

M. Krishna



THE INDIAN ASSOCIATION  
FOR THE  
CULTIVATION OF SCIENCE

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*Annual Report for the Year 1939*

THE  
INDIAN ASSOCIATION  
FOR THE  
CULTIVATION OF SCIENCE

*Annual Report for the Year 1939.*

*Report of the Committee of Management for the year 1939.*

MEMBERS

At the beginning of the year there were 128 members of whom 120 were life-members, 4 non-resident and 4 resident ordinary members. The Association suffered a great loss through the death of two of its life-members (vide obituary notice). One life-member was enrolled during the year. The total number of members at the end of the year was 127 of whom 119 were life-members, 4 non-resident and 4 resident ordinary members.

2. ADMINISTRATION

*Library.* A sum of Rs. 2,826-4-3 was spent for the purchase of Journals and books. Total number of books purchased and added to the library during the year was 28. The subscriptions for the publications mentioned in appendix I were continued. The total number of volumes in the library as given in the accession register on 31st December 1939 was 5677. The authors' catalogue is nearing completion. The classification of the books and journals is now being worked out. On account of the war quite a number of periodicals and journals are not being received and some of those which are still available arrive irregularly. The need for sufficient accomodation for the library is acute. The library was inspected as required by the rules by the Honorary Secretary and Mr. J. C. Pal and it was found that several sets of journals are incomplete. The missing issues have to be purchased to complete these sets. A large number of copies of old journals and books are in a bad condition and require to be bound.

*Alteration in Buildings.* Plans for the new shop rooms have been submitted to the Corporation of Calcutta.

*Leave.* Leave on duty for 97 days was granted to Prof. K. S. Krishnan  
Leave on full pay was granted during the year as follows :—

Sachi Nath Banerjee—7 days.

Subodh Kumar Chakravarty—55 days.

### 3. MAHENDRA LAL SIRCAR PROFESSOR

Prof. K. S. Krishnan attended the Conference on Magnetism at Strasbourg arranged in 1939 by the International Institute for Intellectual Co-operation, which is one of the organisations of the League of Nations.

### 4. RESEARCH FELOWS

Dr. S. C. Deb, D.Sc., was re-appointed a Research Fellow on Rs. 125/- per month for one year from September 1939 to August 1940.

Dr. Santilal Banerjee, D.Sc., was appointed a temporary Research Associate for 3 months from August to October 1939 on Rs. 100/- per month.

### 5. RESEARCH SCHOLARS

Applications were invited by advertisement at different parts of India and the following awards were made for the year 1939.

1. Mr. A. Chandrasekhariah, M.Sc.
2. „ S. L. Chorghade, M.Sc.
3. Dr. Hirendra Kumar Pal, Ph.D.
4. Mr. Dwijesh Chandra Chakravarty, M.Sc.
5. „ Jyotirmay Bhattacharjya, M.Sc.
6. „ Satish Chandra Ganguly, M.Sc.
7. „ M. S. R. Achari, M.Sc.

In addition to the above the following persons also worked in the laboratories without any remuneration from the Association.

1. Mr. Ashutosh Mukherji, M. Sc.
2. „ Nripendra Lal Ganguly, M. Sc.
3. „ P. K. Seshan, M. Sc.
4. „ W. J. John, M. A.
5. „ D. V. Kamat, M. Sc.
6. „ Akshyananda Bose, M. Sc.
7. Dr. Santi Lal Banerjee, D. Sc.
8. Mr. Amar Chand Seth, M. Sc.
9. „ Bishnupada Saha, M. Sc.
10. „ Fazlor Rahman, M. Sc.
11. „ Tripurendra Kumar Kundu

### 6. MEDALS

*Joy Kissen Mookerjee Medal.* Dr. Robert A. Millikan, the famous scientist, arrived in Calcutta from Rangoon on the 25th November last

with the intention of measuring cosmic ray intensities in several places in India. Although his stay in Calcutta was short he very kindly agreed to deliver an address to the Association on the "Educational aims and practices of the California Institute of Technology" and the Joy Kissen Mookerjee Gold Medal for the year 1939 was awarded to him. His lecture will be published as Special Publication No. IX of the Association. After his address he met the Members at an afternoon party.

## 7. PUBLICATIONS

Indian Journal of Physics and Proceedings of the Indian Association for the Cultivation of Science.

### *List of papers published in the Indian Journal of Physics Vol. XIII.*

Part I		Page
1. The Propagation and the Total Reflection of Electromagnetic Waves in the Ionosphere—By M. N. Saha and K. B. Mathur ...		1
2. Raman Spectra of Co-ordination Compounds—By Bholanath Roy		13
3. Crystal Structure of Diphenylamine, Part I—By Jagattaran Dhar		27
4. The Internal Pressure in Liquids—By M. F. Soonawala ...		31
5. A New Theory of Lapse Rate—By D. Subrahmanyam ...		43
6. Further Studies of F-region at Allahabad—By R. R. Bajpai and B. D. Pant ... ..		57
Part II		
7. Jupiter's Atmosphere—By A. C. Banerji and Nizamuddin ...		73
8. A Note on the Transmutation Function for Deuterons—By P. L. Kapur ... ..		87
9. A Study of Sulphur Allotropes by the X-ray Diffraction Method (Part II)—By S. R. Das and K. Ghosh ... ..		91
10. The Fringe of the Atmosphere and the Ultra-violet Light Theory of Aurora and Magnetic Disturbance—By S. K. Mitra and A. K. Banerjee ... ..		107
Part III		
11. Band Spectrum of Antimony Monoxide—By A. K. Sen Gupta ...		145
12. On the Raman Effect in Camphor—By B. M. Anand and S. Narain ... ..		159

13. An Experimental Study of Parabolic Wire Reflectors on a Wave-length of about 3 Metres—By A. K. Datta, M. K. Chakravarty and S. R. Khastgir ... 167
14. On the Absorption and Emission Spectra of Rare Earth Crystals—By P. C. Mukherji ... 185
15. Measurement by means of the Electrometer Triode—By J. A. N. Thaes ... 199
16. An Improved Form of Vacuum Arc Mercury still for Laboratories—By M. V. Sivaramakrishnan ... 205
17. On the Raman Spectrum of o-Diphenyl-benzene—By S. K. Mukerji and S. Abdul Aziz ... 209
18. On the Colour of Paramagnetic Ions in Solution, II. Fine Structure of the Absorption Bands—By D. M. Bose and P. C. Mukherji ... 219

## Part IV

19. New Measurements of Aluminium Monoxide Bands—By Debeschandra Roy ... 231
20. A Simple Method of Coating Optical Surfaces with Aluminium—By M. V. Sivaramakrishnan ... 241
21. Raman Spectrum of Diphenyl in the Solid State—By S. A. Aziz ... 247
22. Studies of the Ionosphere at Calcutta—By J. N. Bhar ... 253
23. Dynamics of the Pianoforte String and the Hammer, Part III. (General Theory)—By Mohinimohan Ghosh ... 277
24. Surface Tension and Lindemann Frequency—By L. Sibaiya and M. Rama Rao ... 293
25. Liquid Drops—By L. D. Mahajan ... 299

## Part V

26. Evaporation from Earthen Jugs—By Hazarilal Gupta and Abinash Chandra ... 305
27. Absorption Spectra of Compounds of Phosphorus—By Sh. Nawazish Ali ... 309
28. Linear Extension of reflected Image produced by a Surface traversed by waves—By F. C. Auluck ... 321
29. Isotope Effect in Band Spectrum of Tin monoxide—By P. C. Mahanti and A. K. Sengupta ... 331
30. On the polarised Fluorescence of Organic Compounds—By Sachindra Mohan Mitra ... 349

## 8. SPECIAL PUBLICATIONS

*Published during the year.*

No.	Pages	Subject	Author	Price		
				Rs.	As.	P.
VI	105	Garnets and their Role in Nature.	Sir Lewis L. Fermor, O.B.E., D.Sc., F.R.S.	2	8	0
VII	49	(1) The Royal Botanic Gardens, Kew. (2) Studies in the Germination of Seeds.	Sir Arthur Hill, K.C.M.G., Sc.D., D.Sc., F.R.S.	1	8	0
VIII	44	Interatomic Forces.	Professor J. E. Lennard-Jones, F.R.S.	1	8	0

## 9. FINANCIAL

The accounts of the following funds have been finally adjusted by paying the amounts due to them out of the undistributed G. P. Notes held in the General Fund. A sum of Rs. 645-8-10 however remains due to the General Fund which will be recouped from the interest accruing to the credit of the funds. The cash balances of these funds have been invested as far as possible in G. P. Notes by transference from the General Fund. The corresponding increase in the cash balance of the General Fund will render it unnecessary to borrow money under normal conditions.

The following sums were due to the funds mentioned below :—

1. Jatindra Chandra Prize Fund	Rs.	377	6	0
2. Victoria Professorship Fund		313	6	0
3. Dr. Sircar Research Medal Fund		603	8	0
4. Hare Professorship Fund		313	6	0
5. Woodburn Medal Fund		349	14	0
6. Nikunja Garabini Prize Fund		389	9	2
7. Coochbehar Professorship Fund		937	13	0
8. Joykissen Mookerjee Medal Fund		207	1	6
9. Building Fund		330	5	0
10. Mahendra Lal Sircar Professorship Fund		178	0	0
	Rs.	4,000	4	8

The following transfers of securities were made—

3½% G. P. Notes of the face value of Rs. 1,000/-	to Ripon Professorship Fund.
500/-	to Jatindra Chandra Prize Fund.
500/-	to Victoria Professorship Fund.
500/-	to Dr. Sircar Research Medal Fund.
500/-	to Hare Professorship Fund.
500/-	to Woodburn Medal Fund.
2,500/-	to Coochbehar Professorship Fund.
1,000/-	to Joykissen Mookerjee Medal Fund.
1,000/-	to Building Fund.
500/-	to Nikunja Garabini Prize Fund.

Rs. 8,500/-

The following amounts were paid in cash from the current balance of the General Fund.

Rs. 122 9 0 to Dr. Sircar Research Medal Fund.

178 0 0 to Mahendra Lal Sircar Professorship Fund.

Rs. 300 9 0

In consequence of the above transfers of G. P. Notes the amounts (market value of the securities at the time of the transfer) detailed under statement A below, required to be paid from these funds to the General Fund.

STATEMENT. A

Rs. 961 14 0	from Ripon Professorship Fund.
103 9 0	from Jatindra Chandra Prize Fund.
167 9 0	from Victoria Professorship Fund.
131 1 0	from Woodburn Medal Fund.
91 5 10	from Nikunja Garabini Prize Fund.
1,466 14 0	from Coochbehar Professorship Fund.
754 12 6	from Joy Kissen Mookerjee Medal Fund.
631 9 0	from Building Fund.
167 9 0	from Hare Professorship Fund.

Rs. 4,476 3 4

The balances standing to the credit of some of these funds were not sufficient to pay the whole of these amounts and the amounts detailed under *Statement B*, were actually paid to the General Fund. Arrangements will be made to adjust the balances later on.

