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THE INDIAN ASSOCIATION FOR THE
CULTIVATION OF SCIENCE

ANNUAL REPORT FOR 1948-1949.

LIST OF JOY KISSEN MOOKHERJEE AND DR. BIMALA CHURN LAW
MEDALLISTS, RIPON AND COOCHBEHAR, PROFESSORS
SINCE THE SEPARATION OF THE ENDOWED FUNDS.

Joy Kissen Mookherjee Medallists

1.	Sir E. J. Russell, D.Sc., F.R.S.	..	..	1936
2.	Sir James H. Jeans, D.Sc., Sc.D., LL.D., F.I.C., F.R.S.	..	..	1937
3.	Professor F. W. Aston, F.R.S., D.Sc., Nobel Laureate.	..	..	1938
4.	Professor Robert A. Millikan, D.Sc., Nobel Laureate.	..	..	1939
5.	Prof. A. V. Hill, O.B.E., M.P., F.R.S., Nobel Laureate.	..	..	1940
6.	Prof. R. A. Fisher, F.R.S.	..	..	1941
7.	Mr. D. N. Wadia, F.N.I.	..	..	1942
8.	Prof. S. K. Mitra, M.B.E., D.Sc.	..	..	1943
9.	Sir S. S. Bhatnagar, Kt., D.Sc., F.R.S.	..	..	1944
10.	Dr. Harlow Shapely, M.A., Ph.D., LL.D., D.Sc., D.Litt.	..	..	1945

Dr. Bimala Churn Law Gold Medallists

1.	Sir Henry H. Dale, G.B.E., P.R.S.	..	..	1943
2.	Prof. Dr. A. Einstein.	..	..	1944
3.	Prof. R. Robinson.	..	..	1945

Ripon Professors

1.	Sir Lewis Leigh Fermor, O.B.E., D.Sc., F.R.S.	..	..	1937
2.	Sir Arthur W. Hill, K.C.M.G., Sc.D., F.R.S.	..	..	1938
3.	Prof. K. S. Krishnan, D.Sc., F.R.S.	..	..	1939
4.	Dr. R. C. Majumdar, Ph.D., F.N.I.	..	..	1940
5.	Prof. S. Chapman, F.R.S.	..	..	1945

Coochbehar Professors

1.	Professor J. E. Lenard-Jones, D.Sc., F.R.S.	..	..	1938
2.	Sir U. N. Brahmachari, Kt., M.A., M.D., Ph.D.	..	..	1939
3.	Prof. J. N. Mukherjee, C.B.E., D.Sc.	..	..	1940
4.	Prof. P. Ray, M.A., F.N.I.	..	..	1941

COUNCIL FOR 1948-49

(As constituted in accordance with the new Regulations on 6th Dec., 1947).

President :

Prof. M. N. Saha, D.Sc., F.R.S., F.N.I.

Vice-President :

1. The Hon'ble Mr. Justice C. C. Biswas, C.I.E., M.A., B.L.
2. Dr. S. K. Banerji, O.B.E., D.Sc., F.N.I.

Hony. Director :

Prof. P. Ray, M.A., F.I.A.S., F.N.I.

Members :

1. Dr. S. Bhagavantam, D.Sc., F.N.I.
2. Sir J. C. Ghosh, Kt., D.Sc., F.N.I.
3. Dr. B. C. Guha, D.Sc., F.N.I.
4. Sir K. S. Krishnan, Kt., D.Sc., F.R.S., F.N.I.
5. Mr. J. M. Majumdar, M.A.
6. Dr. K. N. Mathur, D.Sc., F.N.I.
7. Prof. S. K. Mitra, M.B.E., D.Sc., F.N.I.
8. Dr. H. K. Mookerjee, D.Sc., F.N.I.
9. Dr. J. N. Mukherjee, C.B.E., D.Sc., F.N.I.
10. Prof. S. K. Ray, M.E.E., M.A.I.E., M.I.E.
11. Rev. Fr. A. Verstraeten, S.J., Lic. es Sci.

Trustee-Member :

The Hon'ble Mr. Justice Ramaprasad Mookerjee, M.A., B.L.

Nominees of National Institute of Science of India :

1. Sir S. S. Bhatnagar, Kt., D.Sc., F.R.S., F.N.I.
2. Prof. S. N. Bose, M.A., F.N.I.

Nominees of the Govt. of India :

1. Educational Adviser to the Govt. of India (*Ex-officio*) or his nominee.
2. Accountant-General, W. Bengal, (or his nominee).

Professor-Member :

Prof. K. Banerjee, D.Sc., F.N.I.

THE
INDIAN ASSOCIATION
FOR THE
CULTIVATION OF SCIENCE

Annual Report for 1948-49.

NEW HOME OF THE ASSOCIATION

The most conspicuous event during the year under review is the laying of the foundation stone of the Research Laboratory building at Jadavpore on the 26th September, 1948 by the Hon'ble Dr. Bidhan Chandra Roy, Premier, Government of West Bengal. The function was attended by a respectable gathering of distinguished scientists and representatives of local industry, and the elite of the town. Dr. Shanti Swarup Bhatnagar, Secretary to the Government of India, Department of Scientific Research, also joined the celebrations, which had the blessings and good wishes of the Hon'ble Pandit Jawaharlal Nehru, the Hon'ble Dr. Syamaprasad Mookerjee, H. H. the Maharaja of Coochbehar, and of scientists and public men from all parts of India.

The capital grant for construction from the Government of India was received on the 15th January 1949, and the actual construction work which has been entrusted to Messrs. Martin Burn Ltd., was undertaken in March 1949.

RESEARCH DEPARTMENTS

The three research departments, e.g., the Department of X-rays and Magnetism, Optics, and Physical Chemistry, functioned during this year as in the previous. Several new appointments were made to the Departments of Optics and Physical Chemistry which thus received their full quota of research personnel. The full list of the personnel and the report of the research work for each department are appended.

Efforts were made to start the proposed new Departments of Theoretical Physics and Organic Chemistry. Dr. F. C. Auluck, M.Sc., Ph.D., D.Sc., of the University of Delhi, was appointed to the Professorship of Theoretical Physics, but was unable to accept the appointment as he could not be relieved by the Delhi University. Mr. Phanindra Nath Bagchi, M.Sc., M.S., has been appointed Research Officer to the Department of Organic Chemistry and is expected to join the Association as soon as he is relieved of his duties in the Government of India. The Council hopes to bring into existence both these Departments during 1949-50.

PROFESSORSHIPS, LECTURES, PRIZES, AND MEDALS
OF THE ASSOCIATION

The Director is glad to report that the Council has offered its Professorships, Medals and prizes as under :

Coochbehar Professorship, 1942	.. Dr. B. B. Dey, D.Sc., F.R.I.C., F.B.I.
Ripon Professorship, 1941	.. Prof. A. Szent Gyorgyi, N.L.
Ripon Professorship, 1942	.. Major-General S. S. Sokhey, M.A., M.D., D.T.M. & H., I.M.S.
Ripon Professorship, 1945 *	.. Prof. S. Chapman, F.R.S.
Joy Kissen Mookerjee Medal, 1946	.. Dr. J. C. Ghose, D.Sc., F.N.I.
Joy Kissen Mookerjee Medal, 1947	.. Prof. Irene Joliot-Curie, N.L.
Joy Kissen Mookerjee Medal, 1948	.. Dr. A. E. Morgan, (First President of T.V.A.)
Bimala Churn Medal, 1947	.. Prof. M. V. Laue
Woodburn Medal, 1947	.. Dr. Syamadas Chatterjee, D.Sc.
Jatindra Chandra Prize	.. Sri Ajit Kumar Dutta, M.Sc.
Nikunja Garabani Prize	.. Sri Ranjit Kumar Sen, M.Sc.

Prof. S. Chapman delivered his Ripon Professorship Lectures on "The Magnetism of the Earth" on the 14th and 15th January, 1949.

Dr. B. S. Guha, M.A., Ph.D., F.R.A.S.B., F.N.I., delivered the Mahendra Lal Sircar Memorial Lecture on the 23rd February, 1949 on the "The Aboriginal Tribes and their place in Indian National Life."

LIBRARY

The expansion of the library with larger additions of periodicals and books of reference in order to cope with the increased needs of the newly created departments, continued as in the previous year. The Association received 138 journals in exchange of its own publications and subscribed to 62 periodicals ; the corresponding figures for the previous year were 98 and 48 respectively. 279 books, of which 20 were complimentary copies, were added to the library during the year.

INDIAN JOURNAL OF PHYSICS

It was reported last year that the Journal has been converted into a monthly publication with effect from January, 1948. During the period under review, 11 issues of the Journal were published, 10 for 1948 and 1 for 1949.

As before, Members of the Association received the Journal free ; since January 1949 it has been decided to give it free only to those members of the Association as have registered their names for this purpose. The number of subscribers was 110 through the Indian Physical Society, 60 others in India, and 174 from abroad ; the corresponding figures for the previous year were 110, 59 and 165 respectively.

* No Ripon Professorship was awarded for the years 1943 and 1944.

The 'year' of the Journal continues to be the calendar year. During 1948, 94 papers were received for publication as against 44 in 1947. Of these, 66 were accepted with editorial revision, 10 after modification, and 1 is under consideration. 63 papers were published in 1948 (12 of which were carried over from 1947). These comprised 563 pages as against 321 in 1947. The price of the Journal has been raised with effect from January 1949 to Rs. 20/- (inland) and £2 (foreign) to meet the increased cost of production.

MEMBERS-FELLOWS

The present number of members of the Association is not at all satisfactory. During the year under review, 3 Life and 11 Ordinary members were enrolled. At the end of the year—allowing for loss by death, resignation and non-payment of subscriptions—the membership register showed 239 members (excluding the nominees of the Government of India, and of the National Institute of Sciences of India who enjoy all the rights of members); of these 156 were Life Members. We have the pleasure to announce that the Calcutta Chemical Company has contributed a sum of Rs. 2,500/- to become the first Life Member under regulation 6(b).

Prof. S. N. Bose was elected an Ordinary Fellow of the Association at the last Annual General meeting. This brings the number of Fellows to fifteen, of whom nine are resident Ordinary Fellows.

ADMINISTRATION—MEETINGS

Seven Ordinary and Special meetings of the Council and two Special General meetings, besides the Annual General meeting of the Association, were held during the year. There were, also held 4 meetings of the Finance Committee, 3 meetings of Fellows, 10 meetings of the Staff Committee 15 of the Building Committee (later renamed as Construction Committee), and 15 meetings of the different Selection Committees and Appointing Boards.

DONATIONS & GRANTS-IN-AID

We gratefully acknowledge the receipt of the following grants-in-aid during the year :

- (i) The capital grant of Rs. 4,32,000/- for 1947-48 and 1948-49, from the Government of India towards the cost of construction of the new Laboratory Buildings at Jadavpore.
- (ii) A recurring grant of Rs. 2,66,700/- from the Government of India (together with the second instalment of Rs. 89,000/- for 1947-48 which was actually received during the year). A special contribution of Rs. 10,405/- towards Dearness Allowances of employees.

- (iii) A grant from the C.S.I.R. of Rs. 13,212-14-6 for X-ray studies on metals and alloys, and another grant of Rs. 6,419/- for similar investigations on coal.
- (iv) Rs. 700/- received through the Indian Physical Society for the *Indian Journal of Physics*.

