

BOSE RESEARCH INSTITUTE

ANNUAL REPORT
and
ACCOUNTS

For the Year 1939-40

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ANNUAL REPORT

The Director begs to present the annual report on the working of the BOSE INSTITUTE for the session 1939-40

1. The Governing Body as on 1st April, 1939, consisted of the following members:—

1. Rabindra Nath Tagore.
2. Lady Abala Bose.
3. Sir Nilratan Sircar, M.A., M.D., L.L.D., etc.
4. Mr. J. N. Basu, M.A., M.L.A.
5. Prof. Birbal Sahni, sc.D., D.Sc., F.R.S., Lucknow.
6. Mr. S. C. Mukherji, I.C.S. (retd.).
7. Mr. B. M. Sen, M.A. (Cantab.), M.Sc. (Cal.), I.E.S., Principal Presidency College.
8. Mr. S. K. Mandal, Solicitor.
9. Mr. S. M. Bose, M.A., LL.B. (Cantab.), Member, Public Service Commission, Bengal; Secretary, Bose Institute.
10. Prof. N. C. Nag, M.A., F.I.C., Asst. Director, Bose Institute.
11. Mr. A. N. Mitter, Superintendent, Bose Institute.
12. Dr. D. M. Bose, M.A., PH.D., F.N.I., Director, Bose Institute.

During the year Prof. Birbal Sahni, D.Sc., F.R.S. resigned his membership of the Governing Body, and Prof. P. Parija, M.A., I.E.S., Principal, Ravenshaw College, Cuttack was elected member in his place on 30th August, 1939.

2. *Sir J. C. Bose Memorial Lecture*—Prof. Megnad Saha, F.R.S. delivered the second Sir J. C. Bose Memorial lecture on 30th November 1939. The subject of his discourse was 'World, Atom and Nuclei'.

3. *Staff*—During the year under review the following changes have taken place.

Prof. N. C. Nag, M.A., F.I.C., Assistant Director, on the completion of the 65th year of his age, retired from the 1st October 1939. In recognition of his long and meretorious service Prof. Nag has been appointed honorary

Mr. Surendra Chandra Das, Research Fellow in Plant Physiology, retired from 1st October, 1939 on account of continuous ill health. He was associated with the work of the Founder Director since 1909.

Mr. Sasanka Sekhar Sarkar, M.Sc. of the department of Anthropology, who was awarded last year a Humboldt Scholarship, has returned after spending nearly a year in Prof. Eugen Fischer's Anthropological Institute in Berlin. Mr. Sarkar has been awarded the Griffith Memorial Prize of the Calcutta University for the year 1938.

Dr. P. J. Gregory Research Fellow in Cytogenetics has resigned his post with effect from 1st April, 1940, on being appointed Economic Botanist to the Government of Bengal.

4. *Sir J. C. Bose Research Scholarship for Presidency College students*—Lady Abala Bose has entrusted to the Governing Body of the Bose Institute the management of the Sir. J. C. Bose Presidency College Research Scholarship Fund. The corpus of the fund consists of $3\frac{1}{2}\%$ G. P. Notes of face value Rs. 50,000. Out of the interest received two research scholarships of Rs. 70 each, one in Botany and one in Physiology, are to be awarded to distinguished Bengali Hindu students who have graduated in honours in either of these subjects from the Presidency College, Calcutta, and have subsequently undertaken higher studies in their respective subjects.

Mr. Kalyan Kumar Purkayastha, M.Sc. has been awarded the scholarship in Botany and Mr. Arbindo Roy, M.Sc. the scholarship in Physiology. A separate Trust Fund Account has been opened in the Imperial Bank of India for this fund.