## STATEMENT. B

Rs. 715	0	0	from Ripon Professorship Fund.
42	0	0	from Jatindra Chandra Prize Fund.
85	0	0	from Victoria Professorship Fund.
85	0	0	from Hare Professorship Fund.
85	0	0	from Woodburn Medal Fund.
42	0	0	from Nikunja Garabini Prize Fund.
1,466	14	0	from Coochbehar Professorship Fund.
754	12	6	from Joy Kissen Mookerjee Medal Fund.
555	0	0	from Building Fund.
Rs. 3,830	10	6	

*The amounts due to the General Fund (Plain a/c.) after the transfers are shown below.*

## 1. Ripon Professorship Fund.

	Rs.	A.	P.
Market value of 3½% G. P. Notes ; Rs. 1,000/- @ Rs. 96-3-0	...	961	14 0
Less amount payable from the Plain A/c	...	...	Nil
		961	14 0
Transferred from the cash balance of the Fund to the Plain A/c	715	0	0
Amount due to Plain A/c	...	246	14 0

## 2. Jatindra Chandra Prize Fund.

Market value of 3½% G. P. Notes ; Rs. 500/- @ Rs. 96-3-0	...	480	15 0
Less amount payable from the Plain A/c	...	377	6 0
		103	9 0
Transferred from the cash balance of the Fund to the Plain A/c	42	0	0
Amount due to Plain A/c	...	61	9 0

## 3. Victoria Professorship Fund.

Market value of 3½% G. P. Notes ; Rs. 500/- @ Rs. 96-3-0	...	480	15 0
Less amount payable from the Plain A/c	...	313	6 0
		167	9 0
Transferred from the cash balance of the Fund to the Plain A/c	85	0	0
Amount due to Plain A/c	...	82	9 0

## 4. Hare Professorship Fund.

Market value of 3½% G. P. Notes ; Rs. 500/- @ Rs. 96-3-0	...	480	15	0
Less amount payable from the Plain A/c	...	313	6	0
				<u>167 9 0</u>
Transferred from the cash balance of the Fund to the Plain A/c		85	0	0
Amount due to Plain A/c	... ..	82	9	0

## 5. Woodburn Medal Fund

				Rs. A. P.
Market value of 3½% G. P. Notes ; Rs. 500/- @ Rs. 96-3-0	...	480	15	0
Less amount payable from the Plain A/c	...	349	14	0
				<u>131 1 0</u>
Transferred from the cash balance of the Fund to the Plain A/c		85	0	0
Amount due to Plain A/c	... ..	46	1	0

## 6. Nikunja Garabini Prize Fund

Market value of 3½% G. P. Notes ; Rs. 500/- @ Rs. 96-3-0	...	480	15	0
Less amount payable from the Plain A/c	...	389	9	2
				<u>91 5 10</u>
Transferred from the cash balance of the Fund to the Plain A/c		42	0	0
Amount due to Plain A/c	... ..	49	5	10

## 7. Coochbehar Professorship Fund

Market value of 3½% G. P. Notes ; Rs. 2,500/- @ Rs. 96-3	...	2,401	11	0
Less amount payable from the Plain A/c	...	937	13	0
				<u>1,466 14 0</u>
Transferred from the cash balance of the Fund to the Plain A/c		1,466	14	0
Amount due to Plain A/c	... ..			Nil

## 8. Joykissen Mookerjee Medal Fund

Market value of 3½% G. P. Notes ; Rs. 1,000/- @ Rs. 96-3	...	961	14	0
Less amount payable from the Plain A/c	...	207	1	6
				<u>754 12 6</u>
Transferred from the cash balance of the Fund to the Plain A/c		754	12	6
Amount due to Plain A/c	... ..			Nil

**9. Building Fund**

Market value of 3½% G. P. Notes ; Rs. 1,000/- @ 96-3	...	961	14	0
Less amount payable from the Plain A/c	...	330	5	0
		631	9	0
Transferred from the cash balance of the Fund to the Plain A/c	...	555	0	0
Amount due to Plain A/c	...	76	9	0

Securities to the credit of the General Fund as a result of the transfers are as follows :—

Securities in the plain account before these transfers.

3½% G. P. Notes face value	Rs.	29,500	0	0
Less by transfer		8,500	0	0
Balance to the credit of the General Fund		21,000	0	0

The state of the different Funds on 1st January 1940 and the estimated income and expenditure for 1940 is shown below.

**1. Ripon Professorship Fund.**

3½% G. P. Notes, face value Rs. 19,000) } 23,000 0 0  
 3% G. P. Notes, face value Rs. 4,000) }

<i>Income</i>				<i>Expenditure</i>					
	Rs.	A.	P.		Rs.	A.	P.		
Opening Balance	...	225	1	3	Bank Charges	...	6	0	0
Interest	...	785	0	0	By Repayment of Advances to Genl. Fund	...	246	14	0
		1,010	1	3	Closing Balance	...	757	3	3
							1,010	1	3

**2. Jatindra Chandra Prize Fund.**

3½% G. P. Notes, face value Rs. 1,000

<i>Income</i>				<i>Expenditure</i>					
	Rs.	As.	P.		Rs.	As.	P.		
Opening Balance	...	16	2	0	Bank Charges	...	2	2	0
Interest for 1940	...	35	0	0	Award of Prizes	...	30	0	0
Advance from General Fund	...	51	2	0	Repayment of Advance to General Fund	...	61	9	0
		42	9	0	Closing balance	...	93	11	0
		93	11	0			nil		
							93	11	0

## 3. Victoria Professorship Fund

3½% G. P. Notes, face value Rs. 1,500

<i>Income</i>		<i>Rs. A. P.</i>	<i>Expenditure</i>		<i>Rs. A. P.</i>
Opening Balance	...	25 10 0	Bank Chasges	...	2 2 0
Interest for 1940	...	52 8 0	By Honorarium to Dr.		
			Dube	...	175 0 0
		78 2 0	(Vide Com. resolution		
Advance from Genl.			No. 3 d. 26-12-39)	...	177 2 0
Fund	...	181 9 0	Repayment of Advance		
			to General Fund	...	82 9 0
		259 11 0	Closing Balance	...	Nil
					259 11 0

## 4. Hare Professorship Fund

3½% G. P. Notes, face value Rs. 1,500

<i>Income</i>		<i>Rs. A. P.</i>	<i>Expenditure</i>		<i>Rs. A. P.</i>
Opening Balance	...	25 10 0	Bank Charges	...	2 2 0
Interest for 1940	...	52 8 0	By Honorarium to Dr.		
			Dube	...	175 0 0
		78 2 0			
Advance from Genl.			Repayment of Advance		
Fund	...	181 9 0	to General Fund	...	82 9 0
		259 11 0	Closing Balance	...	Nil
					259 11 0

## 5. Woodburn Medal Fund.

3½% G. P. Notes, face value Rs. 1,500

<i>Income</i>		<i>Rs. As. P.</i>	<i>Expenditure</i>		<i>Rs. As. P.</i>
Opening Balance	...	18 8 0	Bank Charges	...	0 8 0
Interest for 1940	...	52 8 0	Repayment of advance		
			to General Fund	...	46 1 0
			Closing balance	...	46 9 0
					24 7 0
		71 0 0			71 0 0

## 6. Nikunja Garabini Prize Fund

3½% G. P. Notes, face value Rs. 1,000

<i>Income</i>	Rs. As. P.	<i>Expenditure</i>	Rs. As. P.
Opening balance ...	16 2 0	Bank charges ...	2 2 0
Interest for 1940. ...	35 0 0	Award of prizes ...	30 0 0
Advance from Genl. Fund ...	30 5 10	Repayment of Ad- vance to Genl. Fund ...	49 5 10
	81 7 10		81 7 10

## 7. Coochbehar Professorship Fund

3½% G. P. Notes, face value Rs. 30,000

<i>Income</i>	Rs. A. P.	<i>Expenditure</i>	Rs. A. P.
Opening Balance	542 13 0	Bank Charges ...	10 1 0
Interest for 1940	1,050 0 0	Closing Balance ...	1,582 12 0
	1,592 13 0		1,592 13 0

## 8. Joy Kissen Mookerjee Medal Fund

3½% G. P. Notes, face value Rs. 12,400

<i>Income</i>	Rs. As. P.	<i>Expenditure</i>	Rs. As. P.
Opening Balance ...	366 1 3	Bank charges ...	4 8 0
Interest for 1940 ...	434 0 0	Cost of the Medal awarded to Dr. Robert Millikan ...	296 0 0
	800 1 3	Cost of printing lecture of Dr. Millikan ...	30 0 0
		Closing Balance ...	330 8 0
			469 9 3
			800 1 3

## 9. Building Fund

3½% G. P. Notes, face value Rs. 8,500

<i>Income</i>		<i>Expenditure</i>	
	Rs. A. P.		Rs. A. P.
Opening Balance ...	228 0 0	Bank Charges ...	1 8 0
Interest for 1940 ...	297 8 0	Repayment of Advance to General Fund ...	76 9 0
	<u>525 8 0</u>		<u>78 1 1</u>
		Closing Balance ...	447 7 0
			<u>525 8 0</u>

## 10. Dr. Sircar Research Medal Fund

3½% G. P. Notes, face value Rs. 4,500

<i>Income</i>		<i>Expenditure</i>	
	Rs. A. P.		Rs. A. P.
Opening Balance ...	515 7 0	Bank Charges ...	2 10 0
Interest for 1940 ...	157 8 0	Award of Medal to Dr. S. L. Banerji ...	300 0 0
		Cost of printing papers submitted by him ...	100 0 0
			<u>402 10 0</u>
		Closing Balance ...	270 5 0
	<u>672 15 0</u>		<u>672 15 0</u>

## 11. Mahendra Lal Sircar Professorship Fund

3½% G. P. Notes, face value Rs. 1,47,000

<i>Income</i>		<i>Expenditure</i>	
	Rs. A. P.		Rs. A. P.
Opening Balance ...	141 10 0	Bank Charges ...	13 8 0
Interest for 1940 ...	5,145 0 0	Salary & Contribution of M. L. Sircar Professor ...	5,265 8 0
			<u>5,279 0 0</u>
		Closing balance ...	7 10 0
	<u>5,286 10 0</u>		<u>5,286 10 0</u>

## 12. Veharilala Mitra Fund

3½% G. P. Notes, face value Rs. 1,32,000

<i>Income</i>		<i>Expenditure</i>		Rs.	As.	P.			
Opening Balance	...	0	14	0	Bank charges	...	13	0	0
Interest for 1940	...	4620	0	0	Salary & Contribution of Mahendra Lal Sircar Professor	...	4,484	8	0
							4,497	8	0
					Closing Balance	...	123	6	0
		4620	14	0			4,620	14	0

The Government of India in their letter No. F. 42-9-39-E dated 30-8-37 conveyed sanction to a restoration of the 10% cut in the grant-in-aid of Rs. 20,000 to the Association with effect from the year 1938-39 and accordingly the full amount of grant viz. Rs. 20,000 was provided for in the budget estimates for 1939, but subsequently in their letter No. F. 41-35-38-E dated 28-2-39 they expressed their inability to restore the cut on account of financial difficulties. The Government of India were moved to enhance the present grant to Rs. 27,500 so as to enable the Association to provide for additional annual expenditure as under :—

	Rs.	As.	P.			
(a) for Library	...	...	...	1,000	0	0
(b) for Laboratory	...	...	...	2,000	0	0
(c) for increasing the salary of Mahendra Lal Sircar Professor (average for 5 years)	...	...	...	1,500	0	0
(d) for increasing the number of Research Scholarships and of Research Fellowships	...	...	...	3,000	0	0
				7,500	0	0
Present grant	...	...	...	20,000	0	0
				27,500	0	0

They were also requested to sanction a non-recurring grant of Rs. 32,000 for the following purposes :—

	Rs.	As.	P.			
*(a) Hostel building	...	...	...	15,000	0	0
(b) Library (to provide for steel almirahs and to bind books and journals)	...	...	...	5,000	0	0
(c) Workshop	...	...	...	5,000	0	0
(d) Chemical Laboratory (Equipment)	...	...	...	7,000	0	0
				32,000	0	0

\* The Association undertook to contribute the whole of the amount standing to the credit of the Building Fund, amounting to Rs. 8,000-0-0 and also to make an additional contribution to meet the total expenses estimated to be Rs. 30,000-0-0.