ACKNOWLEDGEMENTS

The Council wishes to record its deep appreciation and sincerest thanks to Dr. S. K. Banerjee, the retiring Vice-President, Dr. Bhagavantam, Dr. J. C. Ghose, Dr. K. S. Krishnan and Dr. J. N. Mukherjee, retiring members of the Council and also to Professors S. N. Bose and K. Banerjee who have vacated their offices from the Council, for their services to the cause of the Association, specially during the last two years of vital reorganisation.

The Council also records its thanks to the members of the various Selection Committees, Appointing Boards, and other Committees of the Association, Board of Editors, Associate Editors and Referees for their voluntary services.

Our grateful thanks are also due to the University of Calcutta for printing the *Indian Journal of Physics* free of cost, to the Calcutta Corporation for exemption of municipal taxes in respect of the Laboratory Buildings, and to the members of the Board of Trustees for their ungrudging services throughout the year.

CONCLUSION

As already reported, the Association has already taken in hand the construction of the new Research Laboratory Building at Jadavpore, our immediate programme being the construction, equipment and fitting of the ground floor of the buildings, so that the laboratories may be shifted to the new premises as early as possible. The Council appeals to all members and to the generous public for liberal donations to the Building Fund, so that the Development Plan of the Association may proceed unhampered.

P. RAY,
Hony. Director.

RESEARCH WORK OF THE ASSOCIATION
DURING THE FINANCIAL YEAR 1948-49

DEPARTMENT OF X-RAYS & MAGNETISM

(Report of Prof. K. Banerjee, Mahendra Lal Sircar Professor of Physics)

Study of Extra Reflections in Laue Photographs

Study of Extra Reflections in Laue Photographs was continued during the year under review. R. K. Sen studied isodiffusion surfaces from the extra reflections of NaClO_3 . It was found from his calculations that the shape of the isodiffusion surfaces around the reciprocal lattice points obtained by Garrido, does not agree with the isodiffusion surfaces drawn according to the thermal theory of Jahn. A systematic attempt is, therefore, being made to investigate experimentally the isodiffusion surfaces around the reciprocal lattice points of NaClO_3 .

The low temperature studies of the different types of extra reflections are expected to yield interesting results, particularly in the cases of sharp extra reflections of benzil and phloroglucine dihydrate. Such studies have been undertaken by R. K. Sen. A camera has been designed for taking Laue photographs at any desired low temperature (upto the temperature of the liquid oxygen). The construction of the camera has been nearly completed.

The investigations of the sharp extra spots of phloroglucine dihydrate crystal at various temperatures by M. N. Datta have shown that the amplitudes of the derangement waves which are responsible for the sharp extra spots change very slowly with temperature. This is in sharp contrast with the changes produced in the case of diffuse extra spots of thermal origin. In following individual sharp extra spots for different orientations of the crystal, they were found to persist over very wide angles of mis-setting with not much change of intensity. The fourier transforms which are linear are thus continuous and cross through the reciprocal lattice points along the C -axis. Wave-lengths of the derangement waves thus range from very long to those of the order of axial lengths. In order to test whether this phenomenon is due to a breaking up of the lattice by evaporation of the water of crystallisation, the process of dehydration by heating has been very critically studied by X-rays by M. N. Datta. The blank spaces in the interior of the extra spots tempt one to try such an idea for it is natural to imagine that the interior of the crystal is shielded off from giving out the water molecules. It was, however, found that the effect does neither appreciably increase in intensity, nor extend further to the interior on raising the temperature even upto just less than complete dehydration. So, an explanation based on such an idea is not capable of explaining the experimental observations.

X-Ray Study of Glass

X-ray investigation of oxyacids and oxides of boron has been undertaken at this Laboratory by B. K. Banerjee. Boric acid when heated undergoes many transformations and finally it gives rise to B_2O_3 glass, but during this period some condensation products are formed and each product is very sensitive to moisture. Previous workers on the above line were not agreed as to the action of heat on boric acid. Consequently, a thorough investigation of the above substance prepared between $100^\circ C$ to $300^\circ C$ under controlled conditions has been made with the help of X-rays. Samples prepared by subjecting the material to between $105^\circ C$ to $139^\circ C$ for 10 hours show a new pattern of lines. By treatment at higher temperatures, a distinct halo accompanied by a few lines makes its appearance. Attempts are being made to interpret these pictures.

The following glass systems have been investigated by X-rays: $ZrO_2-Na_2O-B_2O_3$; $Pt-Li_2O-BeO-B_2O_3$ and $ZrO_2-Li_2O-BeO-B_2O_3$. Samples are prepared in the usual process. In the X-ray diffraction photographs of Zr-glass, bands are obtained. Work is in progress to study the effect of concentration of ZrO_2 on the nature of the bands. In the case of Pt-glass, Pt was introduced upto 3%, broad lines of Pt are obtained on the diffraction photographs, besides the characteristic halo of $Li_2O-BeO-B_2O_3$ glass.

Further studies by means of X-rays of Al-Sn samples have been made by B. S. Basak and A. K. Rai Choudhury working in the scheme of X-ray studies of Metals and Alloys sponsored by the C.S.I.R. It has been found that the higher the quenching temperature, the higher is the resultant strain as is evident from the X-ray powder diagrams. On the other hand, higher quenching temperature leads to smaller grain size indicated by the broadening of the lines. Another fact has become apparent that Sn which goes in solution in Al at temperatures higher than $700^\circ C$ separates out on cooling and the solid solubility under these conditions is inappreciable. The amount of strain and the grain size at different quenching temperatures are being studied by measuring the relative intensities and line breadths of the powder diagram lines by means of a microphotometer.

X-ray diffraction studies are being carried out by N. N. Gupta and G. B. Mitra working in the scheme of X-ray studies of coal sponsored by the C.S.I.R. on (1) products of carbonisation of various organic compounds and (2) various samples of natural coal. X-ray diffraction photographs of samples of coal from various seams of Jharia field, and Barakar series have been taken in order to identify the different minerals and their average particle size. The measurements are in progress. Presence of several minerals in coal is detrimental to their use in metallurgical industry. The successive fractions that have been obtained by the application of the washing methods for the removal of the minerals have been studied by the X-ray diffraction methods. The preliminary results that have been obtained show that the lines become weaker and more diffuse by the successive stages of washing and the lines from different minerals are similarly affected showing that removal is controlled mainly by particle size.

Construction of Magnetic and Electrical Apparatus

During the year under review, several new apparatus were constructed in our workshop under the supervision of A. Bose in order to equip the laboratory for systematic electrical and magnetic measurements on crystals. One very useful apparatus deserving special mention, now nearly completed, is a "Crystal Gaussmeter". It consists of a cylindrically cut single crystal of a highly anisotropic paramagnetic substance mounted in a non-magnetic casing on accurately ground jewelled pivots. With this apparatus a magnetic field may be measured to an accuracy of within 0.1% for fields of the magnitude of a few thousand Gauss. A microbalance with jewelled bearing on similar lines for magneocrystallic measurements is also under construction.

Magnetic Properties of Single Crystals

From the previous studies of the magnetism of single crystals it has been definitely proved by A. Mookherjee and A. Bose that the paramagnetism of the crystal and that of the paramagnetic *ion* are not necessarily identical, but may be coordinated with each other if the fine structure of the crystal be known from X-ray studies. The magnetic properties of each atomic group formed about the paramagnetic ion is decided by the relative positions of the atoms and the ions in the group and the strength of the binding between them. These conditions for the nearest neighbours of the paramagnetic ion are not much affected by temperature unless actual constitution of the groups are changed. The different such closely constituted groups in the unit cell however, may more easily change their relative orientations, even without invalidating the conditions imposed by crystal symmetry. The principal magnetic axes of the crystal would thus reflect this change of orientations of the ionic groups, by changing their own directions in the crystal. In general, however, such changes will be too small to be observed without special magnifying arrangements except when a transition temperature for the crystal is approached. The results of some preliminary work in this connection have been published by A. Bose and a systematic investigation to verify the above conclusions is being carried on here by S. C. Mitra

Magnetic Properties of Solutions Containing Paramagnetic Ions

From his investigations, A. Bose has found that though in the state of solutions the unit cell of the crystal as such breaks down, the individual ionic groups themselves should remain intact to a large extent, unless the state of coordination changes radically. Such changes of coordination may bring about radical changes in magnetic properties of the solution and hence the former may be followed magnetically. A detailed study of paramagnetic solutions is in progress by S. C. Mitra.

Production of Low Temperatures

At present our investigations are confined only down to liquid air temperatures. Developing certain simplified techniques for liquefaction of gases we soon hope to

extend our measurements down to liquid H₂ and finally to liquid He temperatures. In connection with the low temperature investigations, A. Bose has been developing a method for liquefaction of gases on large scale by using a gas-turbine expansion machine which has proved to be helpful in initial tests. A detailed account of the development will soon be published elsewhere.

Electrical and Magnetic Properties of Semi-conductors

Recently Wallace studied the properties of graphite theoretically. He took it to be a semi-conductor and assumed a model different from that which has been adopted in experimental works published from this laboratory. Taking Wallace's picture of the Brillouin zone, A. K. Dutta tried to examine experimental results obtained here. But none of the results, magnetic or electrical, seem to support strictly the conclusions derived from the ideas of Wallace. While the conclusions can be quantitatively examined in the case of magnetic properties, those in the case of electrical properties can be discussed only qualitatively due to insufficient data. Dutta is attempting a thorough examination, both theoretical and experimental, of the whole situation regarding the properties of single crystals of graphite.

It is well known that as a direct consequence of the freedom of the mobile electrons in benzene to migrate from atom to atom over the whole ring, there should be an abnormal diamagnetism, confined to the direction perpendicular to the plane of the ring. This diamagnetic effect should be even more marked in plane condensed ring molecules like naphthalene, anthracene, etc. It is also to be expected that this abnormal diamagnetism should be temperature sensitive. A study along a similar line has been undertaken by Dutta.

The measurements of electrical properties of tungstenite crystals which were reported last year have been extended to various other temperatures by A. K. Dutta. In connection with the measurements of the Hall Effect of various semi-conductors like molybdenite, graphite, etc., it has been found that the disturbances due to Ettingshausen effect cause much deviation from the actual values. Consequently, arrangements have been made for measuring this effect as well as the thermo e.m.f. against usual metals (like Cu, Fe, etc.). This is expected to contribute towards a thorough and better understanding of the nature of semi-conductors.

List of Publications

1. The space group of phenanthrene—By B. S. Basak, *Acta. Cryst.* **1**, 224 (1948).
2. Structure of Diphenyl¹—By J. Dhar, *Proc. Nat. Inst. of Science*, **15**, 11 (1949).
3. The Structure of Anthraquinone (A Quantitative X-ray Investigation)—By S. N. Sen, *Ind. Jour. Phys.*, **22**, 347 (1948).
4. Changes in the Orientations of the Principal Magnetic Axes of Single Crystals of the Iron Group of Salts with Variation of Temperature—By A. Bose, *Ind. Jour. Phys.*, **22**, 74 (1948).
5. Paramagnetism of single crystals of the salts of the iron group of elements at low temperature—Part I by A. Bose, *Ind. Jour. Phys.*, **22**, 195 (1948).