4. *Visitors*—Prof. R. A. Millikan of the California Institute of Technology with his two fellow workers Drs. H. V. Neher and W. H. Pickering arrived in Calcutta towards the end of November, 1939 for the purpose of continuing their study of the intensity variation of cosmic rays at different latitudes in India. Prof. and Mrs. Millikan were the guests of Lady Bose during their brief stay in Calcutta. At a meeting of the Physics Seminar Drs. Neher and Pickering gave reports of their measurements of cosmic ray intensities at different latitudes by the balloon ascent method. Before a meeting of the Indian Physical Society held in the lecture hall of the Bose Institute, Prof. Millikan gave a very instructive historical survey of the cosmic ray investigations, which concluded with a discussion of the problems which will be investigated in India. One of our research workers accompanied Prof. Millikan's party to Agra. He had the opportunity of learning some-

5. *Visit of the Committee of Inspection appointed by the Government of India.*

A Committee consisting of:

1. Dr. H. B. Dunncliff, C.I.E., M.A., Sc.D., F.I.C., Chief Chemist, Central Revenues Control Laboratory, New Delhi (Chairman).
2. Dr. Wali Mohammed, M.A., Ph.D., I.E.S., Head of the Department of Physics, Lucknow University and
3. Dr. S. Krishna, Ph.D., D.Sc., F.I.C., Biochemist Forest Research Institute, Dehra Dun,

was appointed by the Government of India to visit the Bose Research Institute and review its working and suggest necessary changes in the organisation, control and activities of the Institute.

The Committee visited the Bose Institute on January 12th, 13th, 15th, 16th, 17th and 18th 1940.

6. *New constructions*—A new laboratory room on the top of the existing workshop has been constructed, and is being equipped at present. A small air conditioned room is being fitted up for investigations in biochemistry and plant tissue culture.

7. *Co-operation with other scientific institutions*—At the request of the Superintendent Government Chincona Plantation at Mungpoo we are undertaking certain investigations on the acclimatisation of chincona plants in Calcutta and Darjeeling and also in finding a suitable method of vegetative reproduction of chincona plants.

The Institute of Rural Reconstruction, Visva Bharati have requested scientific co-operation of the Bose Institute, in their scheme of afforestation and soil reclamation commenced by them at Surul and its neighbourhood in the Birbhum district.

8. *Research Activities*—

A. In the Department of Plant Physiology and Genetics, investigations have been continued on the results obtained by the application of Auxin to different parts of plants, amongst them on the effect of auxin treatment on the growth and geotropism of the Coleoptile of *Triticum*, and on root formation in *Balsam*. Attempts are being made to find suitable methods of vegetative propagation of important economic plants like Mango, Chincona by auxin treatment. The latter is being undertaken at the suggestion of the Government Chincona Plantation at Mungpoo.

being continued. Marked earliness in the flowering has been observed in samples of wheat subjected to pre and post sowing treatment with light of different periods of duration. Similar experiments are being conducted with rice.

Investigations on the physiology of development and ripening of tropical fruits like mango and guavæ have been undertaken. Interesting preliminary results have been obtained. This year the experiments are being conducted in greater detail. The effect of ethylene vapour and of different gas mixtures on the respiratory behaviour of storage organs of plants are being investigated. These have important bearing on the preservation of tropical fruits.

A series of investigations on the physiology and anatomy of jute plants is being undertaken. Work has so far been done on the growth and development of jute, and also on the carbohydrate and nitrogen assimilation in jute plants. The information so obtained will be useful in connection with future work on manuring and nutrition of jute plants.

In the course of investigations on the growth of potted jute plants, certain pathological symptoms were noticed in the plants, which appear to be due to deficiency in certain trace elements in the soil on which the plants were grown. Investigations have been started on the influence of trace elements boron and manganese on the growth of jute.

Cytological study of microsporeogenesis in jute has been undertaken. Certain investigations were commenced on the effect of colchicine treatment on plant chromosomes; the plants treated were jute seedlings and *Allium*. The work has been temporarily discontinued, as the worker in charge has left the Institute on securing an appointment elsewhere.

The investigations on the growth of root tips in nutrient solutions is being continued. Further work is being done on finding the source of the energy on which the pulsatory activity of *Desmodium gyrans* depends.