Mr. John Sargent, Educational Commissioner with the Government of India paid a visit early in October 1939. The difficulties of the Association were explained to him.

### 10. Research

An account of research work carried out in the laboratories of the Association is given in Appendix II.

### 11. Educational Activities

As in previous years a regular course of lectures in Physics and Chemistry were delivered for the benefit of the Calcutta Medical School at the lecture hall with the aid of apparatus and demonstrators of the Association.

Meteorological Reports were sent daily to the following Newspapers :—

1. The Amrita Bazar Patrika
2. „ Hindusthan Standard
3. „ Advance
4. „ Ananda Bazar Patrika
5. „ Basumati
6. „ Jugantar
7. „ Bharat

### 12. Obituary

The Committee place on record their deep sense of sorrow for the loss they have sustained by the death of Maharaja Sir Manmatha Nath Roy Chowdhury of Santosh and Mr. Biraj Mohan Majumdar, M.A.B.L., who were life-members of the Association. In Mr. Biraj Mohan Mazumdar the Association has lost one of its oldest members who took great interest in the Association and was a honorary lecturer from 1904 to 1908. He was for years actively associated with the administration of the University of Calcutta. The late Maharaja of Santosh was president of the Bengal Legislative Assembly and took great interest in sports and social activities.

### 13. Acknowledgment

The Committee of Management have great pleasure in recording their grateful thanks to :

- (a) The Government of India for their generous contribution of Rs. 18,000/- for the year 1939-40.
- (b) The University of Calcutta for printing the journal free of cost.
- (c) The Corporation of Calcutta for exemption of Municipal taxes for premises No. 210, Bowbazar Street.

They also express their grateful appreciation of the honorary services rendered by—

- (a) Messrs. J. N. Basu, N. C. Chunder and J. C. Pal as Trustees of the Association, as well as Trustees of the Science Association Employees' Provident Fund.
- (b) Mr. M. N. Mukerji, B.E., on engineering matters.
- (c) Prof. J. N. Mukherjee, D.Sc., F.R.A.S.B., F.N.I., Honorary Secretary.
- (d) Prof. P. N. Ghosh, M.A., Ph.D., Sc.D., F.N.I., Honorary Secretary, Editorial Board, Indian Journal of Physics and Proceedings of the Indian Association for the Cultivation of Science.
- (e) Messrs. B. N. Basu & Co., solicitors for free services on legal matters.

In presenting this report on behalf of the Committee of Management the Honorary Secretary expresses his thankfulness for the support and encouragement he has received from the President Sir Nilratan Sircar, Kt., M.A., M.D., D.C.L., (Oxon), Vice-Presidents and Trustee Mr. J. N. Basu, M.A., M.L.A. and other members of the Committee of Management including Dr. W. A. Jenkins, the representative of the Government of India in the Executive Committee.

J. N. Mukherjee,

*Honorary Secretary.*

## APPENDIX I

1. Scientific American.
2. Nature.
3. Philosophical Magazine.
4. Science Abstracts, A. & B.
5. Philosophical Transactions of the Royal Society, A.
6. Physical Review.
7. Zeitschrift für Physik.
8. Proceedings of the Royal Society, A.
9. Annalen der Physik.
10. Physikalische Zeitschrift.
11. Journal of the American Chemical Society.
12. Proceedings of the National Academy of Sciences, Washington.
13. Zeitschrift für Physikalische Chemie, A. & B.
14. Zeitschrift für Kristallographie, A.
15. Annales de Physique.
16. Comptes Rendus.
17. Chemical Abstracts.
18. Science Progress.
19. Transactions of the Faraday Society.
20. Die Naturwissenschaften.
21. Journal of Chemical Physics.
22. Reviews of Modern Physics.
23. Journal of Physical Chemistry.
24. Physikalische Berichte.
25. Journal of the Chemical Society, London.
26. British Chemical Abstracts, A.
27. Journal of Applied Physics.
28. Astrophysical Journal.

## Books Purchased

1. The Observational Approach to Cosmology. Edwin Hubble.
- ~~2.~~ Ultrasonics and their Scientific and Technical Applications.  
Ludwig Bergmann.
3. The Theory of Metals. A. H. Wilson.
4. Reports on Progress in Physics. Vol. 2, 1935.
5. do do do Vol. 3, 1936.
6. do do do Vol. 4, 1937.
7. do do do Vol. 5, 1938.
8. Simplified Structure Factor and Electron Density Formulæ for the  
the 230 Space groups of Mathematical Crystallography, Kathleen  
Lonsdale.

- ~~9.~~ Fluorescence and Phosphorescence. E. Hirschlaff.  
~~10.~~ Super Conductivity. D. Shoenberg.  
 M ~~11.~~ The Sun. Its Phenomena and Physical Feature. Giorgio Abetti.  
 12. Mineralogy. An Introduction to the Study of Minerals and  
 Crystals. E. H. Kraus, W. F. Hunt and L. S. Ramsdell.  
 13. The Nature of Crystals. A. G. Ward.  
~~14.~~ Statistical Physics. Landau and Lifshits.  
~~15.~~ Foundations of Physics. Lindsay and Margenau.  
 16. Elements of Nuclear Physics. F. Rasetti.  
~~17.~~ Modern Magnetism. Bates.  
 ch. ~~18.~~ Crystal Chemistry. Evans.  
 h. ~~19.~~ Rutherford. Eve.  
 20. Gmelins Handbuch der anorganischen Chemie Sys. 22, Lief. 6 & 7, 1938  
 21. do do do do do 68, Teil. A. Lief. 1  
 22. do do do do do 27, Teil. B. „ 4  
 23. do do do do do 66. (1939)  
 24. do do do do do 68. Teil. B. „ 1  
 25. do do do do do 35. Teil. A. „ 6  
 26. do do do do do 59. Teil. C. „ 2  
 27. do do do do do 59. Teil. F II „ 2  
 28. do do do do do Ergänzungsband 1, Teil.

The Committee of Management acknowledge with thanks the presentation of Journals and Periodicals in exchange of our Proceedings and Journal from the following Societies and Institutions :

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3. Acta Literarum Ac Scientiarum Regiæ Universitatis Hungaricæ  
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4. Acta Societatis Scientiarum Fennicæ.
5. Annales de L' Institut Pasteur.
6. Annales de L' Institut Henri Poincare.
7. Arhiv Za Hemiju I Farmaciju.
8. Arkiv fur Matematik, Astronomi Och Fysik.
9. Atti della Accademia Nazionale dei Lincei.
10. Berichte Uber Die Verhandlungen.
11. Biological Bulletin.
12. Bulletin of Calcutta Mathematical Society,
13. Bulletin International De L' Academie Polonaise des Sciences.  
Et Des Letters.
14. Bulletin De La Societe Royale Des Sciences Naturelles.
15. Bulletin de la Societe Vaudoise des Sciences Naturelles.
16. Belletin de la Societe Roumaine de Physique,
17. Chinese Journal of Physics.
18. Communications and Broadcast Engineering.

19. Communications from the Kamerlingh Onnes Laboratory of the University of Leiden.
20. Comptes Rendus des Seances de L' Academie des Sciences, de Roumanie.
21. Comptes Rendus Des Seances de la Societe de Physique D' Historie Naturelle de Geneve.
22. Current Science.
23. Det. Kgl. Danske Videnskabernes Selskab (Mathematisk-Fysiske).
24. do do do do (Biologiske).
25. Helvetica Physica Acta.
26. Il Nuovo Cimento.
27. Indian Journal of Agricultural Science.
28. Industrial and Engineering Chemistry.
29. Japanese Journal of Engineering.
30. do do Mathematics.
31. do do Physics.
32. Journal of the Asiatic Society of Bengal.
33. do de Chemie Physique.
34. do of the Franklin Institute.
35. do of the Indian Chemical Society.
36. do of Mathematics and Physics (America).
37. do de Physique.
38. do of Research, National Bureau of Standards, Washington.
39. do of the Institute of Science, Bangalore.
40. do of Science of the Hiroshima University.
41. do of Scientific Instruments.
42. Manchester Literary and Philosophical Society's Publications.
43. Memoirs of the College of Science, (Kyoto).
44. Memoirs of the Faculty of Science of the Tohoku Imperial Univ.
45. Memoirs de L' Academie Royale des Sciences et des Letters de Danemark.
46. Memoirs Societe de Physique.
47. Memoirs de la Societe Vaudoise des Sciences Naturelles.
48. Monthly Weather Review.
49. Nachrichten von der Gesellschaft der wissenschaft Zu Gottigen.
50. National Physical Laboratory Report, London.
51. Report National Research Council of Japan.
52. Nederlandsch Tijdschrift voor Naturkunde

54. Physica.
55. Proceedings Koninklijke Akademie van Wetenschappen  
Amsterdam.
56. do of the American Philosophical Society.
57. do of the Cambridge Philosophical Society.
58. do of the Indian Academy of Sciences, A & B.
59. Proceedings of the Imperial Academy, Tokyo.
60. do of the Notional Academy of Sciences, India.  
Allahabad.
61. do of the National Institute of Sciences of India.
62. do of the Physical Society.
63. do of the Physico-mathematical Society of Japan.
64. do of the Royal Society of Edinburgh.
65. do of the University of Durham Philosophical Society.
66. Revue Generale des Sciences.
67. Report of Radio Research in Japan.
68. Quarterly Journal of the Royal Meteorological Society.
69. Records of the Geological Survey of India.
70. Revue Trimestrelle Cannadienne.
71. Senckenbergiana.
72. Scientific Proceedings of the Royal Dublin Society.
73. Science and Culture.
74. Scientific Papers of the Institute of Physical and Chemical  
Research.
75. Science Reports of the Tohoku Imperial University.
76. Scientific Notes. Indian Meteorological Department.
77. Science Reports of the Tokyo Bunrika, Daigaku, A, B & C.
78. Studies from the Department of the Shanghai Science Institute.
79. Sitzungsberichte der Preussichen Akademie der Wissenchaften.  
(Physikalisch mathematische Klasse)
80. do do (Philosophisch histroischè Klasse)
81. do do (Mathematisch-naturwissenschaftlisch)
82. Sitzungsberichte der preussichen Akademie der Mathematisch-  
naturwissenschaft Munchen.
83. Terrestrial Magnetism and Atmospheric Electricity.
84. Tohoku Mathematical Journal.
85. Transactions of the Society of Mechanical Engineering Japan.
86. do of the National Institute of Sciences of India.