6. Paramagnetism of single crystals of the salts of the Iron Group of elements at low temperature—Part II by A. Bose, *Ind. Jour. Phys.*, **22**, 276 (1948).
7. Paramagnetism of single crystals of the salts of the Iron Group of elements at low Temperature—Part III by A. Bose, *Ind. Jour.*, **22**, 483 (1948).
8. Magnetic studies on Tungstenite—by Ajit Kumar Datta and Benoy Chandra Roy Choudhuri, In course of publication in *Ind. Jour. Phys.*.
9. Apparent non-ohmic nature of conductivity in molybdenite—by Ajit Kumar Dutta, *Proc. Ind. Sc. Congress* 36th Session at Allahabad.

DEPARTMENT OF OPTICS.

(Report by Prof. S. C. Sirkar, Professor of Physics)

The investigations carried out in this department during the year under review relate to (1) Raman spectra and *cis-trans* isomerism, (2) Raman spectra of substances in different states, (3) Raman spectra of organic vapours, (4) fluorescence of organic compounds, (5) the structure of resonance line of mercury filtered through mercury vapour, (6) Brillouin components in solids, and (7) luminescence and absorption spectra of different varieties of diamond.

Raman Spectra and *cis-trans* Isomerism

In continuation of his previous investigations, B. M. Bishui studied the relative intensities of some of the lines in the Raman spectra of ethylene dibromide at different temperatures and also in solution and concluded that the results could not be satisfactorily explained by assuming that changes in the configuration of the molecules take place either with the change of temperature of the substance or on dissolving it in solvents, as had been done by previous workers. He further made comparative studies of the Raman spectra of 1,1-dichloroethane and 1,2-dichloroethane, both in liquid and solid states. The results corroborated the conclusions mentioned above. The results obtained in the case of *n*-propyl bromide and ethylene chlorhydrin in solid and liquid states had also been explained by previous workers on the basis of *cis-trans* isomerism, but Bishui repeated the investigations and came to the conclusion that this explanation was unsatisfactory and he put forward the hypothesis that, in the case of *n*-propyl bromide, probably association of molecules is responsible for the changes observed in the Raman spectra with change of state.

Bishui also studied in this connection the Raman spectra of acetyl chloride, acetyl bromide and ethyl bromide in the solid state at low temperatures and came to the conclusion that in the case of these three substances there is no rotational isomerism in the liquid state and the presence of two extra lines in the case of each of these liquids may also be due to association of the molecules.

S. B. Sanyal and M. M. Majumdar studied the Raman spectra of chloro- and bromo-acetyl chloride in the solid and liquid states and observed that the Raman spectra of these two compounds having similar molecules behaved quite differently when the liquids were solidified. They pointed out that these changes might be due to formation of strongly associated molecules in which the C-Cl and C-Br valence forces of the single molecule are affected.

Raman Spectra of substances in different states

Besides *cis-trans* isomerism there are other changes which may take place in the molecules with the solidification of the substances. Previous investigations in this line were continued by several workers in this laboratory during the year under review. Bishui studied the Raman spectra of acetonitrile, propionitrile and benzonitrile in the solid state at low temperatures and observed that the intensity of the $C \equiv N$ valence oscillation as well as the frequency of the Raman line diminish considerably when the substances are solidified. Only in the case of benzonitrile in the solid state a new line appears in the low frequency region and the line due to deformation oscillation of the $C \equiv N$ group diminishes considerably in intensity. The significance of these results has been discussed by him.

N. C. Majumdar studied the Raman spectra of diphenyl sulphide, diphenyl methane and sulphur-monochloride in the solid state at low temperatures and also in the liquid state. Some significant changes were observed in the positions and intensities of some of the Raman lines with the solidification of these substances. In the case of sulphur monochloride the results led to the conclusion that the molecules underwent some change in configuration with the solidification. He has recently studied the Raman spectra of methyl chloride and methylene chloride in the solid state and the results are awaiting publication.

S. B. Sanyal studied the Raman spectra of trichloroethylene, tetrachloroethylene, butylamine and *n*-butyl bromide in the solid state at low temperatures as well as the polarisation of the lines in the liquid state. These results will be reported shortly.

Raman Spectra of Organic Vapours

The Raman spectra of organic vapours have not yet been investigated extensively owing to some experimental difficulties. With a view to making a systematic study of the Raman spectra of the vapours of a series of organic compounds having simple molecules, M. V. Rao of this department first developed a technique which gave good records of the Raman spectrum of chloroform vapour, but although he used an Adam Hilger two prism spectrograph and the vapour at a pressure of about four atmospheres the exposure required was discouraging. He, therefore, improved the intensity of illumination by surrounding the experimental tube containing the vapour with six mercury arcs and heating the tube by circulating hot air through the transparent jacket with which the tube was provided. This arrangement was just ready by the end of the year under review and Rao now hopes to study successfully the changes

which may take place in the Raman spectra of a large number of substances when a change from liquid to the vapour state takes place.

Fluorescence of Organic Compounds

It was observed previously by Sirkar and Bishui that dinormal propyl ketone shows bright fluorescence bands in the green region of the spectrum when the substance after being solidified is cooled down to about -180°C . As unfiltered light from the mercury arc was used in these investigations it was not known which of the lines were responsible for the excitation of these bands. G. S. Kastha of this department repeated the investigations with a view to finding out the effective exciting lines for the fluorescence in the visible and ultra-violet regions as well as the complete fluorescence spectrum of the solid. He observed that the Hg lines on the shorter wave-length side of the line 4358 \AA are responsible for the excitation of the bands in the green region, and that ultraviolet lines excite a continuous fluorescence spectrum in the violet region. He further corroborated the observations of Sirkar and Bishui that the fluorescence appears only when the solidified compound is cooled down to about -180°C and that this fluorescence is evidently produced by strain.

The Structure of Resonance line of Mercury filtered through Hg vapour

It was observed previously by an Indian investigator that in the resonance line 2537 \AA of mercury scattered by diamond and filtered through mercury vapour appears as a doublet with a separation of about 7 cm^{-1} between the components. This was ascribed to Doppler effect and the components were identified with the Brillouin components. In an attempt to repeat the investigation in this laboratory using a diamond transparent to the resonance line, G. S. Kastha has observed that even the incident resonance line of mercury when filtered through mercury vapour appears as a doublet, the separation between the components depending on the temperature of the absorbing vapour. The intensities of these components relative to those of the neighbouring Hg lines as well as the separation between the components are found to be of the same order of magnitude as those of the Brillouin components mentioned above. It has thus been pointed out by Kastha that the Brillouin components observed by the previous worker may not be genuine and it is difficult to observe such components unless the components of the self reversed resonance line of Hg are somehow suppressed.

Brillouin Components in Crystals

Brillouin components in liquids and binary mixtures of liquids have been studied previously by various workers, but those in crystals have been studied only in a few cases. A. K. Roy of this department has set up an arrangement using a Fabry-Perot interferometer for the study of Brillouin components in transparent crystals. He has observed some patterns in the case of calcite and is studying the components in quartz now. These results will be reported later.

Luminescence and Absorption Spectra of different varieties of Diamond

Investigations on ultraviolet absorption spectra and luminescence of diamond were carried out by a large number of previous workers, and more recently results of extensive investigations on various physical properties of a large number of diamonds have been reported from the Indian Institute of Science, Bangalore. The results have been interpreted on a new theory in which it has been postulated that the characteristic absorption and luminescence spectra are produced by the interpenetration of either two types of tetrahedral lattices, of tetrahedral and octahedral lattices or of the two types of octahedral lattices. The results reported are, however, of varied nature and it appeared difficult to explain all the results on the theory mentioned above and therefore in order to understand the true nature of these phenomena a chosen set of diamonds was purchased from the firm of Messrs. Binud Behari Dutt and Sons, who kindly allowed the crystals to be examined in this laboratory and agreed to have them changed for better ones if not found suitable. B. M. Bishui has studied the absorption and luminescence in the visible region of six diamond crystals of different classes ranging from highly fluorescent rose diamond to ultraviolet transparent variety. He has made quantitative estimation of the relative intensities of the fluorescence band at 4156\AA and the Raman line 1332cm^{-1} excited by 4046\AA at the room temperature, at -180°C and also at higher temperatures. He has also studied the corresponding changes occurring in the absorption spectra with the lowering of temperature. The efficiency of different Hg lines for the excitation of the fluorescence bands has further been studied by him. The results obtained so far do not support the view that strain produced by lamellar twinning or interpenetration of different types of lattices is responsible for the peculiar absorption bands or luminescence spectra observed in the case of these six crystals. These results will be reported in a paper which is in preparation.

List of Publications

1. On the Raman Spectra of a few Nitriles at Low Temperatures—By B. M. Bishui, *Ind. Jour. Phys.*, **22**, 167 (1948).
2. Polarisation of Raman lines of Ethylene dibromide in solution and intensities at different temperatures—By B. M. Bishui, *Ind. Jour. Phys.*, **22**, 253 (1948).
3. On the Raman Spectra of 1,2- and 1,1-Dichloroethane in the solid state—By B. M. Bishui, *Ind. Jour. Phys.*, **22**, 319 (1948).
4. On the Raman Spectra of γ -Propyl chloride and Ethylene Chlorhydrin in different states—By B. M. Bishui, *Ind. Jour. Phys.*, **22**, 333 (1948).
5. The Raman Spectra of Acetyl chloride, Acetyl bromide and ethyl bromide at Low Temperatures—By B. M. Bishui, *Ind. Jour. Phys.*, **22**, 447 (1948).
6. On the Raman Spectra of Chloro- and Bromo acetyl chloride in the solid state—By S. B. Sanyal and M. M. Majumdar, *Ind. Jour. Phys.*, **23**, 1 (1948).
7. The Raman Spectra at Low Temperatures—Diphenyl sulphide, diphenyl methane and sulphur monochloride—By N. C. Majumdar, *Jour. S. I. R.*; **8B**, 25 (1949).
8. On the Fluorescence of solid Dinormal propyl ketone—By G. S. Kastha, *Ind. Jour. Phys.*, **23**, 107 (1949).
9. On the Raman Spectra of CS_2 at different Temperatures—By N. C. Majumdar, *Ind. Jour. Phys.*, **23**, in press.
10. On the Structure of the Resonance line of Hg filtered through Hg vapour—By G. S. Kastha, *Ind. Jour. Phys.*, **23**, in press.

DEPARTMENT OF PHYSICAL CHEMISTRY

(Reported by Dr. Santi R. Palit, Professor of Physical Chemistry.)

Investigations in the following lines have been carried out in the Department of Physical Chemistry during the period under report.

High Polymer Chemistry :

- (1) Fundamental studies on Polymerisation Kinetics.
- (2) Inhibition and Retardation of Vinyl Polymerisation.
- (3) Chain Transfer by Solvents in Vinyl Polymerisation.
- (4) Cellulose Chemistry including benzyl cellulose and acetyl cellulose.
- (5) Trial Experiments on the Preparation of Alkyd Resins from Indian Raw Materials.

Detergents and Surface Active Agents :

- (6) Solubilisation Phenomenon.
- (7) Solubility and Cosolvency of Metallic Soaps.

General Physical Chemistry :

- (8) Kinetics of α -halogenation of Fatty Acids.
- (9) Dielectric Behaviour of High Molecular Weight Substances.