B. *Department of Bio and Agricultural Chemistry.*—Investigations on the nutritional value and vitamin content of different Indian food stuffs is being continued. The cultivation of fine varieties of rice from Sikkim and Assam are being successfully continued. Some of the varieties have attracted the attention of cultivators in the neighbourhood of the Experimental Station at Falta, who are trying them on their fields. Wheat is being grown for two years at Falta on rice lands which lie fallow for 6-7 months in the whole of 24-Perganas. Fairly successful results have been obtained. The chemical and mechanical investigations of the soil at Falta is being continued.

of tropical fruits have been commenced. The change in the bioelectric potential of ripening fruits with the activities of the enzymes present in them is being measured. The bioelectric potential is a measure of the ionic permeability of the cell membranes, and its change under the action of ethylene vapour will, it is expected give information on the nature of the action of ethylene vapour on the ripening of fruits. Another worker is engaged in studying the role of phosphorous in carbohydrate metabolism in plants and on the mechanism of synthesis of amino acids in plants.

Work has been commenced on the biochemical activities in filarial tissues in relation to the activities in normal tissues.

C. *Physics*—The investigations on the dispersion of ultra sonic waves in water and salt solutions are being successfully continued. Experimental evidence has been collected which show that, contrary to what has been found by some investigators, there is a measurable dispersion of ultra sonic waves in water. In this connection a theoretical investigation on the absorption of sound waves in liquids has been carried out.

There has been theoretical investigations on the equilibrium of dense stars and on the theory and properties of Mesotrons. A theory has been worked out which appear satisfactorily to account for the origin of colour shown by paramagnetic salts and solutions. The circular dichroism of paramagnetic crystals is being investigated, with a view to obtaining additional confirmation of the above theory.

Investigations on the temperature variation at low temperature of the specific heats of Lanthanum and Neodymium fluorides is being continued. An apparatus has been constructed to measure the low temperature conductivity of these compounds, with a view to determine the low energy levels in these rare earth ions.

In the subject of artificial radioactivity, investigation have been undertaken on the radioactivity of Na^{22} produced by the bombardment by α -particle of Fluorine; an interpretation of $\beta\gamma$ -coupling of radioactive $^{76}_{35}\text{As}$ and the nature of β -ray disintegration has been given. Radioactive organic bromine compounds, which can be used for biological investigations are being prepared. A new method of introducing radioactive halogens in organic compounds has been worked out. Further a study is being made of the nature of chemical exchange in organic compounds by radioactive indicators.

For want of funds we have not been able to increase our supply of radium nor undertake the building up of apparatus for the production of neutrons and artificial radioactive atoms. Progress in the above lines of

An investigation has been carried out on the relative stability of the two isobars, H^3 and 3He , about which there seems to be some variance between experimental results and theoretical calculations.

The investigations of cosmic rays by means of photographic plates kept at Darjeeling and Sandakphu have given definite results. It appears probable that the star like tracks observed on such photographic plates are due to secondary mesotron showers created by high energy primary radiation. Definite results have been obtained which are in agreement with certain theoretical and experimental conclusions of other investigators. This line of investigation is being continued.

The variation of the intensity of thermal neutrons with altitude is being investigated. At present the value of neutron intensity in Calcutta has been measured. Arrangements for the photography of cosmic ray tracks in counter controlled chamber at high elevation is nearing completion.

A theoretical investigation on the reality of the second maximum in Rossi's transition curve has been completed. It is shown that certain contradictory conclusions about the existence of the second maximum obtained by observers using three respectively fourfold coincidence counters, can be explained as being due to the geometrical arrangement of the counter systems.

D. In the department of Anthropology in addition to anthropometric investigations on primitive Indian tribes, work is being commenced on problems of human heredity. Investigations on finger prints with a view to examine its genetic basis, collection of data of pedigrees of various human abnormalities and of statistics of twins, twin births and multiple births have been started.

E. In the department of Zoology investigations are being made on the Bat-eating spiders of Bengal, and on the development of polymorphism in red ants.

Drowning experiments on air breathing fishes have been made. Fish spawns were collected last year from Rupnarayan river and from Shirajgunj. They are being reared and their habits studied.