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96. Annales Scientifiques de L'Universite de Jassy. 41
97. Universidad Nacional de la Plata. 42
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100. Bulletin of the Far Eastern Branch of the Academy of Sciences of the U.S.S.R. 45
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## APPENDIX II

### *Report by Professor K. S. Krishnan on the Scientific Work of the Association*

#### 1. The Magnetic Properties of a Free-Electron Gas

All the characteristic properties of a metal are explained satisfactorily on the assumption that some of the electrons get detached from their atoms and are free to migrate from atom to atom throughout the metal. These free electrons have many interesting magnetic properties, and some of the important ones were investigated during the year under report.

Much of their interest centres round the fact that these electrons do not obey the laws of classical statistics, which regard them as tiny particles moving about in the metal in much the same manner as the molecules in any ordinary gas. Under the conditions usually obtaining in a metal, the wave aspect of these electrons becomes very conspicuous, and the laws governing their motion will naturally be different from the usual laws of the kinetic theory. The fundamental law of motion appropriate to these electrons will be that only those electron-waves will be maintained in the metal which will ensure that the bounding surface of the metal will be a nodal surface, in the same manner in which only those vibrations will be maintained in a stretched string, which have their nodes at the two ends of the vibrating string. The free electrons in a metal can therefore have only certain discrete wave-lengths, and hence only certain discrete energies. Now these electrons have, besides their translatory motions, also definite spin motions. According to the requirements of the quantum theory each of the above permitted translatory kinetic energies for the electrons in the metal, can be possessed by just two electrons in the metal, one of them having a right-handed spin and the other a left-handed spin. Allowing one pair of electrons to have the longest permitted wave-length, a second pair to have the next lower wave-length, a third pair the next lower, and so on, we find that the wave-length assigned to the last pair becomes extremely short, and of the order of the average distance between neighbouring electrons in the metal. Such a short wave-length corresponds to an enormous kinetic energy for these electrons—an energy of the same magnitude as that possessed by the molecules of an ordinary gas at a temperature of ten thousand degrees or more. At all ordinary temperatures, therefore, the thermal energies supplied will be negligible in comparison with the kinetic energies already possessed by the electrons, and will not make any appreciable difference to the motions of the electrons. Thus the motions will be practically independent of temperature over the whole range from the Absolute Zero to very large temperatures; in other words, in this temperature range the electrons will be degenerate. The region of transition from the degenerate

to the non-degenerate state, which is the most interesting region, will be at very high temperatures, of the order of several thousand degrees, and will not be accessible for experimenting in the laboratory.

A study of the magnetic properties of these free electrons will be a convenient method of investigating their energy distributions. An obvious magnetic property to expect in a free-electron gas will be the paramagnetism due to the spin moments of the electrons. This paramagnetism, however, will be very feeble, since at all ordinary temperatures, the majority of the electrons, as we have seen, will occupy their energy levels in pairs, with opposite spins, and it is only the few stray electrons, with very large energies, which will occupy their energy levels singly, which will be capable of orienting in the magnetic field and contributing to the paramagnetism. At any given temperature  $T$ , the number of such single electrons which contribute to the paramagnetism will bear to the total number of free electrons present the ratio  $T : T_0$ , where  $T_0$  is the degeneracy temperature of the electron gas, which, as we have seen, is usually of the order of ten thousand degrees or more. The number of single electrons will thus be small and proportional to the absolute temperature, and since paramagnetism is itself inversely proportional to the absolute temperature, the result will be a feeble, temperature-independent paramagnetism for the electron gas. This result, which was originally obtained by Pauli, is verified for several metals.

## 2. The Landau Diamagnetism and its Experimental Verification

It was discovered by Landau that an electron gas should have, besides its spin-paramagnetism, an appreciable diamagnetism as well, due to the quantized orbital motions of the electrons in the magnetic field. This is a pure quantum result, and has no counter-part in the classical theory, since it is easily demonstrated that a free electron gas on the classical theory should have no diamagnetism at all. Now this Landau type of diamagnetism is numerically just one third of the spin-paramagnetism, whatever the temperature may be.

It would be of great interest to verify experimentally Landau's diamagnetism. There are, however, two difficulties in verifying it, firstly the predominant paramagnetism with which it is normally associated, and secondly the large degeneracy temperature for the electron gas in most metals, which renders the degenerate state alone accessible for experimenting. There is, however, one substance, namely graphite, in which, owing to certain very special conditions that obtain, both these difficulties are eliminated.

In some of the previous reports I had occasion to refer to the extensive studies made in this laboratory by Mr. N. Ganguli on the magnetic and other properties of this very remarkable crystal. We find that the observed large diamagnetism of this crystal along the normal to the plane of the crystal flake, is really that of its free electrons, and is of the Landau type. Its large tempera-

ture variation suggests that the degeneracy temperature of the electron gas in the crystal should be very low, and indeed, from the magnitude of the variation, the degeneracy temperature can be estimated as  $520^{\circ}\text{K}$ . At low temperatures the diamagnetism tends to reach a constant value, as it should, the value being  $-30 \times 10^{-6}$  per gm., and at high temperatures the diamagnetism follows the Curie law, showing that at these temperatures the energy distribution conforms practically to the laws of classical statistics. Further, the magnitude of the diamagnetism shows that the number of free electrons is just one per carbon atom, and the observation that the electronic diamagnetism is directed wholly along the normal to the plane of the crystal flake, indicates that the freedom of movement of these electrons is confined to the above plane. The last result, namely the restriction of the freedom of motion of the electrons practically to a plane, explains why, in spite of the large concentration of the electrons, namely one per carbon atom, the degeneracy temperature is so low. The restriction will be equivalent to increasing the effective mass of the electron for motion along the normal to the plane; as a consequence, the spacing of the energy levels of the electrons will become much narrower, and the degeneracy temperature much smaller, than for electrons that are free to move in all directions.

Because of the low degeneracy temperature obtaining in this crystal we are able to investigate not only the degenerate state, which is the only one accessible usually in metals, but also the non-degenerate state, and of course the intermediate region of transition from the degenerate to the non-degenerate state, which is perhaps the most interesting region from the point of view of investigating the energy distribution of the electrons, and the laws which govern the distribution. It may be mentioned immediately that the observed temperature variation of the diamagnetism of graphite is in accordance with the quantum statistics of Fermi and Dirac, a brief outline of which was given in an earlier part of this report. With a magnetic field incident along the normal to the above plane we are concerned with the induced electronic motions in the plane alone, and these motions, as we have seen, are free. Hence the simplicity of magnetic behaviour of a free-electron gas is retained.

### 3. The Metallic Properties of Graphite

It would be interesting to investigate in detail the well known metallic properties of graphite (as contrasted with the properties of diamond) in relation to the presence of free electrons having the density and the energy distribution indicated by the magnetic data. I shall content myself here with mentioning only two of these properties. Firstly, from the above number of free electrons, namely one per carbon atom, and the low degeneracy temperature, we should expect the contribution from these electrons to the specific heat of graphite to be much greater than in most metals. This is verified experimentally; at very low temperatures the

electronic specific heat of graphite is found to be more than ten times that of either copper or silver. Secondly, the restriction of the freedom of movement of the electrons to the basal plane should make the electrical conductivity in the basal plane very much greater than along the normal to the plane. Recent measurements by Mr. N. Ganguli and the present writer show that the conductivity in the plane is at least ten thousand times that along the normal to the plane. It may be much more.

#### 4. The Mobile Electrons in Aromatic Molecules

The result obtained from the magnetic data that one electron per carbon atom in graphite is free to migrate from atom to atom over the whole layer is of great significance in connection with the quantum mechanical theory of the structure of aromatic molecules, since each layer in graphite, which is a regular hexagonal net-work of carbon atoms, may be regarded as a single aromatic molecule with an enormous number of condensed benzene rings. The presence of such mobile electrons is an essential feature of the quantum mechanical theory, and indeed follows as a direct consequence of the Uncertainty Principle, according to which the larger the region assigned to these electrons the smaller would be their kinetic energy. Any localization of these electrons, such as is implied in the conventional double-bond of the chemist, in which a pair of such electrons is involved; will naturally correspond to an enhanced kinetic energy; it is equivalent to restricting the wave-lengths of the standing electron waves to small values of the order of the length of the double-bond, whereas if the electrons are mobile, greater wave-lengths, of the order of the dimensions of the whole molecule, will also be permitted, thus conducing to a lowering of the energy, and to a correspondingly enhanced stability.

Thus the magnetic data for graphite indirectly supply the solution for the long-standing controversy regarding the location of the extra bonds in the benzene ring; they are not located at all!

#### 5. The Diamagnetism of Aromatic Molecules

These mobile electrons in the aromatic molecules will naturally endow these molecules with a large extra diamagnetism, which would be confined to the direction perpendicular to the plane of motion of the mobile electrons, i.e., perpendicular to the molecular plane. This explains the marked magnetic anisotropy exhibited by the aromatic molecules. It is the large anisotropy of these molecules, coupled with the fact that these molecules retain their individuality in the crystal state, which makes the magnetic studies on single crystals of aromatic compounds so informative and important. The magnetic studies on these compounds have formed the subject matter of several papers from this laboratory during recent years, by Dr. S. Banerjee and others, and the reader may be referred to these

papers for a detailed account of this important research. A report on the magnetic anisotropies of some of the simple aromatic crystals in relation to the molecular and crystalline structures, was given by the present writer at the Conference on Magnetism arranged by the International Institute for Intellectual Co-operation, at Strasbourg, last May.

### 6. Optical Studies on Aromatic Molecules

The presence of the mobile electrons in the aromatic molecules, and the restriction of their freedom of movement practically to the molecular plane, are also evidenced by the striking directional variations in some of the optical properties of these molecules. In one of the previous reports I had occasion to refer to the observation made by Mr. P. K. Seshan that in plane aromatic molecules, like naphthacene, chrysene, etc., which have characteristic absorption and fluorescence bands in the visible region, presumably arising from the energy transitions of the mobile electrons in these molecules, both the absorption and the fluorescence are uniquely polarized; it is only the component of the electric vector of the incident light, resolved in the plane of the molecule, which is absorbed, or which excites fluorescence, whereas the component of the electric vector perpendicular to the molecular plane is not absorbed at all, nor does it excite the fluorescence. During the year under report Mr. Seshan has extended his optical studies to a number of other aromatic compounds.

### 7. Magnetic Studies on Bismuth in the Neighbourhood of its Melting Point

Before leaving the subject of free electrons, I should like to refer here to some detailed magnetic studies made by Mr. W. J. John on single crystals of spectroscopically pure bismuth (99.998%) in the neighbourhood of their melting point. It is well known that bismuth has an abnormal diamagnetism in the solid state, whereas the diamagnetism of molten bismuth is almost normal. The abnormal diamagnetism of the solid is really due to the free electrons in the lattice, and with the disappearance of the lattice structure on melting, the abnormal part of the diamagnetism also disappears. On the basis of certain observations made near the temperature of melting, it has been surmised that some structural changes might be taking place in the crystal, especially in ordinarily pure specimens of it, before the crystal actually melts.