(1) *Fundamental Studies on Polymerisation Kinetics*—The results of the kinetics for potassium persulphate initiated polymerisation of styrene in solution have been compared with those obtained in benzoyl peroxide initiated polymerisation under otherwise identical conditions. This study has brought to light a number of interesting facts, viz., (a) as a catalyst for polymerisation, persulphate is about 100 times as efficient as benzoyl peroxide; (b) the high speed of reaction with persulphate catalyst is not obtained, as is usually the case, by a sacrifice of the molecular weight of the polymer formed, polystyrene produced by persulphate initiation possesses about 5 to 6 times the molecular weight of the polystyrene produced by benzoyl peroxide initiation; (c) the persulphate initiation has been found to be markedly inhibited by the oxygen of air.

These observations suggest that the present-day view on emulsion polymerisation which shows most of these peculiarities must be reconsidered.

A theoretical examination of the various chain terminating steps of vinyl polymerisation has shown that the catalysts may take part in the chain terminating step; and this reaction, hitherto neglected, may produce profound influence on the molecular weight of the polymers. The above work was undertaken and is still being continued by Sri Ranajit Sengupta.

(2) *Inhibition and Retardation of Vinyl Polymerisation*—An extensive programme to study the effect of metals on the course of polymerisation of styrene and methyl methacrylate has been undertaken on account of the technical importance of the problem. The effect of six metals, viz., Mn, Fe, Co, Ni, Zn, Cu, has been studied. All the metals (except iron in styrene) have been found to exert a retarding influence on the polymerisation of styrene and methyl methacrylate. The tendency is less marked with Ni and Co, but with other metals the effect is quite considerable. It has been found that the effect of metals on polymerisation is much more pronounced in *n*-butyl alcohol than in toluene, though the order of their effectiveness as retarder remains more or less the same in both the solvents.

Of the various combinations studied, the system copper oleate-styrene presented a striking result. It was observed that copper completely inhibited the polymerisation of styrene and the effectiveness of copper is far greater in some respects than that of the hitherto known inhibitors. The work is now in progress in charge of Sri Jyotindra Nath Sen and the first part of our results has been incorporated in a paper which has been communicated for publication.

(3) *Chain Transfer by Solvents in Vinyl Polymerisation*—A long range programme to study the phenomenon in all its aspects has been initiated. Study of chain transfer by various solvents in uncatalysed methyl methacrylate polymerisation has been completed in some detail by Dr. Sadhan Basu. Under otherwise identical conditions it is observed that the molecular weight of the polymer can be made to vary from about 40,000 to 500,000 by a change of solvent without substantially changing the nature of the reaction.

(4) *Cellulose Chemistry*—Benzylation of cellulose from Indian cotton and some foreign cottons has been carried out in this laboratory by a new method by Dr. Sadhan Basu and Sri H. B. Roy. Fractionation and chemical analysis of the benzyl ethers, it is hoped, would provide us with interesting information regarding the molecular complexities of Indian cotton.

Acetylation experiments on medium staple Indian cotton of known history and long staple Egyptian cotton have been carried out by Sri P. K. Chowdhury with a view to ascertaining the suitability of Indian cotton for the manufacture of cellulose acetate and also to throwing light on the molecular mechanism of the whole course of acetylation to triacetate and its subsequent hydrolysis.

The main results are: (1) Indian cotton is more easily acetylated than the Egyptian cotton; (2) the cellulose acetate obtained from Indian cotton is of about 45% lower degree of polymerisation on the average than that derived from Egyptian cotton; (3) the cellulose acetate obtained from Indian cotton has a degree of polymerisation in the commercially useful range; (4) the hydrolysis even under quite drastic conditions brings about only a slight break down of the cellulose chain. The different behaviour of Egyptian cotton may be due to its molecular complexity and difference in crystalline structure.

(5) *Trial Experiments in Alkyd resins*—Since India abounds in oils and fats and not all the oils are fit for human consumption, utilisation of these oils for the production of alkyd resins from indigenous raw materials seems to be feasible. Some trial experiments were carried out in this laboratory and the results were quite encouraging. A more thorough investigation is contemplated.

(6) *Solubilisation Phenomenon*—It is well known that water can be solubilised in chloroform, carbon tetrachloride, benzene, hexane, etc. in presence of suitable surface active agents. During our study on this phenomenon, an important and yet unexplained observation has been made. It has been observed by the writer that cetyl-dimethyl-ethyl-ammonium-bromide solubilises water in chloroform or in benzene to a very weak degree, but if the chloroform and benzene are mixed the solubilisation of water is very much enhanced to a value as high as over 6 times the weight of this surface active agent. Similar behaviour has also been observed with chloroform-carbon tetrachloride mixture. A preliminary paper has already been communicated for publication.

(7) *Solubility and Cosolvency of Metallic Soaps*—Soaps have been observed to dissolve more in mixtures of a glycol and a hydrocarbon dissolving solvent than in any of the individual pure solvents alone. Work in this line has been continued with stearates of lithium and potassium by H. Sreepathi Rao.

Metallic soaps exhibit a behaviour similar to the alkali metal soaps. For dissolving oleates, alcohols can be used as a cosolvent in place of a glycol. Solubility studies on oleates of barium, lead, zinc, etc. in mixtures composed of non-polar solvent and a monohydroxylic solvent, such as chloroform and alcohol, etc. are in progress. This work is being carried out by Sri B. K. Chatterjee.

(8) *Kinetics of α -halogenation of Fatty Acids*—It is known that glacial acetic acid cannot be brominated or iodinated at ordinary temperature or some time even on boiling without a catalyst. It has been newly observed in this laboratory that sodium acetate also serves as a catalyst at room temperature. The kinetics and iodination of acetic acid catalysed by sodium acetate and also the kinetics of bromination of acetic acid catalysed by sodium acetate are being studied by Sri M. N. Das. It has been found that the reaction is a bimolecular one. This is rather unusual because most iodination is 0 molecular with respect to iodine. The effect of water, metallic salts and other substances is now being studied.

(9) *Dielectric Behaviour of High Molecular Weight Substances*—A precision apparatus for the measurement of dielectric constant and dipole moment has been assembled for studying the dielectric behaviour of high molecular weight compounds. At present this apparatus is being employed by Sri B. Banerji for the measurement of dipole moment of metallic soaps particularly oleates of copper, zinc, silver etc. Though generally supposed to be non-polar the results so far obtained show that they have got a small dipole moment whose value lies generally within the range of 1-2 Debye.

List of Publications

1. Electric Interpretation of Organic Chemistry III. Effect of Substituents on the Strength of Organic Bases.—By Santi R. Palit, *J. Ind. Chem. Soc.* **25**, 127 (1948).
2. Soaps and Soap.—By Santi R. Palit, *Science & Culture*, **13**, 449 (1948).
3. Iodination of Sodium Acetate in Glacial Acetic Acid Medium.—By Mihir Nath Das, *Science & Culture*, **14**, 165 (1948).

IN THE PRESS

4. Kinetics of Halogenation of Fatty Acids I. Iodination of Acetic Acid.—By Mihir Nath Das, and Santi R. Palit, *J. Ind. Chem. Soc.*
5. Comparative Study of Potassium Persulphate and Benzoyl Peroxide as Initiators of Polymerization in Solution.—By Ranajit Sengupta & Santi R. Palit, *J. Polymer Sc.*
6. Potassium Persulphate as Initiators of Polymerization in Solution.—By Ranajit Sengupta, and Santi R. Palit, *Current Science*.
7. The Chain Terminating Step in the Catalysed Vinyl Polymerization.—By Ranajit Sengupta & Santi R. Palit, *J. Ind. Chem. Soc.*
8. A Note on Mixed Solvent Effect in Solubilization.—By Santi R. Palit, *J. Colloid Sc.*
9. The Effect of Metals on Polymerization.—By Jyotindra Nath Sen, Ranajit Sengupta and Santi R. Palit, *J. Ind. Chem. Soc.*

List of Books Added During 1948-49.

1. Still, Alfred .. Communication through the ages.
2. Delmonte, John .. Technology of adhesives.
3. Berkman, Morrel & Egloff .. Catalysis inorganic & organic.
4. Huntress & Mulliken, .. Identification of pure organic compounds.
5. Pratt, L. S. .. Chemistry and physics of organic pigments.
6. Mantell, Krof, Curtis & Rogers .. Technology of natural resins.
7. Hund, A. .. High-frequency measurements.
8. Hardy, A. & Perrin, F. .. The principles of optics.
9. Kennard, E. H. .. Kinetic theory of gases.
10. Slater, J. C. .. Microwave transmission.
11. Parke, N. G. .. Guide to the literature of mathematics and physics.
12. Faraday Society .. General discussion on swelling & shrinking. (vol. 42B, 1946).
13. Molloy, E. .. Milling practice.
14. Wostrel & Praetz .. Household electric refrigeration.
15. Sokolnikoff, I. S. & Sokolnikoff, E. S. .. Higher mathematics for engineers and physicists.
16. Hall, J. S. .. Radar aids to navigation.
17. Harnwell, G. P. & Livingood, J. J. .. Experimental atomic physics.
18. Timoshenko, S. .. Theory of elasticity.
19. Pauling, L. & Goudsmit, S. .. Structure of line spectra.
20. Williams, S. R. .. Magnetic phenomena.
21. Hund, August .. Phenomena in high-frequency systems.
22. Clark, G. L. .. Applied X-rays.
23. Houston, W. V. .. Principles of mathematical physics.
24. Emswiler, & Schwartz .. Thermodynamics.
25. Humphrey, D. .. Advanced mathematics for students of physics and engineering, Pt. I & II.
26. Ferrar, W. L. .. Algebra.
27. Conrady, A. E. .. Applied optics & optical design, Pt. I.
28. Waters, W. A. .. Chemistry of free radicals.
29. Nuffield College .. Problems of Scientific and industrial research.
30. Emeleus, H. J. & Anderson, J. S. .. Modern aspects of inorganic chemistry.
31. Gilman, H. Edt. .. Organic chemistry, Vol. II.
32. Furnas, C. C. .. Roger's industrial chemistry, Vol. I & II.
33. Morgan, S. T. & Pratt, D. D. .. British chemical industry.
34. Stewart, A. W. & Wilson, C. W. .. Recent advances in physical and inorganic chemistry.
35. Frankel, J. .. Kinetic theory of liquids.
36. Royal Society .. Newton tercentenary celebrations.
37. .. Selected values of properties of Hydrocarbons.
38. Shriner, Ralph. L. & Fuson, Reynold C. .. Systematic identification of organic compounds.
39. Shreve, R. Norris .. Chemical process industries.
40. Callahan, L. I. .. Russian-English technical and chemical dictionary.
41. Baker, E. A. .. Cassell's French-English, English-French dictionary.
42. Schrodinger, Erwin .. What is life.
43. Partington, J. R. .. A short history of chemistry.
44. Fleck, H. R. .. Plastics manual.
45. Daniels, Mathews & Williams .. Experimental physical chemistry.
46. George Westinghouse Centennial Forum .. Science and life in the world, Vol. II & III.
47. Haslam, R. T. & Russell .. Fuels and their combustion.
48. Harrison, G. R. .. Wave length tables.
49. Ghirardi, A. A. .. Radio physics course.
50. Gilman, H. Ed-i-ch. .. Organic chemistry, Vol. I.
51. Nilson, A. R. & Hornung .. Practical radio communication.
52. Glasgow, R. S. .. Principles of radio engineering.
53. Henney, D. Ed. .. Radio engineering handbook.
54. Witts, A. T. .. Radio upkeep and repairs.
55. Marshak, Nelson, Schiff. .. Our atomic world.
56. Michener, W. H. .. Physics for students of science and engineering.
57. Mantell, C. L. .. Water-soluble gums.
58. James, Nichols, Phillips. .. Theory of serromechanisms.
59. Wislicenus, G. F. .. Fluid mechanics of turbomachinery.
60. Montgomery, C. L. .. Technique of microwave measurements.
61. Torrey & Whitmer. .. Crystal rectifiers.
62. Roberts, A. .. Radar beacons.
63. Randell, W. L. .. S. Z. De Ferranti.
64. .. International control of atomic energy, scientific information transmitted to the United Nations atomic energy Commission June 14, 1946, Vol. I.