Sir J. C. Bose Research Fellow in Biophysics is continuing his work on human brain potentials. An air conditioned sound proof room has been constructed and so also a single channel high gain ink recording amplifier. A large number of data has already been collected.

Seminar and Symposium—A physics seminar in co-operation with the Physics and Applied Mathematics Department of the University College of

discussions have taken place, details of which are given in Appendix III. A four days' Symposium was held during the Easter week on the properties of the Mesotron as revealed by Cosmic ray investigations. Many interested workers from other University centres took part in it.

Publications—The Vol. XIII of the Transactions of the Bose Institute has been printed by the Baptist Mission Press during the course of the year. The special grant of Rs. 3000/- for the publication of the Transactions has been discontinued by the Government of India from this year. Without the receipt of a government grant it will not be possible to print all the papers embodying the results of the investigations carried out in this Institute. A number of these papers will be sent out for publications in outside journals.

Library—During the year 40 books and 56 bound volumes of Journals have been added to the library. Due to the outbreak of war, there has been a large decrease in the number of books and journals received since September, 1939. The list of journals subscribed and received in exchange is given in Appendix II:

Mr. Sasi Bhusan Khan B.Sc. officiating librarian has been confirmed in his post.

Workshop—Mr. Nisikanta Baul, Workshop Superintendent who was on sick leave for over a year has resigned. Dr. Jyotiprakas Sircar has been appointed Superintendent in charge of the laboratories and workshops.

Audited Accounts—The audited income and expenditure account of the Institute is given in the following pages. The Institute has received a grant of Rs. 50,000/- from the Government of India for the year 1939-40, which represents a reduction of Rs. 3000/- on the grant which the Institute has received since 1933.

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Income and Expenditure Account

INCOME.	Rs	A. P.	Rs	A. P.	Rs	A. P.
A. Income on Government Grant						
Account—						
Grant from Government of India—						
For Research Work ..	....		50,000	0 0		
Calcutta University's Contribution—						
For works done for them	....		148 14 6		50,148 14 6	
B. Income on Trust Fund						
Account—						
Interest	51,376	0 0				
Add Interest accrued to end of year	12,749	15 8				
	64,125	15 8				
Less Interest accrued last year	12,749	15 8	51,376	0 0		
Dividend						
(for Birla Scholarship) ..	....		1,500	0 0		
Refund of Income Tax ..	....		220	1 0		
House Rent	583	1 0				
Less outstanding last year ..	58	1 0	525	0 0		
Ground Rent	1,820	0 0				
Add outstanding this year ..	130	0 0				
	1,950	0 0				
Less outstanding last year ..	390	0 0	1,560	0 0		
Miscellaneous Receipts ..	....		460 14 3		55,641 15 0	
Amounts transferred from physical & Biological Capital A/c.					4,224 12 0	
TOTAL ..					1,10,015 10 0	

D. M. BOSE,
Director.

A. N. MITTER,
Superintendent.

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INSTITUTE.

for the Year ended 31st March, 1940.

EXPENDITURE.

	Rs	A. P.	Rs	A. P.	Rs	A. P.
<i>A. Expenditure on Government Grant Account—</i>						
Scholarships and Allowances (Director's and Staff's) ..			56,914	11 6		
Wages of Mistries and Servants ..			5,467	9 6		
Provident Fund Contribution ..			2,373	8 6		
Staff Retirement Bonus Fund ..			2,000	0 0		
Laboratory Expenses ..			9,925	2 1		
Purchase of Apparatus ..						
Purchases of Books and Journals ..			4,837	0 6		
Purchases of Furniture ..			1,597	3 3		
Addition to Buildings ..			1,614	11 3		
General Expenses (including Printing, Stationery, Electric, Telephone, Staff's Tiffin, etc.) ..			6,048	4 0		
Sir J. C. Bose Memorial Lecture ..			3,128	8 8		
Travelling and Conveyance ..			250	0 0		
Rents, Rates and Taxes ..			1,024	1 9		
Repairs to Buildings, etc. ..			757	0 9		
			5,274	10 0		
			1,01,212	7 9	50,148	14 6
Less Deficit recouped from Trust Fund ..			51,063	9 3		
<i>B. Expenditure on Trust Fund Account—</i>						
Birla Scholarship ..			900	0 0		
Bank Charges, Renewal Fees, etc. ..			137	14 4		
Income Tax Deduction ..			494	4 0		
Depreciation ..			21,368	3 0		
Deficit on Govt. Grant a/c. as above ..	51,063	9 3				
Less Capital Expenditure ..	14,097	3 0	36,966	6 3	59,866	11 7
Balance carried to Balance sheet ..					Nil	
TOTAL ..					1,10,015	10 1

Examined and found correct.