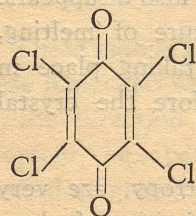
Since the abnormal diamagnetism, and its large anisotropy, are very sensitive to structural changes, a detailed study of the variations of these quantities in the neighbourhood of the melting point would be very useful. Mr. John has made such a study, and he finds that in the spectroscopically pure specimen of bismuth the drop of the diamagnetism to the liquid value is abrupt and takes place within  $1^\circ$  of the melting point. This is not the case, however, with ordinarily pure specimens of bismuth.

### 8. Some Paramagnetic Studies

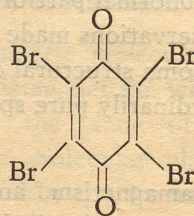
Paramagnetic studies on single crystals of the salts of both the rare earth and the iron groups of metals, have been continued during the year under report, particularly at low temperatures. A short account of this work was presented at the International Conference on Magnetism referred to before. I should like to mention here just one result, which seems to be of special interest. It is well-known from X-ray studies that in many of the highly hydrated salts of the above groups the paramagnetic cation is surrounded by an octahedron of water molecules. The strong electric field that would obtain in the neighbourhood of the central cation, due to the surrounding water molecules, would explain the observed deviation of the magnetic behaviour of the ion in the crystal from its behaviour when free. There is considerable magnetic evidence to show that for a given cation, the magnitude of this field, and its asymmetry, are nearly the same in all the various highly hydrated salts containing the ion. This requirement will be satisfied in a simple manner if the octahedron of water molecules surrounding the cation, instead of being a regular one, deviates from it slightly—a slight deviation is permitted by the available X-ray data—and the deviation is determined in some manner by the nature of the cation in the centre. The mechanism for such a control by the central ion of the precise geometry of distribution of the surrounding molecules, is supplied by the condition for stability of such a system, postulated sometime ago by Jahn and Teller ; the condition being that there should be sufficient asymmetry in the electric field, to remove the degeneracy of the electronic state of the central ion. This asymmetric arrangement of water molecules, with the cation in the centre, will be a more or less rigidly bound structure, and there is much evidence to show that the structure persists even in the aqueous solutions of these salts.

### 9. Structural Studies on Organic Crystals

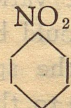
Mr. S. L. Chorghade has continued his X-ray studies on the structures of some of the simple aromatic crystals, and during the year under report has determined the space-groups of the well known halogen derivatives of benzoquinone, namely, chloranil



, and bromanil



, and also of s-trinitro-

benzene . The readers may be referred to the original papers, published in the Zeitschrift für Kristallographie for 1939, for details about these structural studies.

*Report on the Scientific Work by the Research Fellow.*

SPECTROSCOPIC WORK.

In connection with the band spectra of sulphides of the transitional group of elements reported previously it was found that a systematic study of the bands of these group of elements is very much wanting due to insufficient or incomplete data. I collected the material so far published and with the help of some supplementary work tried to find out some relation in their position of occurrence and the electronic structure of the metal atoms forming the molecules. The molecules studied were mostly oxides and some chlorides. In case of chlorides it was established that the chloride bands of the 1st transition group are excited as monochlorides in emission. The emission thus recorded corresponds in many cases to the atomic transition amongst the different, more or less forbidden, states of the ground term  $nd^x(n+1)s^2$  or a transition between the states of the type  $nd^x(n+1)s^2 \leftarrow nd^{x+1}(n+1)s$  or  $nd^{x+1}(n+1)s \leftarrow nd^{x+2}$ . These transitions in many cases lie in the near or far infra red part of the spectrum but in some cases lie in the visible but rarely in the ultra violet. It was also found that some of the chloride salts of the first transition group give out coloured flames when put in the bunsen burner. The colour of the flame could be accounted for with the help of the above mentioned forbidden type of transition in the metal part of the molecule.

It was also noticed that most of the chloride molecules of the 1st transition group when put into the bunsen flame fail to excite the chloride bands strongly and instead they show a preference for oxide bands. These oxide bands are found to enhance if the flame happens to be a gas-oxygen flame. Thus putting  $MnCl_2$  in oxygen-gas flame, which could be vapourised more easily than  $MnO$  without decomposition, a number of unreported  $MnO$  bands were observed. These bands were measured and freshly analysed. The band heads were found to fit in with the following equation :—

$$\nu = 17895 + (77.6\nu' - 14.2\nu'^2 + 42\nu'^3) - (835.8\nu'' - \nu''^2)$$
 It is proposed to study other oxide bands of the group with this technique.

As pointed out above for a good excitation of chloride bands the flame should be free from oxygen. A flame apparatus in which hydrogen burning in an atmosphere of chlorine in an air free space is designed. With the help of this oxygen free flame it is proposed to study the emission bands of the entire system of 1st transition group of chlorides.

**The Upper Atmosphere Work**

In the Upper atmospheres a new ionisation layer has recently been discovered and named as the D-Layer. It is found to exist at a height of about 50-60 kilometer. It has been established that the D-lines of sodium

found in the evening and night sky spectrum, and also the continuous background of the night sky spectrum originate at about this level. Another important characteristic of this layer is that it is a potential layer for the recently discovered phenomenon termed as "radio fade outs" found to occur practically simultaneously with certain solar out-burst. Any theory to account for its existence so far is without much success.

If one follows the temperature of the upper atmosphere in a vertical direction one finds that at about 50 kilometers the temperature attains a very low value and above which it again rises to a height of about 80 kilometers. This rise may be accounted for by the heating of the atmosphere by enormous number of meteoric particles that are absorbed in the atmosphere in a layer between 60-80 kilometers. This warmer layer over a colder low lying layer makes the lower cold layer over-stable, which in turn supports heavy metallic particles from shattered meteors, giving in the characteristic properties discovered by various investigators. In a paper, introductory part of which is communicated to the Indian Physical Society, the stability and other properties of such a layer are discussed.

#### *List of Papers published during the year*

1. Jahn-Teller Theorem and the Arrangement of Water Molecules Around Paramagnetic Ions in Aqueous Solutions.—By K. S. Krishnan, *Nature*, Vol. 143, p. 600.
2. Temperature Variation of the Magnetic Anisotropy of Graphite.—By K. S. Krishnan and N. Ganguli, *Zeitschrift für Kristallographie (A)*, Vol. 100, pp. 530-536.
3. Temperature Variation of the Magnetic Anisotropy of Bismuth Crystal.—By W. J. John, *Zeitschrift für Kristallographie (A)*, Vol. 101, pp. 337-344.
4. Magnetic Studies on Braunitz,  $3\text{Mn}_2\text{O}_3 \cdot \text{MnSiO}_3$ —by K. S. Krishnan and S. Banerjee, *Zeitschrift für Kristallographie (A)*, Vol. 101, pp. 507—511.
5. The Crystal Structure of Chloranil,  $\text{C}_6\text{Cl}_4\text{O}_2$ .—By S. L. Chorghade, *Zeitschrift für Kristallographie*, Vol. 101 pp. 418—424.
6. The Space Group of 1, 3, 5—Trinitrobenzene Crystal.—By S. L. Chorghade, *Zeitschrift für Kristallographie (A)*, Vol. 101, pp. 376—382.
7. The Crystal Structure of Bromanil,  $\text{C}_6\text{Br}_4\text{O}_2$ —By S. L. Chorghade *Zeitschrift für Kristallographie (A)*, Vol. 102, pp. 112—118.
8. The Large Anisotropy of the Electrical Conductivity of Graphite.—By K. S. Krishnan and N. Ganguli, *Nature*, Vol. 144, p. 667.
- 9-10. The Magnetic Anisotropy of Crystals :  
 Part I. Paramagnetic Crystals  
 Part II. Organic Crystals—  
 By K. S. Krishnan : *Collection Scientifique Institut International de Coopération Intellectuelle*. (Report of the meeting on "Magnetism", arranged by the Institute at Strasbourg, May 1939).

11. The Diamagnetism of the Mobile Electrons in Aromatic Molecules.—By K. S. Krishnan, Presidential Address to the Physics Section of the Indian Science Congress, Madras session.

12. The Landau Diamagnetism and the Fermi-Dirac Energy Distribution of the Metallic Electrons in Graphite.—By K. S. Krishnan, Nature, Vol. 145, p. 31.

13. Origin of D-Layer I.—By S. C. Deb, Indian Journal of Physics.

14. On the Distribution of Rainfall in a moving Low Pressure System.—By S. C. Deb, Geographical Journal.

15. MnCl-Bands in Emission.—By B. Saha, Science & Culture, Vol. 5, p. 197.

16. Spectra of the Salts of the First Transition group of Elements.—By S. C. Deb and B. Saha, Science & Culture, Vol. 5, p. 262.

### *Seminar Lectures Delivered During the year*

Subject	Speaker
1-2. The Production of Low Temperatures in Theory and Practice	Mr. Akshayananda Bose
3. Some Magnetic Problems discussed at the International Conference, Strasbourg	Prof. K. S. Krishnan
4. Some Aspects of X-Ray Crystallography	Dr. K. Banerjee
5. The Magnetic Properties of Electrons in Metals	Prof. K. S. Krishnan
6. The Electron Theory of Metals	Dr. G. P. Dube
7. Specific Heats of Metals	do
8. Electric Conduction of Metals	do
9. The Cyclotron	Prof. K. S. Krishnan

APPEN  
INDIAN ASSOCIATION FOR  
*Receipts and Payments Account for the*

RECEIPTS	Rs. As. P.	Rs. As. P.
<b>To Opening Balance as at 1. 1. 1939.</b>		
In hand (Imprest Cash) ... ..	115 0 0	
„ Imperial Bank of India ... ..	2,260 5 5	
„ „ „ on Interest Account ... ..	4,303 9 0	
„ Post Office Savings Bank ... ..	5,556 15 7	
„ Postal Cash Certificates (Cost) ... ..	7,331 4 0	
„ 3% G. P. Notes ... ..	4,978 12 0	
		24,545 14 0
„ Government of India Grant ... ..	...	36,000 0 0
„ Subscriptions from Members ... ..	...	60 0 0
„ Suspense Account ... ..	...	1,000 0 0
„ Special Scholarships ... ..	...	375 0 0
„ Loan Realised ... ..	...	332 14 0
„ Rent from Tenants ... ..	...	5,249 4 0
„ Staff Income-Tax ... ..	...	418 7 0
„ Indian Journal of Physics (Sales and Subscriptions.) ... ..	...	2,807 9 11
„ Special Publication ... ..	...	158 9 0
„ Municipal Tax from Tenants ... ..	...	586 1 3
„ Deposit (Rent) ... ..	...	90 0 0
„ Advertisement ... ..	...	83 7 0
„ <b>Interest</b>		
Ripon P. F. ... ..	767 8 0	
Joykissen Mookerjee Medal Fund ... ..	416 8 0	
Victoria P. F. ... ..	43 12 0	
Dr. Sircar R. M. F. ... ..	148 12 0	
Coochbehar P. F. ... ..	1,006 4 0	
Woodburn M. F. ... ..	35 0 0	
Hare P. F. ... ..	43 12 0	
Jatindra Ch. P. F. ... ..	26 4 0	
Building Fund ... ..	262 8 0	
Nikunja Garabini P. F. ... ..	26 4 0	
General Fund ... ..	910 8 0	
		3,687 0 0
„ <b>Mahendralal Sircar Professorship A/c</b>		
Interest on M. L. Sircar Prof. Fund ... ..	5,145 0 0	
„ „ V. L. Mitra Fund ... ..	4,620 0 0	
Advance Realised ... ..	9,765 0 0	
	10,562 8 0	20,327 8 0
„ Dr. Sircar Memorial Fund ... ..	...	250 0 0
„ Demonstration Allowance ... ..	...	600 0 0
„ Other Miscellaneous Income ... ..	...	169 4 3
Amount Carried Over ... ..	...	96,740 14 5

# DIX III

## THE CULTIVATION OF SCIENCE

year ended 31st December, 1939.