65. Hamilton, Knipp, Kuper. .. Klystrons and microwave triodes.
66. Pound, R. V. .. Microwave mixers.
67. Svoboda, A. .. Computing mechanisms and linkages.
68. Van Voorhis, S. N. .. Microwave receivers.
69. Reich, H. J. .. Very high-frequency techniques, Vol. I & II.
70. Bates, L. F. .. Modern Magnetism.
71. Gamow, G. .. One, two, three, infinity.
72. Powell & Occhialino. .. Nuclear physics in photographs.
73. Pledge, H. T. .. Science since 1500.
74. Fink, D. G. .. Radar engineering.
75. Silman, H. .. Chemical and electroplated finishes.
76. Loeb & Meek. .. Mechanism of the electric spark.
77. Suydam, V. A. .. Fundamentals of electricity and electromagnetism.
78. Howard, F. A. .. Buna Rubber.
79. Knight, S. A. .. Fundamentals of radar.
80. Weiland, H. .. On the mechanism of oxidation.
81. Cramer, H. .. Mathematical methods of statistics.
82. Moyer, & Fittz. .. Refrigeration.
83. Griffiths, E. .. Methods of measuring temperature.
84. McLachlan, N. W. .. Modern operational calculus.
85. Kearton, W. J. .. Steam turbine theory and practice.
86. Abramson, Moyer, Gorin. .. Electrophoresis of proteins.
87. Walker, R. C. .. Electronic equipment and accessories.
88. Mauersberger, H. R. Edt. .. Textile fibres.
89. DeBell, Goffin, Gloor. .. German plastics practice.
90. Cutter, C. A. .. Three-figure alphabetic-order tables.
91. Johnson, M. .. Time, knowledge, and the nebulae.
92. Herrick, A. D. .. New Drugs.
93. Knaggs, N. S. .. Adventures in man's first plastic.
94. Steacie, E. W. R. .. Free radical mechanisms.
95. Venable, W. M. .. The interpretation of spectra.
96. Masing, G. .. Ternary systems.
97. Baeza, W. J. .. A course in powder metallurgy.
98. Gulliksen & Vedder. .. Industrial electronics.
99. Yarwood, J. .. High vacuum technique.
100. Smyth, H. D. .. Atomic energy for military purposes.
101. Ghirardi, A. A. .. Modern radio servicing.
102. Korff, S. A. .. Electron and nuclear counters.
103. Glasoe & Lebacqz. .. Pulse generators.
104. Hoel, P. G. .. Introduction to mathematical statistics.
105. Tauber, H. .. Enzyme technology.
106. Dept. of State, U.S.A. .. A report on the International control of atomic energy
107. Govt. of U.S.A. .. Atomic energy Act of 1946 for the development and
control of atomic energy.
108. Culver, C. A. .. Musical acoustics.
109. Courant, R. .. Differential and integral calculus, Vol. I.
110. Cosslett, V. E. .. Introduction to electron optics.
111. Rogers & Kerr. .. Optical mineralogy.
112. Albert, A. L. .. Fundamental electronics and vacuum tubes.
113. Booth, H. S. Edt. .. Inorganic syntheses, Vol. I.
114. Mason & Manning. .. Technology of plastics and resins.
115. Schwab, G. .. Catalysis.
116. Sherman & Sherman. .. New fibers.
117. Simonds, Bigelow, Sherman. .. New plastics.
118. Thompson, J. W. .. Report on experimental work on fluorine.
118. Thompson, J. W. .. Report on experimental work on fluorine production
to May, 1939, BDDA No. 74.
119. Haworth, W. N. .. Investigations on oxides of Uranium BDDA No. 75.
120. Feather, N. .. A new method of investigating the angular distribution
of high-energy neutrons scattered by protons. BDDA
No. 76.
121. Ferguson, J. .. Preparation of fluorine BDDA No. 77.
122. Fenning, F. W. & Seligman, H. .. Capture cross section of N, Mg., S, Ca and Pb for
thermal neutrons. BDDA No. 78.
123. Feather, N. .. Note on the inelastic scattering of fast neutrons. BDDA.
No. 79.
124. Feather, N. .. Neutron-produced radioactivity in relation to the
detection of high-energy neutrons: Maximum
sensitivity of a counter. BDDA No. 80.
125. Peierls, R. .. Equilibrium time in a separation plant. BDDA No. 81.
126. Peierls, R. .. Effect of a stationary layer of thickness in front of the
diffusing membrane, BDDA No. 82.

127. Peierls, R. .. Separating effect of a passage through capillary BDDA No. 83.
128. Fuchs, K. .. Effect of boundary layer for swept membranes. BDDA No. 84.
129. Peierls, R. .. Clusius-Dickel device as gland. BDDA No. 85.
130. Pryce, M. H. L. .. Critical conditions in neutron multiplication BDDA No. 86.
131. Fuchs, K. .. Effect of a scattering container on the critical radius and time constant. BDDA No. 87.
132. Haworth, W. N. .. Preparation of metallic uranium by electrolysis of the fused salts. BDDA No. 88.
133. Haworth, W. N. .. "Metalectris" furnace (with sketch) Tomilson (Metaelectric Co. Ltd.). BDDA No. 89.
134. Friedlander, F. G. .. Note on the compression at the diffuser entry in compressor I.Z.I. BDDA No. 91.
135. Booker, Broda & Kowarski .. Density of resonance neutrons in hydrogenous media near the source. BDDA No. 91.
136. Cranshaw, T. E. .. Receiving time and counting errors in discriminators and scaling units. BDDA No. 92.
137. Kowarski & West .. Distribution of slow neutrons in rarefied hydrogenous media. BDDA No. 93.
138. James, A. G. .. Determination of uranium in urine. A proposed modification and some notes on the method. BDDA No. 94.
139. Wilson, H. A. .. New method of determining the time constant of a sphere in a container. BDDA No. 95.
140. Broda & Wright .. Extraction of protactinium from a siliceous raw material. BDDA No. 96.
141. Peierls & Fuchs. .. Separation of isotopes. BDDA No. 97.
142. Walsh, A. .. Spectrographic analysis of uranium. BDDA No. 98.
143. Members of the Staff of the Radar School (M.I.T.) .. Principles of radar.
144. Whittaker, & Watson. .. A course of modern analysis.
145. Eddington, A. S. .. Fundamental theory.
146. Michell & Belz. .. Elements of mathematical analysis. Vol. I & II.
147. Fite, W. B. .. Advanced calculus.
148. Richerdson, M. .. Fundamentals of mathematics.
149. Jone, B. W. .. Elementary concepts of mathematics.
150. Barnard & Child. .. Advanced algebra.
151. Hodge & Pedoe. .. Methods of algebraic geometry, Vol. I.
152. Young, J. W. .. Lectures on fundamental concepts of algebra and geometry.
153. Ball, W. W. R. .. Mathematical recreations and essays.
154. Barr, J. R. .. Electrical engineering.
155. Weyl, H. .. Theory of groups and quantum mechanics.
156. Roy, P. .. Theory of valency and the structure of chemical compounds.
157. Twiss, S. B. .. Advancing fronts in chemistry, Vo. I.
158. Karpinski, L. C. .. Bibliography of mathematical works printed in America through 1850.
159. .. Annual report of the Librarian of Congress. 30.4.46.
160. American Inst. Phys. .. Temperature, its measurement and control in science and industry.
161. Noyes & Leighton. .. Photochemistry of gases.
162. Nevins, A. .. John D. Rockefeller, the heroic age of American enterprise, Vol. II.
163. Brunauer, S. .. Absorption of gases and vapors, Vol. I.
164. Maxfield & Benedict. .. Theory of gaseous conduction and electronics.
165. Reich, H. J. .. Theory and applications of electron tubes.
166. Buerger, M. J. .. X-ray crystallography.
167. Eyring, Walter, Kimbol. .. Quantum chemistry.
168. Keenan, J. H. .. Thermodynamics.
169. Roters, H. C. .. Electromagnetic devices.
170. Nevins, A. .. John D. Rockefeller, the heroic age of American enterprise, Vol. I.
171. Conrad, V. .. Fundamentals of physical climatology.
172. Books published in the United States 1939-43.
173. Richtmyer & Kennard. .. Introduction to modern physics.
174. Harrod, L. M. .. Lending library methods.
175. Merrill, Wm. S. .. Code for classifiers.
176. Russell, B. .. Principles of Mathematics.

177. Probst, E. .. Principles of plan and reinforced concrete construction.
178. Brame, & King. .. Fuel, solid, liquid and gaseous.
179. Krynine, D. P. .. Soil mechanics.
180. Tietjens, O. G. .. Fundamentals of Hydro-and aeromechanics.
181. Klein, F. X. .. Elementary mathematics from an advanced standpoint
Geometry.
182. Graustein, Wm. C. .. Differential geometry.
183. Coulthard, W. B. .. Transients in electric circuits.
184. Dover, A. T. .. Theory and practice of alternating currents.
185. Levy & Roth. .. Elements of probability.
186. Chwistek, L. .. Limits of science.
184. Albert, A. A. .. Modern higher algebra.
185. Thomas, H. A. .. Theory and design of valve oscillators, Vol. II. 7.
186. Scott, Wm. B. .. Introduction to geology, Vol. I.
187. Brailsford, F. .. Magnetic materials.
188. Jackson, L. C. .. Low temperature physics.
189. Tolansky, S. .. Hyperfine structure in line spectra and nuclear spin.
190. Welcher, F. J. .. Chemical solutions.
191. Levens, A. S. .. Nomography.
192. MacInnes, D. A. .. Principles of electrochemistry.
193. Hawley & Leifson. .. Atomic energy in war and peace.
194. Lovell, B., Edt. .. Electronics and their application in industry and
research.
195. .. Report on the petroleum and synthetic oil industry of
Germany.
196. Pierce & Haenisch. .. Quantitative analysis.
197. Cohen, J. B. .. Practical organic chemistry.
198. Ince, E. L. .. Ordinary differential equation.
199. Conwey, E. J. .. Micro-diffusion analysis and volumetric error.
200. Bromwich, T. J. I. .. Introduction to the theory of infinite series.
201. Fort. .. Finite differences and difference equations in the
real domain.
202. Gatterman, L. .. Laboratory methods of organic chemistry.
203. Remick, A. E. .. Electronic interpretation of organic chemistry,
204. Treadwell, & Hall. .. Analytical chemistry Vol. I.
205. Vogel, A. I. .. Practical organic chemistry.
206. Bocher, M. .. Introduction to higher algebra.
207. Mitra, S. K. .. Upper atmosphere.
208. .. International control of atomic energy.
209. Zachariasen, W. H. .. Theory of X-ray diffraction in crystals.
210. Staff of the Computation Laboratory .. Tables of the Bessel functions of the first kind of orders
Zero and One.
211. Do .. Do Two and three.
212. Do .. Do four, five and six.
213. Do .. Do seven eight and nine.
214. Brown, S. P. .. Air conditioning and elements of refrigeration.
215. Fink, D. G. .. Engineering electronics.
216. Hunsaker, & Rightmire. .. Engineering applications of fluid mechanics.
217. Rossers; Newton; Gross. .. Mathematical theory of rocket flight
218. Slurzberg & Osterheld. .. Electrical essentials of radio.
219. Spangenberg, K. R. .. Vacuum tubes.
220. Ridenour, L. N. Edt. .. Radar System engineering, Vol. I. (M.I.T. sr).
221. Pierce; Mckenzie; Woodhard. .. Loran (M.I.T.Sr), Vol. 4.
222. Collins, G. B. .. Microwave magnetrons, Vol. 6 (M.I.T.Sr).
223. Montgomery; Dicke; Purcell. edt. .. Principles of microwave circuits (M.I.T.Sr) Vol. 8.
224. Ragon, G. L. edt. .. Microwave transmission circuits, (M.I.T.Sr) Vol. 9.
225. Smullin & Montgomery edt. .. Microwave duplexers (M.I.T.Sr), Vol. 14.
226. Dryer, W. P. .. Calculating high vacuum system.
227. Stratton, J. A. .. Electromagnetic theory.
228. .. United States strategic bombing survey.
229. Darrow, K. K. .. Atomic energy.
230. Richter, W. .. Fundamentals of industrial electronic circuits,
231. Greenwood & Others edt. .. Electronic instruments.
232. Soller, T. & Others edt. .. Cathode ray tube displays.
233. Cady, W. M. & Others edt. .. Radar scanners and radomes.
234. Mann, W. B. edt. .. Report on progress in physics, Vol. X (1944-45).
235. Huxley, L. G. H. .. Survey of the principles and practice of wave guides.
236. Angell, F. G. edt. .. Bayley's chemists's pocketbook.
237. Gardner, Wm. .. Chemical synonyms and trade names.
238. Read, John. .. Humour and humanism in chemistry.
239. Smith, E. S. C.; Fox, A. H.;
Sawyer, R. T. & Austin, H. R. .. Applied atomic power.