Balance Sheet as at 31st

LIABILITIES.				Rs	A. P.	Rs	A. P.
<i>Liability for Unpaid Salaries—</i>							
As per last Balance Sheet	..	..		574	13 6		
Less paid this year	..	..		420	0 0	154	13 6
<i>Provision for Contingent Liabilities</i>				....		4,257	0 0
<i>Staff Retirement Bonus Fund—</i>							
As per last Balance Sheet	..	6,500/-					
Addition this year	..	2,000/-					
				8,500	0 0		
Less paid this year	..			5,000	0 0	3,500	0 0
<i>Investment Fluctuation Fund</i>				....		1,29,104	5 7
<i>Sir J. C. Bose Research Scholarship Fund—</i>							
Capital amount	..			50,000	0 0		
Interest realised during the year	..			437	8 0	50,437	8 0
<i>Physical and Biological Dept. Capital a/c.</i>							
As per last Balance Sheet	..			10,000	0 0		
Less transferred to Income and Expenditure a/c.	..			4,224	12 4	5,775	3 8
<i>Donations—</i>							
As per last Balance Sheet	..			....		11,03,165	12 5
<i>Amount Accumulated for Trust Fund—</i>							
During 22 years (1917-39)	..			4,67,335	4 3		
Add Balance of Incomes and Expenditure Account for 1939-40	..			Nil		4,67,335	4 3
TOTAL ..						17,63,729	15 5

D. M. BOSE,
Director.

A. N. MITTER,
Superintendent.

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INSTITUTE.

March, 1940.

ASSETS.	Rs	A. P.	Rs	A. P.	Rs	A. P.
<i>Fixed Assets—</i> (As per statement annexed)						
<i>Land—</i>						
At Calcutta	1,65,613	0 0				
At Darjeeling	16,000	0 0	1,81,613	0 0		
<i>Buildings—</i>						
At Calcutta	2,33,118	0 0				
At Darjeeling	20,614	0 0				
At Falta	34,731	0 0	2,88,463	0 0		
<i>Furniture and Fixtures</i>						
	.....		9,535	0 0		
<i>Apparatus</i>						
	.....		23,114	0 0		
<i>Books and Journals</i>						
	.....		8,655	0 0	5,11,330	0 0
<i>Investments—</i>						
Rs. 12,09,200 3½% G. P. Notes (of which, 8,000/- with A. G. B.) ..			9,44,574	6 4		
„ 1,35,100 4% Govt. Loans ..			1,27,585	1 0		
„ 70,000 4½% Govt. Loans ..			66,450	12 6		
„ 10,000 5% Govt. Loans ..			9,787	8 5		
„ 20,000 7½% Preference Shares ..			20,000	0 0		
					11,68,397	12 3
<i>Interest Accrued on Investments</i> ..	.....		.....		12,749	15 8
<i>Sir J. C. Bose Research Scholarship Trust Fund—</i>						
Rs. 50,000 3½% G. P. Notes .. ..	.....				50,000	0 0
<i>Ground Rent Outstanding</i> .. ..	.....				130	0 0
<i>Security Deposit</i> .. ..	.....				50	0 0
<i>Advance to Scholar (for Foreign Education)</i> .. ..	.....				775	0 0
<i>Cash—</i>						
<i>Trust Fund Account at Bank</i> ..	.....		18,776	6 0		
<i>Establishment Account in hand and at Bank</i> .. ..	.....		1,470	13 6	20,247	3 6
TOTAL ..	.....		.....		17,63,729	15 5

We have examined the above Balance Sheet of the Bose Institute and beg to report that the same is correctly stated according to the best of our information and the explanations given to us and as shown by the books of account of the Institute. We have also verified the Investments with the Bankers' lodgment certificates.