PAYMENTS	Rs. As. P.	Rs. As. P.
By Library ... ..		2,826 4 3
„ Indian Journal of Physics (Publication Expenses) ... ..		2,964 7 9
„ Office Establishment ... ..		2,023 11 9
„ Research Staff ... ..		10,834 3 0
„ Municipal Tax ... ..		779 10 0
„ Advertisements ... ..		52 13 0
„ Special Scholarships ... ..		375 0 0
„ Postages ... ..		45 0 3
„ Staff Income-Tax ... ..		418 7 0
„ Association Provident Fund Contribution ... ..		529 14 0
„ Telephone ... ..		201 11 0
„ Office contingency ... ..		321 1 6
„ Travelling Allowance ... ..		853 9 6
„ Audit Fee ... ..		150 0 0
„ Insurance ... ..		125 0 0
„ Laboratory Charges ... ..		3,868 0 9
„ Gas Charges ... ..		534 5 0
„ Electricity ... ..		546 3 3
„ Laboratory Contingency ... ..		635 3 3
„ Deposit (Rent) ... ..		30 0 0
„ Furniture ... ..		218 8 0
„ Bank Commission		
Ripon P. F. ... ..	6 0 0	
Joykissen Mookerjee Medal Fund ... ..	4 8 0	
Victoria P. F. ... ..	2 2 0	
Dr. Sircar R. M. F. ... ..	2 10 0	
Coochbehar P. F. ... ..	10 1 0	
Woodburn M. F. ... ..	0 8 0	
Hare P. F. ... ..	2 2 0	
Jatindra Ch. P. F. ... ..	2 2 0	
Building Fund ... ..	1 8 0	
Nikunja Garabini P. F. ... ..	2 2 0	
General Fund ... ..	19 2 0	
		52 13 0
„ Electric Installation ... ..		25 0 0
„ Employees' Provident Fund		
Insurance Premium of Prof. Krishnan ... ..	399 0 0	
Loan to Prof. Krishnan ... ..	2,000 0 0	
Suspense ... ..	1,000 0 0	
		3,399 0 0
Amount Carried Over ... ..		31,609 14 3



# THE CULTIVATION OF SCIENCE

year ended 31st December, 1939—Continued.

PAYMENTS		Rs.	As.	P.	Rs.	As.	P.
By	Amount Brought Forward	...	...	...	31,609	14	3
"	Building Repairs	...	...	...	154	6	0
"	Workshop Expense	...	...	...	359	11	3
"	Printing	...	...	...	113	0	0
"	Science Congress Tickets	...	...	...	10	0	0
"	Renovation of Oil Painting	...	...	...	159	0	0
"	Miscellaneous (Refund of Municipal Tax)	...	...	...	7	9	9
"	Suspense	...	...	...	2,777	0	0
"	<b>Mahendralal Sircar Professorship Account</b>						
	Salary	...	...	9,000	0	0	
	Provident Fund Contribution	...	...	750	0	0	
"	Bank Commission	...	...	26	8	0	
"	Repayment to General Fund	...	...	10,562	8	0	
					20,339	0	0
"	<b>Ripon Prof. Fund</b>						
	Cost of Printing of Special Publication	...	...	...	564	14	0
"	<b>Coochbehar Prof. Fund</b>						
	Contingency Expense	...	...	...	5	8	0
"	<b>Repayment of Amount due by Association</b>						
	Dr. Sircar Research Medal Fund	...	...	603	8	0	
	Mahendralal Sircar Prof. Fund	...	...	200	0	0	
	Joykissen Mookerjee Medal Fund	...	...	207	1	6	
	Victoria Prof. Fund	...	...	313	6	0	
	Coochbehar Prof. Fund	...	...	937	13	0	
	Woodburn Medal Fund	...	...	349	14	0	
	Hare Prof. Fund	...	...	313	6	0	
	Jatindra Ch. Prize Fund	...	...	377	6	0	
	Building Fund	...	...	330	5	0	
	Nikunja Garabini Prize Fund	...	...	389	9	2	
					4,022	4	8
"	<b>Amount Advanced by Association on account of transfer of Securities per Contra.</b>						
	To Joykissen Mookerjee Medal Fund	...	...	754	12	6	
	" Victoria Prof. Fund	...	...	167	9	0	
	" Coochbehar Prof. Fund	...	...	1,466	14	0	
	" Woodburn Medal Fund	...	...	131	1	0	
	" Hare Prof. Fund	...	...	167	9	0	
	" Jatindra Ch. Prize Fund	...	...	103	9	0	
	" Building Fund	...	...	631	9	0	
	" Nikunja Garabini Prize Fund	...	...	91	5	10	
	" Ripon Prof. Fund	...	...	961	14	0	
					4,476	3	4
"	<b>Joykissen Medal Fund</b>						
	Advance repaid to Association	...	...	...	754	12	6
"	<b>Victoria Prof. Fund</b>						
	Advance repaid to Association	...	...	...	85	0	0
"	<b>Coochbehar Prof. Fund</b>						
	Advance repaid	...	...	...	1,466	14	0
	Amount Carried Over	...	...	...	66,905	1	9





## INDIAN ASSOCIATION FOR

Balance Sheet as at

LIABILITIES				Rs.	As.	P.	Rs.	As.	P.
General Fund ... ..	...	...	...	2,04,465	11	2			
Add, Depreciation Reserve ... ..	...	...	...	1,69,099	10	3			
„ Investment Reserve ... ..	...	...	...	6,173	8	0			
(As per Resolution of the Committee dated 19th May, 1938)							3,79,738	13	5
Government of India Grant (Unappropriated)				...			23,033	2	3
Coochbehar Prof. Fund ... ..	...	...	...	29,904	11	0			
Accrued Interest thereon ... ..	...	...	...	542	13	0			
							30,447	8	0
Ripon Prof. Fund ... ..	...	...	...	22,961	14	0			
Accrued Interest thereon ... ..	...	...	...	225	1	3			
							23,186	15	3
Joykissen Mookerjee Medal Fund ... ..	...	...	...	12,361	14	0			
Accrued Interest thereon ... ..	...	...	...	366	1	3			
							12,727	15	3
Building Fund ... ..	...	...	...	8,461	14	0			
Accrued Interest thereon ... ..	...	...	...	228	0	0			
							8,689	14	0
Dr. Sircar Research Medal Fund ... ..	...	...	...	4,480	15	0			
Accrued Interest thereon ... ..	...	...	...	515	7	0			
							4,996	6	0
Woodburn Medal Fund ... ..	...	...	...	1,480	15	0			
Accrued Interest thereon ... ..	...	...	...	18	8	0			
							1,499	7	0
Victoria Prof. Fund ... ..	...	...	...	1,480	15	0			
Accrued Interest thereon ... ..	...	...	...	25	10	0			
							1,506	9	0
Hare Prof. Fund ... ..	...	...	...	1,480	15	0			
Accrued Interest thereon ... ..	...	...	...	25	10	0			
							1,506	9	0
Nikunja Garabini Prize Fund ... ..	...	...	...	980	15	0			
Accrued Interest thereon ... ..	...	...	...	16	2	0			
							997	1	0
Jatindra Chandra Prize Fund ... ..	...	...	...	980	15	0			
Accrued Interest thereon ... ..	...	...	...	16	2	0			
							997	1	0
Mahendralal Sircar Research Professorship Fund				1,47,000	0	0			
Accrued Interest thereon ... ..	...	...	...	141	10	0			
							1,47,141	10	0
Veharilala Mitra Fund ... ..	...	...	...	1,00,000	0	0			
Accrued Interest thereon ... ..	...	...	...	0	14	0			
							1,00,000	14	0
<b>Deposit</b>									
For Rent ... ..	...	...	...	60	0	0			
„ Library ... ..	...	...	...	10	0	0			
							70	0	0
Employees' Provident Fund ... ..	...	...	...	...			19,941	12	9
<b>TOTAL Rs. ...</b>				...			<b>7,56,481</b>	<b>9</b>	<b>11</b>

Examined the Balance Sheet as at 31st December 1939 of the Indian Association the Association and found it correct.

1B, Old Post Office Street, Calcutta.

9th February, 1940.

# THE CULTIVATION OF SCIENCE

31st December, 1939

ASSETS			Rs. As. P.	Rs. As. P.
Land and Building	...	...	...	31,680 11 9
Lecture Hall and Gallery	...	...	...	23,465 5 3
Vizianagram Laboratory	...	...	...	40,900 14 0
Observatory Room	...	...	...	3,320 9 9
Range of Shops (East)	...	...	...	2,516 10 9
Range of Shops (West)	...	...	...	2,308 5 0
Servants' Quarters	...	...	...	1,024 0 0
Darwans' Quarter	...	...	...	303 13 9
Scientific Instruments (Including K. K. Tagore Account)	Rs. 25,000/-	on	...	1,18,532 5 2
Botanical Instruments	...	...	...	2,329 6 0
Workshops Instruments	...	...	...	9,861 5 9
Tools and Implements	...	...	...	225 7 3
Furniture	...	...	...	19,436 10 6
Library	...	...	...	67,148 11 10
<b>Investments in G. P. Notes (Face Value)</b>				
Mahendralal Sircar Research Prof. Fund	...	...	1,47,000 0 0	
Veharilala Mitra Fund	...	...	1,32,000 0 0	
General Fund	...	...	21,000 0 0	
Coochbehar Prof. Fund	...	...	30,000 0 0	
Ripon Prof. Fund	...	...	23,000 0 0	
Joykissen Mookerjee Medal Fund	...	...	12,400 0 0	
Building Fund	...	...	8,500 0 0	
Dr. Sircar Research Medal Fund	...	...	4,500 0 0	
Victoria Prof. Fund	...	...	1,500 0 0	
Hare Prof. Fund	...	...	1,500 0 0	
Nikunja Garabini Prize Fund	...	...	1,000 0 0	
Woodburn Medal Fund	...	...	1,500 0 0	
Jatindra Ch. Prize Fund	...	...	1,000 0 0	
				3,84,900 0 0
Interest Accrued	...	...	...	2,121 14 6
Advance to Ripon Prof. Fund	...	...	246 14 0	
" " Victoria Prof. Fund	...	...	82 9 0	
" " Woodburn Medal Fund	...	...	46 1 0	
" " Hare Prof. Fund	...	...	82 9 0	
" " Jatindra Ch. Prize Fund	...	...	61 9 0	
" " Building Fund	...	...	76 9 0	
" " Nikunja Garabini Prize Fund	...	...	49 5 10	
				645 8 10
<b>Employees' Provident Fund Investment (At Cost)</b>				
Postal Cash Certificates	...	...	7,331 4 0	
Imperial Bank of India (Savings)	...	...	5,864 12 9	
Imperial Bank of India (Suspense paid for Cash Certificates)	...	...	1,767 0 0	
3% G. P. Notes (Face Value Rs. 5,000/-)	...	...	4,978 12 0	
				19,941 12 9
<b>Closing Balances</b>				
In hand (Imprest)	...	...	115 0 0	
" Imperial Bank of India	...	...	25,703 1 1	25,818 1 1
<b>TOTAL Rs.</b>	...	...	...	<b>7,56,481 9 11</b>