240. Joos ; .. Physics of solids.
 241. Gorter, C. J. .. Paramagnetic relaxation.
 242. Stevels, J. M. .. Progress in the theory of the physics.
 242. Stevels, J. M. .. Progress in the theory of the physics properties of glass.
 243. .. Ionospheric radio propagation.
 244. Jeffreys, H. .. Theory of probability.
 245. Lemaon & Ference. .. Analytical experimental physics.
 246. .. Report on progress in physics, Vol. II, 1946-47.
 247. Riegel, E. R. .. Chemical machinery.
 248. Bhagavantam, & Venkatarayudu, T. Theory and groups and its application to physical problems.
 249. Dewey, M. .. Decimal classification and relative index.
 250. Ralston, A. W. .. Fatty acids and their derivatives.
 251. Bailey, C. H. .. Constituents of wheat and wheat products.
 252. Harned & Owen. .. Physical chemistry of electrolytic solutions.
 253. Franklin, E. C. .. Nitrogen system of compounds.
 254. Marsh, J. S. .. Principles of phase Diagrams.
 255. Rosenfeild, L. .. Nuclear forces, Vol. I.
 256. Suthem, G. M. .. Introduction to emulsions.
 257. Fevre, R. J. W. .. Dipole moments : their measurement and application in chemistry.
 258. Nimmo, R. R. .. Atomic energy.
 259. Valley & Wallman. edt. .. Vacuum tube amplifiers Vol. 18.
 260. Electronics Training Staff of the Cruft Laboratory. .. Electronic circuits and tubes.
 261. Forrester & Majumder. .. Washability of Indian coals.
 262. Burchard, J. .. Q. E. D. (M.I.T. in World war II).
 263. M. I. T. Radar School. .. Principles of Radar.
 264. Bethe, H. A. .. Elementary nuclear theory.
 265. Richardson, E. G. .. Physical science in modern life.
 266. Heindlhofer, K. .. Evaluation of residual stress.
 267. Bailsell, G. A. Edt. .. Science in progress, 5th series, 1947.
 278. National Research Council. .. Handbook of scientific and technical societies and Institutions of the United States of Canada.
 269. Wallace, W. S. edt. .. Royal Canadian Institute (Centennial volume 1939-1949)
 270. Wrinch, D. .. Fourier transform and structure factors.
 271. .. Beilsteins Handbuch der organischen chemie Full series.
 272. Goodstein, R. L. .. A text-book of mathematical analysis.
 273. Keesom, W. H. .. Helium.
 274. Chem. Rubber Pub. Co. .. Hand-book of chemistry and physics.
 275. Courant, R. .. Differential and integral calculus, Vol. 2.
 276. Watson, H. R. .. Modern theories of organic chemistry.

In addition to those of 1947-48 the following Journals were received through exchange during 1948-49.

1. Acta Universitatis Agriculturae et Silviculturae Brno.
 2. Angewandte Chemie A & B.
 3. Annalender Chemie.
 4. Annales D'Astrophysique.
 5. Annales de Geophysique.
 6. Archives des Sciences.
 7. Attidella Accademia Nazionale dei Lincei. Rendiconto dell Adunanzagenerale a classi riunite.
 8. Astrophysica Norvegica.
 9. Bell Laboratories Record.
 10. British Institution of Radio Engineers : Journal.
 11. British Science News.
 12. Chemische Berichte.
 13. Chemisches Zentralblatt (Akademic-Verlag.).
 14. Chemisches Zentralblatt (Verlag Chemie.).
 15. Contribution for the Institute of Physics.
 16. Dept. of Scientific and Industrial Research : New Zealand.
 17. Der. Akad. Der Wissenschaften : Nachrichten : Biologisch-Physio-Chem : Abteilung.
 18. Do Do : Math-Physik-Chem : Abteilung.
 19. Det. Kgl. Danske Videnskapernes Selskab : Biologiske Meddelelser.
 20. Det. Kongelige Danske Videnskabernes Selskab : Biologiske Skrifter.
 21. Faculte des Science de Marseille : Annales.
 22. Indian Agricultural Research Institute : Scientific Report.
 23. Indian Chemical Society : Industrial & News Editions : Journal.
 24. Indian Science Congress : Proceedings.
 25. Institution of Radio Engineers : Proceedings (Australia).
 26. Journal of Science and Technology Sec. B. (New Zealand).
 27. Kungl. Fysiografiska Sallskapetets I Lund Forhandlingar.
 28. National Tsing Hua University : Science Report.
 29. Naturwissenschaften.
 30. Nuffield Foundation : Report.
 31. Philips Research Report.
 32. Physical Society of Japan : Journal.
 33. Physikalische Blatter.
 34. Revue D'Optique Theorique et Instrumentale.
 35. Royal Canadian Institute : Proceedings. sr. IIIA.
 36. Saim Science Bulletin.
 37. Science Record.
 38. Society Scientifique : Annales de la.
 39. Societe Royale des Sciences de Liege : Bulletin.
 40. South African Journal of Science.
 41. Television Society : Journal.
 42. Tohoku Mathematical Journal.
 43. Transactions : National Institute of Science of India.
 44. Universidad Nicional de Tucuman : Revista Sr. A.
 45. Universidad Nacional de la : Revista.
 46. Zamm Zeitschrift fur Angewandte Mathematik und Mechanik.
 47. Zeitschrift fur Anorganische Chemie.
 48. Zeitschrift fur Astrophysik.
 49. Zeitschrift fur Physik.
-

1947-48 only

1. Matematikai es Fizikai Lapok.
2. Nuovo Cimento.
3. Pacific Science.
4. Plata. Universidad Nacional. Facultad de Ciencias Fisicomatematicas Publicaciones especiales, Sr. 3.
5. Revue generale des Sciences Pures et Appliques.
6. Royal Institute of Great Britain -Proceedings.
7. Sociedad Mexicana de Historia Natural : Revista.

In addition to those of 1947-48, the following Journals were subscribed during 1948-49.

1. Applied Mechanics Review.
2. Chemical Industry.
3. Faraday Society : Discussions.
4. Helvetica Chemica Acta.
5. Mathematische Annalen.
6. Mathematische Zeitschrift.
7. National Academy of Sciences of U.S.A. : Proceedings.
8. Physikalische Berichte.
9. Royal Institute of Gt. Britain : Proceedings.
10. Science.
11. Societe Française de Mineralogie : Bulletin.
12. Zeitschrift fur Angewandte Physik.
13. Zeitschrift fur Astrophysik.
14. Zeitschrift fur Naturforschung : A & B.

INDIAN ASSOCIATION

Balance Sheet

LIABILITIES.	Rs. As. P.	Rs. As. P.
<i>General Fund</i> —		
.. .. .	10,05,261 13 5	
Less, Fluctuation on Investment in G. P. Notes	350 10 0	10,04,911 3 5
Library Reserve Fund .. .. .	..	3,359 8 0
Research Endowment Fund .. .. .	..	20,411 1 6
<i>Special Funds</i> —		
Mahendralal Sircar Professorship Fund ..	1,49,500 0 0	
Viharilal Mitra Fund	1,00,000 0 0	
Ripon Professorship Fund	25,000 0 0	
Coochbehar Professorship Fund	33 000 0 0	
Hare Professorship Fund	1,500 0 0	
Victoria Professorship Fund	1,500 0 0	
Joykissen Mookherjee Gold Medal Fund ..	13,400 0 0	
Dr. Bimala Churn Law Gold Medal Fund ..	7,000 0 0	
Dr. Sircar Research Medal Fund	5,000 0 0	
Woodburn Medal Fund	1,500 0 0	
Nikunja Garabini Prize Fund	1,000 0 0	
Jatindra Chandra Prize Fund	1,000 0 0	
Building Fund	9,500 0 0	
	3,48,900 0 0	
Less, Fluctuation on Investments in G. P. Notes	8,094 2 0	3,40,805 14 0
Amount Carried Over		13,69,487 10 11

FOR THE CULTIVATION OF SCIENCE.

as at 31st March, 1949.

ASSETS.	Rs.	As.	P.	Rs.	As.	P.
<i>Land and Building</i> —as per last Account				31,680	11	9
Lecture Hall and Gallery	23,465	5	3			
Less, Depreciation @2%	469	3	3			
				22,996	2	0
Vizianagram Laboratory	40,900	14	0			
Less, Depreciation @2%	818	0	0			
				40,082	14	0
Observatory Room	3,320	9	9			
Less, Depreciation @2%	66	5	9			
				3,254	4	0
Range of Shops (East)	2,516	10	9			
Less, Depreciation @2%	50	2	9			
				2,466	8	0
Range of Shops (West)	2,308	5	0			
Less, Depreciation @2%	46	0	0			
				2,262	5	0
Servants' Quarters	1,024	0	0			
Less, Depreciation @2%	20	8	0			
				1,003	8	0
Darwans' Quarters	303	13	9			
Less, Depreciation @2%	6	8	9			
				297	5	0
<i>Scientific Instruments</i> —						
X-Ray and Magnetism Department	1,11,745	14	6			
Less, Depreciation @2%	2,234	14	6			
	1,09,511	0	0			
Since Added	29,294	14	0			
				1,38,805	14	0
Optics Department	3,173	5	9			
Less, Depreciation @2%	63	6	9			
	3,109	15	0			
Since Added	5,151	13	6			
				8,261	12	6
Physical Chemistry Department	460	0	0			
Less, Depreciation @2%	9	3	0			
	450	13	0			
Amount Carried Over				2,51,111	4	3

FOR THE CULTIVATION OF SCIENCE.

as at 31st March, 1949.