P. K. GHOSH & Co.,

Chartered Accountants (Lond.)

BOSE INSTITUTE.

Re: Balance Sheet as at 31st March, 1940.

STATEMENT showing how the values of the FIXED ASSETS have been arrived at.

	Revolution price at 31-3-31 after adjust- ment of additions and sales to 31-3-39		Additions (Capital Expenditure) in 1939-40.		Total Gross Value at 31-3-40.		Depreciation to 31-3-39.		Depreciation for 1939-40 and rates thereof.		Total Depreciation 31-3-40.		Net Balance at 31-3-40 (as shown in annexed Balance Sheet).		
	Rs.	A. P.	Rs.	A. P.	Rs.	A. P.	Rs.	A. P.	Rs.	A. P.	Rs.	A. P.	Rs.	A. P.	
..	1,65,613	0 0	....		1,65,613	0 0	....				....		1,65,613	0 0	
..	16,000	0 0	....		16,000	0 0	....				....		16,000	0 0	
..	2,83,572	0 0	6,048	4 0	2,39,620	4 0	50,710	0 0	(2%)	5,792	4 0	56,502	4 0	2,33,118	0 0
ng	27,566	0 0	....		27,566	0 0	6,125	0 0	(3%)	827	0 0	6,952	0 0	20,614	0 0
..	49,992	0 0	....		49,992	0 0	13,261	0 0	(4%)	2,000	0 0	15,261	0 0	34,731	0 0
ures	17,401	2 0	1,614	11 3	19,015	13 3	8,530	2 0	(5%)	950	11 3	9,480	13 3	9,535	0 0
ding insti- ..	66,977	14 9	4,837	0 6	71,814	15 3	39,724	14 9	(12½%)	8,976	0 6	48,700	15 3	23,114	0 0
ex- hed ..	20,991	8 9	1,597	3 3	22,588	12 0	11,111	8 9	(12½%)	2,822	3 3	13,933	12 0	8,655	0 0
L ..	6,48,113	9 6	14,097	3 0	6,62,210	12 6	1,29,462	9 6		21,368	3 0	1,50,830	12 6	5,11,380	0 0

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The Annual Meeting of the Governing Body of the Bose Research Institute was held on Thursday the 2nd May, 1940 at the Bose Institution at 6 P.M.

Present—

Principal B. M. Sen (in the chair)
Lady Abala Bose
Mr. S. M. Bose
Mr. S. K. Mandal
Prof. N. C. Nag
Mr. A. N. Mitter
Dr. D. M. Bose

Read letters from Mr. J. N. Basu and Principal P. Parija regretting for unavoidable reasons their inability to be present at the Annual Meeting.

Mr. A. N. Mitter presented the audited accounts for the year 1939-40.

Resolved that the audited accounts be passed.

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APPENDIX I

ABSTRACT OF PAPERS AND REPORTS

A. Department of Plant Physiology and Genetics.

1. Effect of high concentration Auxin on the Growth and Geotropism of the Coleoptile (Triticum). By A. GUHA & B. K. DUTT (Trans. Bose Inst., Vol. XIII).

It has been conclusively proved that the treated auxin itself does not react on growth; it only attracts the growth substance normally present in the plant towards the point of its application and the accumulation or withdrawal of growth substance at or from the growing region is responsible for the changes in the growth and geotropism of the organ.

2. Study of the Effect of High Concentration Auxin on the Root Formation in Balsam. By A. GUHA THAKURTA and B. K. DUTT.

It has been found in Balsam that root is formed at the treated region within 4 or 5 days. It has been shown that rooting occurs due to the accumulation of the root forming substance present in the plant at the treated region. The chemical changes in relation to carbohydrates occurring at the treated region has also been investigated.