For the Cultivation of Science as set forth above with the books and vouchers of

S. N. MUKHERJI, R.A.  
Incorporated Accountant.

## INDIAN ASSOCIATION FOR

## General Fund Account for the

INCOME		Rs.	As.	P.	Rs.	As.	P.
Fund at the beginning of the year	...	...	...	...	1,98	070	8 6
Government of India Grant	...	...	...	...	19,069	3	6
Subscription from Members	...	...	...	...	60	0	0
Special Scholarship	...	...	...	...	375	0	0
Rent	...	...	...	...	5,249	4	0
Income-Tax	...	...	...	...	418	7	0
Indian Journal of Physics	...	...	...	...	2,807	9	11
Municipal Tax	...	...	...	...	578	7	6
Interest (General Fund)	...	...	...	...	910	8	0
Advertisement	...	...	...	...	83	7	0
Dr. Sircar Memorial Fund	...	...	...	...	250	0	0
Demonstration Allowance	...	...	...	...	600	0	0
Special Publication	...	...	...	...	158	9	0
Miscellaneous	...	...	...	...	169	4	3
<b>Appropriation of Government of India Grant A/c</b>							
Opening balance as at 1. 1. 1939	Rs.	6,102	5	9			
Amount received in 1939 (for 1938-39 and 1939-40).	"	36,000	0	0			
					42,102	5	9
Less, appropriation in 1939							
Research Staff	"	10,834	3	0			
Electric and Gas Charges	"	880	8	3			
Electric Installation	"	25	0	0			
Laboratory Charges	"	3,868	0	9			
Laboratory Contingency	"	635	3	3			
Library	"	2,826	4	3			
					19,069	3	6
Balance transferred to Balance Sheet	...	23,033	2	3			
Expenses previously borne by General Fund now repaid :-							
Ripon Prof. A/c	...	823	2	3			
Nikunja Garabini Prize Fund	...	31	0	0			
Joykissen Mookerjee Medal Fund	...	656	12	6			
Jatindra Chandra Prize Fund	...	31	0	0			
Mahendralal Sircar Prof. Fund	...	22	0	0			
					1,563	14	9
					2,30,364	3	5

1B, Old Post Office Street,  
CALCUTTA,

9th February, 1940.

# THE CULTIVATION OF SCIENCE

*year ended 31st Decmber, 1939.*

P.	OUTGO	Rs.	As.	P.	Rs.	As.	P.
6	Indian Journal of Physics				2,964	7	9
6	Office Establishment				2,023	11	9
0	Research Staff				10,834	3	0
0	Municipal Tax				779	10	0
0	Advertisement				52	13	0
0	Special Scholarship				375	0	0
11	Postage				45	0	3
6	Staff Inoome-Tax				418	7	0
0	Provident Fund Contribution (Association)				529	14	0
0	Telephone				201	11	0
0	Office Contingency				321	1	6
0	Laboratory Charges				3,868	0	9
0	Science Congress Tickets				10	0	0
3	Audit Fee				150	0	0
	Insurance				125	0	0
	Gas Charges				334	5	0
	Electricity				546	3	3
	Bank Commission				19	2	0
	Building Repairs				154	6	0
	Printing				113	0	0
	Travelling Allowance				853	9	6
	Laboratory Contingency...				635	3	3
	Workshop Expense				359	11	3
	Renovation of Oil painting				159	0	0
	Electric Installation				25	0	0
9	Fund at the end of the year				2,04,465	11	2
5					2,30,364	3	5

Examined and found correct,  
**S. N. MUKHERJI, R. A.,**  
*Incorporated Accountant.*

# INDIAN ASSOCIATION FOR EMPLOYEES'

*Balance Sheet as at*

LIABILITIES	Rs.	As.	P.
Prof. K. S. Krishnan ... ..	9,334	6	6
Ashutosh Dey ... ..	6,437	14	3
Nalinaksha Sinha ... ..	2,439	10	0
Sachi Nath Banerjee ... ..	201	4	9
Dhirendra Nath Das ... ..	1,852	10	0
Subodh K. Chakravarty ... ..	345	6	6
Satish Chandra Das ... ..	1,069	9	3
Dwija Pada Roy ... ..	84	10	7
Harakali Mukherjee ... ..	40	14	0
B. M. Bhattacharjee ... ..	13	12	9
Interest Undistributed ... ..	4	12	2
TOTAL	21,824	14	9

1B, Old Post Office Street,  
CALCUTTA

*9th February, 1940.*

# THE CULTIVATION OF SCIENCE

## PROVIDENT FUND

31st December, 1939

ASSETS	Rs.	As.	P.
<i>Loans</i>			
Prof. K. S. Krishnan (Loan) ... ..	833	3	0
Do Do Payment of Premium on Life Insurance ... ..	823	14	0
Ashutosh Dey ... ..	120	0	0
Satish Chandra Das ... ..	32	8	0
Subodh K. Chakravarty ... ..	37	8	0
Sachi Nath Banerjee ... ..	36	1	0
<i>Other Investments</i>			
3% G. P. Notes (Cost) ... ..	4,978	12	0
Postal Cash Certificates (Cost) ... ..	7,331	4	0
Imperial Bank of India (Savings A/c.) ... ..	5,864	12	9
Imperial Bank of India (In Suspense for purchasing Cash Certificates) ... ..	1,767	0	0
<b>TOTAL Rs. ...</b>	<b>21,824</b>	<b>14</b>	<b>9</b>

Examined and found correct.

**S. N. MUKHERJI, R.A.**

*Incorporated Accountant.*

## APPENDIX IV

### *Office Bearers and Members of the Committee of Management For the year 1939.*

#### President.

Sir Nilratan Sircar, Kt., M.A., M.D., D.C.L., (Oxon).  
7, Short Street, Calcutta.

#### Vice-Presidents.

1. J. N. Basu, Esq., M.A., M.L.A.,  
6. Old Post Office Street, Calcutta.
2. Sir U. N. Brahmachari, Kt., M.A., M.D., Ph.D., F.R.A.S.B., F.N.I.  
82-3, Cornwallis Street, Calcutta.
3. Sir B. C. Mahtab, G.C.I.E., K.C.S.I., I.O.M.  
The Maharajadhiraja Bahadur of Burdwan, Bejoy Manzil,  
Alipore.
4. Prof. S. K. Mitra, M.B.E., D.Sc.,  
92, Upper Circular Road, Calcutta.
5. Dr. S. P. Mookherjee, M.A., B.L., D. Litt., Bar-at-Law.,  
77, Asutosh Mookerjee Road, Bhowaipore.
6. Prof. M. N. Saha, D.Sc., F.R.S., F.R.A.S.B., F.N.I.,  
92, Upper Circular Road, Calcutta.
7. Rao Bahadur B. Venkatesachar, M.A.,  
"Ambica Vilas", Bull Temple Road,  
Basavangudi, Bangalore, Mysore.

#### Members.

1. Dr. S. K. Banerji, D.Sc.,  
Meteorological Office, Poona.
2. The Hon'ble Mr. Justice C. C. Biswas, C.I.E., M.A., B.L.,  
58, Puddapuker Road, Bhowanipore, Calcutta.
3. Dr. A. Chakravarty, B.Sc., M.B., F.R.C.P., F.R.S.E.  
1, Fariapuker Road, Calcutta
4. Capt. N. Datta, M.B.,  
158, Dhurumtollah Street, Calcutta.
5. Sir M. O. Forster, Kt., D.Sc., Ph.D., F.R.S., F.N.I.,—Mysore.  
Old Banni Mantap, Mysore City.,
6. Prof. P. N. Ghosh, M.A., Ph.D., Sc.D., F.N.I.,  
92, Upper Circular Road, Calcutta.

7. Prof. D. M. Bose, M.A., Ph.D.,  
Bose Institute, 93, Upper Circular Road, Calcutta.
8. Dr. B. S. Guha, D.Sc., F.N.I.,  
Indian Museum, Calcutta.
9. Dr. M. S. Krishnan, D.Sc.,  
Indian Museum, Calcutta.
10. Dr. W. A. Jenkins, D.Sc. Ph.D. Nominee of the Government  
of India.
11. Prof. K. S. Krishnan, D.Sc., (Ex-Officio).  
210, Bowbazar Street, Calcutta.
12. J. M. Majumdar, Esq., M.A.,  
29, School Row, Bhowanipore.
13. Prof. J. N. Mukherjee, D.Sc., F.R.A.S.B., F.N.I., Hony. Secretary.  
(Ex-Officio), 92, Upper Circular Road, Calcutta.
14. M. N. Mukherji, Esq., B.E..  
12, Old Post Office Street, Calcutta,
15. Prof. H. K. Mookerjee, D.Sc.,  
35, Ballygunge Circular Road, Calcutta.
16. J. C. Pal, Esq., M.A., B.L.,  
16, Komedanbagan Lane, Calcutta.
17. N. C. Ray, Esq., M.A., B.L.,  
213-1, Cornwallis Street, Calcutta.
18. Dr. S. N. Ray, M.B., F.R.C.S.,  
34, Allenby Road, Bhowanipore.
19. Dr. C. M. Sogani, D.Sc.,  
Benares Hindu University, Benares.—U. P.
20. Dr. N. K. Sethi, D.Sc.,  
Agra College,—Agra. U.P.
21. S. Bhagavantam, Esq., M.Sc..  
Andhra University, Waltair.—Andhra

APPENDIX V

*A list of Joy Kissen Mookerjee Medallists, Ripon and Coochbehar Professors since the separation of the endowed funds:—*

JOY KISSEN MOOKERJEE MEDALLISTS

1. Sir E. J. Russell, D.Sc., F.R.S. ... 1936
2. Sir James H. Jeans, D.Sc., Sc.D., L.L.D., F.I.C., F.R.S. ... 1937
3. Prof. F. W. Aston, F.R.S., D.Sc., Nobel Laureate ... 1938
4. Dr. Robert A. Millikan, Nobel Laureate... 1939