ASSETS.				Rs.	As.	P.	Rs.	As.	P.
	Amount Brought Forward			..			2,51,111	4	3
Since Added	..	..	..	4,512	8	6			
							4,963	5	6
Botany	..	..	..	1,805	0	0			
Less, Depreciation @ 2%	..	..	..	36	1	0			
							1,768	15	0
Workshop Instruments	..	..	..	33,702	3	0			
Less, Depreciation @ 2%	..	..	..	674	0	0			
				33,028	3	0			
Since Added	..	..	..	12,089	12	3			
							45,117	15	3
Tools and Implements	..	..	..	223	0	0			
Less, Depreciation @ 2%	..	..	..	4	6	0			
				218	10	0			
Since Added	..	..	..	1,057	2	3			
							1,275	12	3
Vehicle	..	..	..	274	0	0			
Less, Depreciation @ 10%	..	..	..	27	6	0			
							246	10	0
Furniture and Fittings	..	..	..	20,437	6	6			
Less, Depreciation @ 2%	..	..	..	408	11	6			
				20,028	11	0			
Since Added	..	..	..	3,510	3	9			
							23,538	14	9
Library—as per last Account	..	..	..	84,880	11	0			
Less, Depreciation @ 2%	..	..	..	1,697	11	0			
				83,183	0	0			
Since Added	..	..	..	15,024	2	0			
							98,207	2	0
Tube Well	..	..	..				1,878	4	6
	Amount Carried Over	..	..				4,28,108	3	6

FOR THE CULTIVATION OF SCIENCE

as at 31st March 1949.

ASSETS.	Rs.	As.	P.	Rs.	As.	P.
Amount Brought Forward				4,28,108	3	6
<i>Investments (in 3% G. P. Notes lodged with Imperial Bank of India)—</i>						
Mahendralal Sircar Professorship Fund	1,49,500	0	0			
Viharilal Mitra Fund	1,32,000	0	0			
Ripon Professorship Fund	25,000	0	0			
Coochbehar Professorship Fund	33,000	0	0			
Hare Professorship Fund	1,500	0	0			
Victoria Professorship Fund	1,500	0	0			
Joykissen Mookherjee Gold Medal Fund	13,400	0	0			
Dr. Bimala Churn Law Gold Medal Fund	7,000	0	0			
Dr. Sircar Research Medal Fund	5,000	0	0			
Woodburn Medal Fund	1,500	0	0			
Nikunja Garabini Prize Fund	1,000	0	0			
Jatindia Chandra Prize Fund	1,000	0	0			
General Fund	16,500	0	0			
Building Fund	9,500	0	0			
	3,97,400	0	0			
<i>Less, Fluctuations on Investments</i>	8,444	12	0			
				3,88,955	4	0
<i>Suspense (Advances)—</i>				12,155	14	3
<i>Land Acquisition and Construction Expenses—</i>				4,95,465	6	11
<i>Special Funds—</i>						
Imperial Bank of India (Current Account)				18,431	13	5
<i>Library Reserve Fund—</i>						
Imperial Bank of India (Current Account)				3,359	8	0
<i>Research Endowment Fund—</i>						
Imperial Bank of India (Current Account)				20,411	1	6
<i>Provident Fund—</i>						
Imperial Bank of India (Savings Bank Account)	23,485	12	1			
Imperial Bank of India (Fixed Deposit Account)	2,060	0	0			
3% Con. Loan lodged with Imperial Bank of India (Face Value Rs. 5,000)	4,978	12	0			
Advance to Members	195	0	0			
				30,719	8	1
<i>Cash and Other Balances as at 31st March, 1949—</i>						
Imprest Cash (as per Cash Books)	550	0	0			
Imperial Bank of India (Current Account)	5,24,188	1	6	5,24,738	1	6
TOTAL				Rs. 19,22,344	13	2

INDIAN ASSOCIATION

Receipts and Payments Accounts

RECEIPTS.	Rs.	As.	P.	Rs.	As.	P.
To <i>Opening Balances</i> —						
Imprest Cash	300	0	0			
Imperial Bank of India (Current Account) ..	17,188	2	6	17,488	2	6
„ <i>Government of India Grant (Recurring)</i> —						
Arrear (1947-48)	89,000	0	0			
Current (1948-49)	2,66,700	0	0	3,55,700	0	0
„ Government of India Grant (Non-recurring) ..				4,32,000	0	0
„ Government Contribution towards Dearness Allowance				10,405	0	0
„ <i>Miscellaneous</i> —						
Interest on Investment—General Fund ..	534	8	0			
Ordinary Membership Subscriptions ..	745	0	0			
Life Membership Fees	2,750	0	0			
Rent	5,280	6	9			
Demonstration Allowance	250	0	0	9,559	14	9
„ <i>Receipts on Account of Indian Journal of Physics</i> —						
Contributions	2,020	0	0			
Subscriptions	3,081	12	9			
Advertisements	299	8	6	5,401	5	3
Amount Carried Over				8,30,554	6	6

FOR THE CULTIVATION OF SCIENCE.

for the year ended 31st March, 1949.

PAYMENTS.		Rs.	As.	P.	Rs.	As.	P.
By Establishment—							
Department of X-Rays and Magnetism	..	22,710	13	0			
Department of Optics	..	23,473	3	0			
Department of Physical Chemistry	..	21,031	15	0			
Library	..	4,435	12	0			
Workshop	..	10,187	15	0			
Indian Journal of Physics	..	5,079	9	0			
Administration	..	19,044	1	0			
					1,05,963	4	0
Contribution to Provident Fund	..	..			4,704	13	0
Contribution towards Salary of M. L. S.							
Professor of Physics	..	..			7,193	0	0
„ Laboratory Grants—							
X-Rays and Magnetism—							
Recurring—		Rs.	As.	P.			
Laboratory Charges	..	2,258	10	9			
Scientific Instruments	..	6,823	9	0			
					9,082	3	9
Non-recurring—Scientific Instruments	..	22,471	5	0			
					31,553	8	9
Optics—							
Recurring—		Rs.	As.	P.			
Laboratory Charges	..	3,299	7	9			
Scientific Instruments	..	3,401	13	6			
					6,701	5	3
Non-recurring—Scientific Instruments	..	1,750	0	0			
					8,451	5	3
Physical Chemistry—							
Recurring—		Rs.	As.	P.			
Laboratory Charges	..	4,968	3	6			
Scientific Instruments	..	3,105	2	6			
					8,073	6	0
Non-recurring—							
Laboratory Charges	..	16,078	6	6			
Scientific Instruments	..	1,407	6	0	17,485	12	6
					25,559	2	6
Amount Carried Over	..	..			1,83,425	1	6

INDIAN ASSOCIATION

Receipts and Payments Accounts

RECEIPTS.	Rs.	As.	P.	Rs.	As.	P.
Amount Brought Forward				8,30,554	6	6
To <i>Other Items</i> —						
Receipts from Special Funds	19,000	0	0			
Receipts from M. L. S. Professorship Fund ..	23,630	8	0	42,630	8	0
„ <i>Grants from Council of Scientific and Industrial Research</i> —						
X-Ray Studies on Metals and Alloys	13,212	14	6			
X-Ray Investigation on Coal	6,419	0	0	19,631	14	6
„ <i>Suspense (Recoveries)</i>				18,829	0	9
„ <i>Sale Proceeds of Tender Forms, etc.</i>				1,176	15	3
Amount Carried Over				9,12,822	13	0

FOR THE CULTIVATION OF SCIENCE.

for the year ended 31st March, 1949.

PAYMENTS.		Rs.	As.	P.	Rs.	As.	P.
By	Amount Brought Forward				1,83,425	1	6
	<i>Organic Chemistry—</i>						
	Recurring—Laboratory Charges				102	0	0
„	Library	15,024	2	0			
„	Contingency	261	11	9			
					15,285	13	9
„	<i>Workshop Grants—</i>						
	Recurring—						
	Workshop Charges	1,973	14	0			
	Tools & Implements	1,057	2	3			
	Instruments	2,109	7	3			
					5,140	7	6
	Non-recurring—Instruments	9,980	5	0			
					15,120	12	6
„	<i>Indian Journal of Physics—</i> Publication Expenses				6,990	4	9
„	<i>Contribution to Indian Science News Association</i>				1,000	0	0
„	<i>Mahendralal Sircar Professorship Fund</i>				2,750	0	0
„	<i>Other Items—</i>						
	Payments to Special Funds	27,000	0	0			
	Payments to M. L. S. Professorship Fund	13,791	12	0			
					40,791	12	0
	<i>C. S. I. R. Scheme—</i>						
	On Metals & Alloys	11,903	11	6			
„	Coal	10,658	11	6			
					22,562	7	0
„	<i>Suspense (Advances)</i>				23,286	5	9
	Amount Carried Over				3,11,314	9	3

FOR THE CULTIVATION OF SCIENCE.

for the year ended 31st March, 1949.

PAYMENTS.				Rs.	As.	P.	Rs.	As.	P.
By Amount Brought Forward	..	..	..	3,11,314	9	3			
„ <i>Miscellaneous—</i>									
Building Repair	..	..	..	2,208	15	0			
Electric Fittings	..	..	..	967	13	3			
Gas Charges	..	..	..	1,371	1	0			
Electric Charges	..	..	..	2,768	6	9			
Telephone Charges	..	..	..	431	14	0			
Printing Charges	..	..	..	2,351	4	3			
Stationery & Contingency	..	..	..	2,851	12	6			
Postage	..	..	..	400	10	9			
Advertisements	..	..	..	995	4	0			
Municipal Tax	..	..	..	1,068	5	0			
Science Congress Association	..	..	..	12	0	0			
T. A. to Research Staff for attending Science Congress	..	..	..	498	0	0			
T. A. to Members of Selection Committees	..	..	..	1,630	9	0			
Bank Charges	..	..	..	17	1	0			
Audit Fees	..	..	..	250	0	0			
Insurance Charges	..	..	..	125	0	0			
Meeting Expenses	..	..	..	411	2	0			
Contribution to Tiffin Club, etc.	..	..	..	607	7	9			
							18,966	10	3
„ <i>Tube Well</i>	..	..	..				1,878	4	6
„ <i>Furniture and Fittings</i>	..	..	..				3,510	3	9
„ <i>Land Acquisition and Construction Expenses</i>	..	..	..				52,350	15	9
„ <i>Deposit (Refunded)</i>	..	..	..				54	0	0
„ <i>Library Deposit (Refunded)</i>	..	..	..				10	0	0
„ <i>Closing Balances—</i>									
Imprest Cash (as per Petty Cash Books)	..	..	..	550	0	0			
Imperial Bank of India (Current Account)	..	..	..	5,24,188	1	6			
							5,24,738	1	6
TOTAL	..	..	..				Rs. 9,12,822	13	0

Examined and found correct.

S. N. MUKHERJI & CO.,
Registered Accountants,
Auditors.

BUDGET ESTIMATES FOR 1949-50.