Attempt is being made to introduce an easier and better substitute for propagation of mango other than the present method of inarching. In some preliminary experiments rooting has occurred in the ring grafts within 6 weeks by the treatment with 1% indole acetic acid. The work is being further continued. (A preliminary note has been published in the Current Science, Vol. IX, 1940.)

3. Investigation on the Parthenogenetic Fruit Setting by Auxin Treatment. By A. GUHA THAKURTA and B. K. DUTT.

Different concentrations of various synthetic growth producing substances are being tried on different kinds of flowers in order to find out which particular substance and its concentration is suitable for fruit setting in each of them.

The difference between the normal and the parthenocarpic fruits as regards to their growth, size and internal compositions will also be investigated.

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Hormone extraction from both normal and etiolated plants has been undertaken with a view to finding out the difference in the hormone content between the normal and the etiolated plants.

4. Automatic Pulsation in *Desmodium Gyans*. By A. GUHA THAKURTA and B. K. DUTT.

Attempt is being made to record photographically the diurnal changes of the *Desmodium* pulsation under various conditions of environment and also of maturity of the leaf; the aim is to investigate the mechanism of energy absorption and its conservation in these plants on which the pulsatory activity and its maintenance depend.

Investigation on the viability of Jute seeds stored at different temperature and humidity conditions has been undertaken and the corresponding changes of respiration will also be studied throughout the year.

Attempt is being made to acclimatise *Cinchona* plant in Lower Bengal, and to find out a suitable method of vegetative propagation of the same.

5. Deficiency of certain trace elements and their toxic effects. By B. K. Palit.

In the course of investigation on potted specimens of Jute (*capsularis*) plants kept inside and outside a glass house certain pathological symptoms in the plants were noticed.

These are probably due to deficiency of certain trace elements in the soil in which the plants are grown. To study the effect of these trace elements on the growth of Jute plants the following investigations are being undertaken. The plants are grown in glazed pots in sand culture to which definite amounts of boron and manganese will either be added or withheld.

6. Investigations in the physiology of development and ripening of tropical fruits. By B. K. KAR and H. K. BANERJEE.

I. Effect of ethylene on *Mangifera indica* (Nature, Vol. 144, 597, 1939.)

The variations in the chemical changes of the respirable substrate accompanying the process of fruit development and ripening in tropical fruits has been studied in the case of *Mangifera indica*. The presence of

II. The available substrate in the different stages of a developing fruit of *Pisidium guavæ* and its behaviour under different conditions of storage, by B. K. Kar and H. K. Banerjee.

Different samples from the earliest to the fully matured and ripened fruits were collected during the growing season of *Pisidium guavæ*. The analysis of the chemical constituents of the fruit at different stages of growth reveal that in the early stages the protein content of the fruit is very high with lower carbohydrate content. As the fruit matures the protein content is gradually depleted while starch and sugar content increases to a certain stage and then starch disappears but sugar continues to increase. The effect of ethylene vapour on the fruit is different according to the stage in which it is taken and on the available substrate of the fruit.

7. Vernalisation of Indian Crops. By B. K. KAR.
(To appear shortly in the Current Science.)

This paper gives an account of some experiments undertaken to vernalise (accelerate the flowering date) of wheat by means of pre and post sowing thermal and photo treatment. While no earliness in ear emergence was observed either in cold or warm presowing treatment, a marked earliness of flowering sets in as a result of supplemented postsowing photo periodic treatments, being 6 days for 24 hours and 12 hours periods and no earliness for six hours periods. For plants vernalised in light and subjected to post sowing photo periodic treatment, the earliness of flowering was 7 and 15 days for 12 hours and 24 hours periods of treatment. Similar experiments have been commenced on rice plants.

8. A Cytological study of Microsporgogenesis in Jute. By P. J. GREGORY.

The microsporgogenesis of Jute has been investigated and the cytological details of the whole process through the stages of meiosis is described and discussed.

