. Dr. J. N. Nanda
Director,
Defence Research Laboratory (Material),
Kanpur.

6. Dr. Lal C. Verman
Director,
Indian Standards Institution,
Manak Bhavan,
9, Bahadur Shah Zafar Marg,
New Delhi -1.

Members of the Building and Finance Subcommittee

Chairman

Dr. A. R. Verma
Director,
National Physical Daboratory,
Hillside Road, New Delhi -12.

Members

1. Secretary,
C.S.I.R.
Rafi Marg,
New Delhi -1.
2. Architect,
C.S.I.R.
Rafi Marg,
New Delhi - 1.
3. Dr. Lal C. Verman
Director-General,
Indian Standards Institution,
Manak Bhavan,
9, Bahadur Shah Zafar Marg,
New Delhi - 1.
4. Financial Adivisor C.S.I.R., New Delhi.

Sub-committee for the Development-cum Production Unit of Electronic Components.

Chatrman

Shri B.V. Baliga
Managing Director,
Bharat Electronics Ltd.,
Bangalore.

Members

1. Dr. A. Rao
Atomic Energy Fstablishment
Bombay.
2. Dr. Amarjeet Singh
Director,
Central Electronics Engineering
Research Institute,
Pilani.
3. Representative of
Director-General of Scientific and
Industrial Research,
New Delhi.

4. Financial Adviser to C.S.I.R., New Delhi.
5. Director,
National Physical Laboratory,
Hillside Road, New Delhi - 12.

Secretary

6. Shri T.V. Ramamurti,
Officer Incharge,
D.P.E.C.
N.P.L., New Delhi.

Advisory Committee of Rain and Cloud Physics Research Unit.

Chairman

1. Dr. K.R. Ramanathan,
Director, Physical Research Laboratory,
Navrangpura, Ahmedabad - 9

Member

2. Shri P.R.Krishna Rao,
Director-General of Observatories,
Lodi Road, New Delhi - 3.
3. Group Captain S.Das Sarma,
Director of Meteorology,
Air Headquarters, New Delhi
4. Shri Baleshwar Nath,
Minor Irrigation Team,
Committee on Plan Projects,
Planning Commission, Link House,
Mathura Road, New Delhi.
4. Director,
National Physical Laboratory,
Hillside Road, New Delhi.
5. Shri C.Balasubramaniam
Agricultural Meteorologist,
Coimbatore.
(Representative of the Deptt. of
Agriculture and Irrigation, Madras State).
6. Command Meteorological Officer,
Headquarters Operational Command,
India Air Force, New Delhi.
7. Prof. P.S.Gill,
Director,
Central Scientific Instruments Organisation.
Chandigarh.
8. Shri A.K.Roy
Suit No. 3, P-286, Darga Road,
Calcutta.

Secretary

9. Dr. Bh. V.Ramanamurthy,
Officer-in-Charge,
Rain and Cloud Physics Research Unit,
N.P.L. Building, Pusa Road, New Delhi.