I. General Funds—Recurring
(excluding C.S.I.R. Grants).

Heads of income.	RECEIPTS.				
	Actual 1946.	Actual(a) 1947-48.	Budget 1948-49.	Budget Estimates 1949-50.	
	Rs.	A.	Rs.	Rs.	Rs.
I. Government of India grant-in-aid ..	20,000	0	1,79,000(b) +10,000(c)	2,66,700	2,66,700
II. Government contribution towards D. A. ..	..	..	5,522 +1,500(c)	14,500 (Revised 10,665)	13,335
III.					
1. Interest from General Fund.			664	445	495
2. Membership (Ordinary.)			1,080	1,000	1,000
3. Life Membership Fee			2,900 (Revised 3,000)	2,000	2,000
4. Rent			6,911	6,500	7,500(d)
5. From Calcutta Medi- cal School.			1,000	650	..
6. Indian Journal of Physics :	20,910	10			
Contribution from Government and Rockefeller Inst. Subscriptions ..			2,500		
Advertisements ..			67		
Ind. Phy. Soc. ..			3,434		
Sale of reprints ..			188		
7. Miscellaneous ..			225	50	100
For approximation ..					—130
	40,910	10	2,14,991	..	2,95,000

Notes.—(a) This covers a period of 15 months.

(b) Half of it was actually received during the year 1948-49.

(c) Grants for 1946 received during 1947-48.

(d) Provided the proposal of increasing the rent be approved.

BUDGET ESTIMATES FOR 1949-50.—Recurring.**II. Salary, etc., of M. L. S. Professor**

RECEIPTS.		Rs.	As.	P.	EXPENDITURES.		Rs.	As.	P.
1.	Interest from M. L. S. Prof. and V. L. M. Funds ..	8,420	0	0*	1.	Salary of Professor (800—40—1,000 ; 1,000—50—1,250). 920×7+960×5 ..	11,240	0	0
2.	Contribution from General Fund ..	4,957	0	0	2.	Contribution to Provident Fund ..	937	0	0
					3.	Dearness Allowance	1,200	0	0
TOTAL ..		Rs. 13,377	0	0	TOTAL ..		Rs. 13,377	0	0

*Interest	Rs. 8,445	} Income-tax on securities not deducted.
Less, Bank charges	„ 25	
	Rs. 8,420	

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE,

BUDGET ESTIMATES FOR 1949-50.

I. General Funds—Recurring (excluding C. S. I. R. Grants).

EXPENDITURES.

Heads of expenditure.	Actual		Budget	Revised	Actual		Budget	
	1946.	1947-48 (15 months).	1948-49.	Budget 1948-49.	1948-49.	1949-50.	Estimates 1949-50.	
	Rs.	A. P.	Rs.	Rs.	Rs.	A. P.	Rs.	
I. Establishment—								
1. Salary :								
Dept. of X-Rays & Magnetism .. ..	..	..	43,9051	(1) 30,950	..	29,903-13-0	(2) 21,200
Optics .. ..	..	..	6,170	23,300	..	23,473- 3-0	25,000
Phy. Chem. .. ..	..	..	5,769	23,100	..	21,031-15-0	25,400
Theor. Physics .. ..	..	..	..	18,300	..	..	20,600
Organic Chemistry .. ..	..	..	..	19,200	..	..	15,600
Workshop .. ..	..	..	(Included in	11,500	..	10,187-15-0	10,400
Library .. ..	..	..	Dept. of X-ray)	3,100	..	4,435-12-0	3,325
Administration .. ..	..	..	14,797	17,000	..	19,044-1-0	16,175
	25,161	10 0	70,641	1,46,450	94,000	1,08,076-11-0	..	
2. Dearness Allowance	3,502 0 0	Incl. in Salary.	29,000	21,330	Incl. in Salary	28,250
				1,75,450	1,15,330	..	1,65,950	
3. Prov. Fund Contribution	1,199 1 0	2,385	8,950	(3) 6,600	4,704-13-0	8,100

II. Laboratory Grants	.. ..	.. 4,515 1 6	6,365	24,000	(4) 24,000	23,958-15-0	24,000
IIA. Laboratory Grants, Special	.. ..	.. ..	16,665	36,500	(5) 63,000	41,707-1-6	29,000
				+4,500				
III. Library Grants	.. ..	.. 2,011 3 9	6,710	5,000	13,000	15,285-13-9	10,000
				+5,000	+8,000			
IV. Workshop Grants	.. ..	.. 297 10 9	24,080	5 000	17,000	15,120-12-6	5,000
				+10,000				
V. Grants for I. J. P.	.. ..	.. 3,248 15 0	8,846	9,000	13,000	12,069-13-9	16,150
VIA. To corpus of M. L. S. Prof. Fund (against receipt item III-3)	.. ..	.. ..	2,900	2,000	3,000	2,750-0-0	2,000
VIB. To income of M. L. S. Prof. Fund from General Fund	.. ..	.. ..	-----Included in I above-----			..	(6) 4,957
VII. Laboratory services and Miscellaneous	.. ..	.. 7,840 7 6	24,362	37,000	34,800	25,355-2-6	33,250
			11,000	1,000	1,000	..	1,000	
			<u>47,776 1 6</u>	<u>1,73,954</u>	<u>3,23,400</u>	<u>2,98,730</u>	<u>2,43,949-10-0</u>	<u>2,99,407</u>
					(say) 2,98,750		(say) 2 99 400	

(39)

1—including 2—excluding salary, etc., of M. L. S. Professor.
3—including Rs. 2,200 to be revoted.
4—including Rs. 5,800 to be revoted for Organic Chemistry Department.
5—including Rs. 2,000 to be revoted for Organic Chemistry Department.
6—see budget II.

STATEMENT OF CAPITAL EXPENDITURES ACCOUNT

RECEIPTS.	Rs.	As.	P.	EXPENDITURES.	Rs.	As.	P.
1. Government of India loan	5,00,000	0	0	1. Paid to Collector, 24-Parganas (part of L. A. costs) ..	4,34,556	11	2
2. Government of India non-recurring grants for 1947-48-49 ..	4,32,000	0	0	2. Purchase of American fencing & transport	12,489	15	9
3. Government of West Bengal non-recurring grant promised. (1)				3. Construction of store-room ..	5,244	0	0
4. By sale of Bowbazar properties. (1)				4. Paid on account of erection of fencing	7,500	0	0
				5. Expenses in connection with foundation stone laying ..	1,962	4	9
				6. Purchase of cement for items 3 and 4 ..	5,335	2	6
				7. Part purchase of iron rods and joists (including Rs. 4,200 advanced to Tata Iron & Steel Co., Ltd. ..	26,374	13	6
				8. Miscellaneous(2) ..	3,990	1	9
				9. Available amount (3)	4,34,546	14	7
TOTAL Rs. ..	9,32,000	0	0	TOTAL Rs. ..	9,32,000	0	0

Note.— (1) Under negotiation

(2) Miscellaneous includes pay of the Darwan at Jadavpur and other sundry charges.

(3) Cost of Land Acquisition still due 49,723 10 10
 Amount to be set apart for excess price that the Association may have to pay in revision cases now pending before the Court 50,000 0 0
 Fencing account 15,000 0 0

Staff of the Association (as on March 31, 1949)

DEPARTMENT OF X-RAYS AND MAGNETISM

- Dr. K. Banerjee, D.Sc., F.N.I., M.L.S. *Professor of Physics.*
Dr. A. Bose, D.Sc., *Research Officer.*
Sri Pramatha Kumar Halder, M.Sc., *Laboratory Technician.*
Sri Jyotibrata Ray, *Laboratory Assistant.*
Sri Ajit Kumar Dutta, M.Sc., *Senior Research Scholar.*
Sri Ranjit Kumar Sen, M.Sc., *Senior Research Scholar.*
Sri Jnanendra Chandra Maitra, M.Sc., *Junior Research Scholar.*
Sri Bhupati Kumar Banerji, M.Sc., *Junior Research Scholar.*
Sri Subodh Chandra Mitra, M.Sc., *Junior Research Scholar.*
Sri Nirmal Kumar Dutta, B.Sc., *Typist Clerk.*
Sri Mangal Chandra Das, *Laboratory Attendant.*

DEPARTMENT OF OPTICS

- Dr. S. C. Sarker, D.Sc., F.N.I., *Professor of Physics.*
Sri B. M. Bishui, M.Sc., *Research Officer.*
Sri Samarendra Nath Sen, M.Sc., *Laboratory Technician.*
Sri Atul Chandra Choudhuri, B.Sc., *Laboratory Assistant.*
Sri M. V. Rao, M.Sc., *Senior Research Scholar.*
Sri Gourangasundar Kastha, M.Sc., *Junior Research Scholar.*
Sri Anil Krishna Roy, M.Sc., *Junior Research Scholar.*
Sri Madhab Chandra Chatterji, B.Sc., *Clerk Typist.*
Sri Hemanta Kumar Sirkar, *Laboratory Attendant.*

DEPARTMENT OF PHYSICAL CHEMISTRY

- Dr. S. R. Palit, D.Sc., F.R.I.C., *Professor of Physical Chemistry.*
Dr. Sadhan Basu, D.Sc., *Research Officer.*
Sri Birendra Chandra Banerji, M.Sc., *Laboratory Technician.*
Sri Amiyendu Basu, B.Sc., *Laboratory Assistant.*
Sri Jyotirindra Nath Sen, M.Sc., *Senior Research Scholar.*
Sri Ranjit Kumar Sen Gupta, M.Sc., *Junior Research Scholar.*
Sri H. Shripati Rao, M.Sc., *Junior Research Scholar.*
Sri Kanai Krishna Mullick, B.Com., *Typist Clerk.*
Sri Satya Ranjan Paul, *Laboratory Attendant.*

ADMINISTRATION

- Sri S. N. Sen, M.Sc., *Registrar (on leave).*
Sri Ramani Mohan Roy, M.Sc., *Registrar.*
Sri Nalinaksha Sinha, *Accountant.*
Sri Sunil Chandra Roy, B.Sc., *Accounts Clerk.*
Sri Dwijapada Roy, *Clerk Typist.*
Sri Harakali Mukherji, *Record Clerk.*

LIBRARY

- Sri Sashi Bhusan Khan, B.Sc., *Librarian (on leave)*.
Sri Narayan Chandra Mukherji, *Library Clerk*.
Sri Jaydeb Banerji, *Library Attendant*.

INDIAN JOURNAL OF PHYSICS

- Sri Amarendra Nath Banerji, M.Sc., *Assistant Editor*.
Sri Adhir Ranjan Deb, M.Sc., *Assistant Secretary*.
Sri Satya Charan Mukherjee, *Compositor*.

WORKSHOP

- Sri Dharendra Nath Das, *Mechanic*.
Sri Pulin Behary Kar, *Mechanic*.
Sri Megh Lal Das, *Mechanic*.
Sri Lalit Mohan Mullick, *Assistant Mechanic*.
Sri Patit Paban Chandra, *Workshop mate*.
Sri Narendra Nath Sen Gupta, *Glass Blower*.
Sri Keshab Chandra Banerji, *Electrician*.
Sri S. K. Ray Chaudhuri, B.E., *Resident Engineer, Jadavpore*.

C. S. I. R. SCHEME (COAL)

- Sri N. N. Gupta, M.Sc.
Sri G. B. Mitra, M.Sc.

C. S. I. R. (METAL & ALLOYS)

- Sri Bijay Sankar Basak, M.Sc.
Sri A. K. Ray Choudhury, M.Sc.

BENGAL CHEMICAL RESEARCH SCHOLAR

- Sri Nakuleswar Kundu, M.Sc., *Sir P. C. Ray—Bengal Chemical Research Scholar*.