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., D.Sc., F.R.S. ... 1938

COOCHBEHAR PROFESSOR

1. Prof. J. E. Lennard-Jones, F.R.S. ... 1938

APPENDIX III  
INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE  
**BUDGET ESTIMATES FOR THE YEAR, 1940**

Receipts

Expenditure

ACCOUNTS	Actuals 1937		Actuals 1938		Budget Estimates for 1939		Actuals 1939.		Budget Estimates for 1940		ACCOUNTS	Actuals 1937		Actuals 1938		Budget Estimate 1939		Actuals 1939		Budget Estimate 1940		
	Rs.	As. P.	Rs.	As. P.	Rs.	As. P.	Rs.	As. P.	Rs.	As. P.		Rs.	As. P.	Rs.	As. P.	Rs.	As. P.	Rs.	As. P.	Rs.	As. P.	
Membership Fees (Life) ...	150	0 0	...	...	...	...	250	0 0	...	...	STAFF—											
Do. (Ordinary) ...	115	0 0	75	0 0	100	0 0	60	0 0 <sup>1</sup>	85	0 0	1. Research Department—											
Indian Jr. of Physics ...	2,976	10 11	2,660	5 8	2,500	0 0	2,807	9 11 <sup>2</sup>	2,500	0 0	(a) M. L. S. Professor 750 (1) ...	9,000										
Advertisement ...	9	0 0	16	11 0	20	0 0	83	7 0	25	0 0	(b) Research Fellowship and Scholarship 125 (1), 50 (5) (25+25) 2 ...	5,700										
Rent ...	5,007	8 0	5,727	0 0	6,435	0 0	5,249	4 0 <sup>3</sup>	6,076	8 0*	(c) Demonstrator 205 (1) ...	2,460										
Demonstration Allowance (from Calcutta Medical Institute) ...	600	0 0	550	0 0	600	0 0	600	0 0 <sup>4</sup>	800	0 0	17,160	19,103	9 6	19,515	10 0	20,004	0 0	19,834	3 0	20,028	0 0	
Special Scholarship ...	160	0 0	200	0 0	...	...	375	0 0	...	...	2. Workshop—											
Special Publication ...	...	...	...	...	...	...	158	9 0	...	...	(a) Mechanics 80 (1), 48 (1), 15 (1), 30 (1) ...	2,076										
Sale of Old Materials ...	1	2 0	6	8 0	...	...	36	1 3	30	0 0	(b) Library Attendant 25 (1) ...	300										
Misc. Receipts ...	...	...	...	...	...	...	133	3 0 <sup>5</sup>	...	...	(c) Laboratory Attendant 22 (1) ...	264										
Amount received from Several Funds for adjustment ...	...	...	...	...	...	...	3,830	10 6 <sup>6</sup>	...	...	(d) Bearer 19 (1) ...	228										
Staff Income Tax ...	403	6 0	402	12 0	...	...	418	7 0	418	7 0	2,868	2,106	2,127	11 3	2,113	12 0	1,992	0 0	2,023	11 9	2,106	0 0
INTEREST											3. Equipment & Working Expenses of Laboratories—											
Veharilala Mitra Fund } ...	9,765	0 0	9,765	0 0	9,772	0 0	9,765	0 0	9,772	0 0	Research Grant of M. L. S. Professor ...	1,694	9 9	2,000	0 0	2,000	0 0	3,868	0 9 <sup>1</sup>	2,000	0 0	
Mahendralal Sircar P. Fund } ...	...	...	...	...	...	...	...	...	...	...	General Equipment, contingent and working expenses (apparatus, chemicals etc.) ...	397	7 0	507	14 0	700	0 0 <sup>3</sup>	2,096	0 0 <sup>2</sup>	700	0 0	
General Fund ...	1,117	4 0	1,033	0 0	927	8 0	910	8 0	735	0 0 <sup>7</sup>	Workshop ...	...										
Government of India Grant ...	...	...	18,000	0 0	20,000	0 0	36,000	0 0 <sup>8</sup>	18,000	0 0	Gas ...	389	2 6	307	15 3	800	0 0	635	3 3	800	0 0 <sup>9a</sup>	
Municipal Tax (Occupiers' share) ...	277	5 9	333	9 3	390	2 0	586	1 3 <sup>9</sup>	593	8 0	Electricity ...	685	14 6	746	12 3	359	11 3	334	5 0	350	0 0	
Loan ...	3,000	0 0	...	...	...	...	...	...	...	...	4. Office Establishment—											
Loan realised from M. L. S. Professor ...	1,666	14 0	2,000	4 0	...	...	332	14 0	...	...	Ministerial Staff 94 (1), 35 (1) ...	1,548										
Suspense ...	...	...	15	0 0	...	...	...	...	...	...	Menials 19-8 (1), 15 (1), 12 (1) ...	558										
Rent Deposit ...	...	...	...	...	...	...	90	0 0	...	...	2,106	2,127	11 3	2,113	12 0	1,992	0 0	2,023	11 9	2,106	0 0	
Deposit, Library ...	...	...	20	0 0	...	...	...	...	...	...	5. General—											
Opening Balance ...	12,451	2 4	2,500	3 9	3,163	13 5	3,163	13 5	25,960	9 1	Telephone ...	216	10 0	229	5 0	220	0 0	201	11 0	200	0 0	
	37,700	5 0	43,305	5 8	43,908	7 5	64,850	8 4	64,996	0 1	Postage ...	90	11 3	61	11 6	75	0 0	45	0 3	37	8 0	
											Printing ...	198	2 0	209	3 0	200	0 0	113	0 0	200	0 0	
											Auditor's Fee ...	150	0 0	150	0 0	150	0 0	150	0 0	150	0 0	
											Insurance ...	125	0 0	125	0 0	125	0 0	125	0 0	125	0 0	
											Office Stationery and Contingency ...	195	4 3	655	15 9	200	0 0	321	1 6 <sup>4</sup>	700	0 0 <sup>†</sup>	
											Bank Charges ...	36	12 0	7	0 0	35	0 0	19	2 0	35	0 0	
											Bank Charges for V. L. Mitra and M. L. S. Prof. Funds ...	...		25	8 0	...		26	8 0	26	8 0	
											Staff Incometax ...	403	6 0	402	12 0	...		418	7 0	418	7 0	
											6. Contribution to Prov. Fund ...	1,233	0 0	1,249	8 0	1,275	0 0	1,279	14 0	1,290	0 0	
											7. Indian Journal of Physics ...	1,858	13 3	1,861	10 9	2,500	0 0	2,964	7 9 <sup>5</sup>	2,500	0 0	
											8. Library ...	217	12 0	3,386	13 9	300	0 0	875	13 6	...		
											9. Municipal Tax ...	703	6 0	948	11 0	948	11 0	779	10 0	780	4 0	
											10. Special Scholarship ...	160	0 0	200	0 0	...		7 9 9 <sup>6</sup>	375	0 0	...	
											11. Contribution to Science News Association ...	100	0 0	100	0 0	...		...	...	100	0 0	
											12. Travelling Allowance ...	439	11 0	...	...	105	0 0	853	9 6	120	0 0	
											13. Miscellaneous charges ...	...	...	23	14 6	...		...	...	50	0 0	
											Amount transferred to several Funds for adjustment ...	...	...	...	...	...	...	122	9 0	100	0 0	
											14. Nikunja Garabini Prize Fund ...	...	...	31	0 0	...		...	...	...	...	
											15. Jatindra Chandra Prize Fund ...	...	...	31	0 0	...		...	...	...	...	
											16. Advertisement ...	59	14 0	27	14 0	25	0 0	52	13 0	30	0 0	
											17. Furniture ...	...	...	200	0 0	200	0 0	218	8 0 <sup>10</sup>	100	0 0	
											18. Repairs (Sanitary fittings) ...	...	...	155	2 6 <sup>11</sup>	154	6 0	154	6 0	150	0 0	
											19. Science Congress Ticket ...	10	2 0	10	2 0	10	2 0	10	0 0	10	0 0	
											20. Renovation of Oil paintings ...	...	...	...	...	...		...	...	...		
											21. Renovation of Electric Wires ...	...	...	800	0 0	800	0 0	159	0 0	...		
											22. Renovation of Meteoro. Inst ...	...	...	400	0 0	400	0 0	25	0 0	400	0 0	
											23. Donation ...	250	0 0	...	...	...		...	...	...		
											24. Ripon Prof. A/c (Advance) ...	...	...	823	2 3	...		...	...	...		
											25. Joykissen Mookerjee Medal Fund A/c ...	329	2 6	656	12 6	...		...	...	600	0 0	
											26. Loan Repayment ...	...	...	3,000	0 0	...		...	...	...		
											27. Loan (Prof. Krishnan) ...	4,000	0 0	...	...	...		...	...	...		
											28. Suspense ...	24	0 0	...	...	...		40	0 0	...		
											Closing Balance ...	2,500	3 9	3,163	13 5	5,745	0 8	25,960	9 1	26,115	7 1	
												37,700	5 0	43,305	6 2	43,908	7 5	64,850	8 4	64,996	0 1	

\* Including rent for Dec. 1940.  
<sup>1</sup> Outstanding ; Rs. 40.  
<sup>2</sup> " " 368-4.  
<sup>3</sup> " " 649-8, since realised Rs. 273-8.  
<sup>4</sup> " " 200.  
<sup>5</sup> Rs. 30 realised on account of Salami, Rs. 91-8 o/a of sale of reprints Rs. 7-11-0 realised on account of Indian Science Congress Association for duplicating, Rs. 4-0-0 Miscellaneous receipts.

<sup>6</sup> Amount received as a result of transferring Government Securities of the face value of Rs. 8,500 to several funds by way of adjustment.  
<sup>7</sup> Out of Rs. 29,500 Government Securities of the face value of Rs. 8,500 have been transferred to several funds to which they were due. Hence the decrease in interest as compared to 1938.  
<sup>8</sup> Rs. 18,000 on account of Government of India grant for 1939-40 have been received in November, 1939.  
<sup>9</sup> To be realised ; Rs. 109-15-6, Rs. 74-1-0 since realised.

\* On account of increments to mechanics sanctioned by the Committee after the budget estimates.  
<sup>1</sup> Rs. 2,000 have been paid on account of a Microscope, vide item No. 7, Meeting of the Committee dated 7-2-39.  
<sup>2</sup> Rs. 4,096 were sanctioned by the Committee vide item No. 7, dated 7-2-39.  
<sup>3</sup> Same as above.  
<sup>3a</sup> Includes the unspent balance of Rs. 440 out of Rs. 800 sanctioned for Workshop.  
<sup>4</sup> Sanctioned at the meeting of the Committee item No. 9 dated 20-12-38.  
<sup>5</sup> Sanctioned by the Committee to Pitam Singh Durwan as half pay during his absence on leave, vide item No. 16, dated 5-4-39.  
<sup>6</sup> Rs. 116-4 sanctioned by the Committee dated 5-3-39 and 5-10-39, Rs. 13-6 o/a arrear bills for 1938.  
<sup>†</sup> Includes provision for a type writer.  
<sup>‡</sup> Travelling allowance for Prof. Krishnan and Dr. S. C. Deb, sanctioned by the Committee after the budget estimates.

<sup>7</sup> Sanctioned at a meeting of the Committee item No. 9, dated 20-12-39.  
<sup>8</sup> Includes Rs. 648-14-0 on account of arrear bills for 1938.  
<sup>9</sup> The sum of Rs. 7-9-9 was refunded to Mr. Judhishir Daw, Meeting of the Committee item No. 6, dated 16-8-39.  
<sup>9a</sup> Sanctioned by the Committee at their meeting, item No. 5, dated 5-4-39.  
<sup>10</sup> Rs. 18-8 were sanctioned by the Committee vide item No. 7, dated 5-4-39.  
<sup>11</sup> Rs. 155-2-6 were sanctioned by the Committee, vide item Nos. 11 and 15, 16 dated 28-2-39 and 16-8-39.  
<sup>12</sup> Rs. 54 were sanctioned by the Committee, vide item No. 4, dated 11-7-39.

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