9. On the respiration of plants in different gas mixtures. By J. K. CHOUDHURY.

A study of the effects of different gases and gas mixtures on the respiratory behaviour of plants and plant parts has a bearing which is both of academic interest, as well as of practical utility. In recent years investigations on these lines have yielded results which are of immense importance for the preservation of perishable food stuff. Work on these lines was started at the University of Birmingham. (Re. Proc. Roy. Soc. B., 1939) and will be continued in this Institute as soon as some of the appliances necessary are available. At present they are being made at the workshop of the Institute and are undergoing preliminary trials.

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10. Growth and development of the Jute plant. By J. K. CHOUDHURY and B. K. PALIT.

Records have been taken by direct measurements in the field at regular intervals, of the growth and development of the plants, their successive internodes and leaves from the very early seedling stage to the mature flowering and fruiting stage. Daily records were also taken of the total heights together with the course of the growth followed by the 'growth recorder' devised by the late Sir J. C. Bose. Periodicity of growth has been observed with about six pulses in 24 hours. These data have been correlated with the records taken of the increase in dry weight of the plants (separately into parts of leaves and stems).

These studies of the physiology of growth of the plants, if extended suitably, may prove to be of importance in defining factors which determine differences in yield of the fibre.

11. On the carbohydrate and nitrogen metabolism of the Jute plant. By J. K. CHOUHURY and K. N. BOSE.

Samples of leaves and stems were collected at regular intervals throughout the life of the plant and their carbohydrate content (separately into fractions of mono-, di-, and poly-saccharides) and the total nitrogen content determined.

The problem connected with the translocation of the carbohydrate and nitrogenous compounds also engaged our attention and were followed by "ringing" experiments and subsequent chemical analysis.

The investigations mentioned above, were undertaken to get some information about the metabolic behaviour of the plant and thus to understand its general physiology. This knowledge may be of great help in future work in nutrition and manuring, which we propose to undertake at an early opportunity.

B. Department of Bio-and Agricultural Chemistry.

12. Cell Activity and Enzymes of Tropical Fruits. By H. K. BANERJEE.

The metabolic activity during the 'climacteric' phase in the ripening tomato was indicated by a rapid rise in its bio-electric potential as measured by a potentiometer. It is found that this phase is marked by a rapid rise in the catalase activity in the fruit. Oxidase and peroxidase activity was found practically unchanged, but amylase activity showed an upward tendency.

With the onset of ripening (post climacteric) the potential came down

Parallel to this electric behaviour of the fruit, the catalase activity also declined so that there was definite correlation between the catalase activity and the bioelectric potential in the fruit, as indices of its vitality.

Similar studies are being continued in the case of mango. Catalase, peroxidase, amylase and phosphatase activities of the fruit have been traced from the flowering stage and will be continued till ripening and death.

From the work already done regarding the enhancement of ripening of fruits by artificial chemical methods such as treatment with ethylene, it appears that the action is purely physical to start with. It involves diminution of organisation-resistance which is the hindrance offered by the protoplasmic membrane to substrate diffusion. The chemicals simply permeate the cell membrane causing such physical changes as are prerequisite to the subsequent train of chemical reactions that take place in ripening. It is proposed to correlate this physical change associated with the difference in permeability of the cell membrane with the chemical change that take place, *e.g.*, change in the activity of the so-called respiratory enzymes, catalase, oxidase, peroxidase and of phosphates which is known to be directly responsible for carbohydrate breakdown and synthesis.

Action current is said to arise as a consequence of changes in the ionic permeability of certain membranes. As a result of these changes ions which were previously unable to diffuse through the membrane became free to do so, and so lead to a change in the bioelectric potential.

Measurement of this change along with permeability measurements will throw definite light on the mechanism of ethylene action on fruits.

13. Phosphorus in carbohydrate metabolism in plants. By N. B. DAS.

Cell free enzymes dephosphorylating α & β glycerophosphate, adenylic acid, pyrophosphate, and hexosemonophosphate have been isolated from pea, bean, cucumber seed as well as from rice and wheat bran. The enzymes occur in different organs of the plant, such as, in the root, stem and leaves and develop in the course of germination. Their specificity and kinetics have been thoroughly studied.

Glycerophosphate can be synthesised *in vitro* in presence of isolated vegetable enzymes.

Starch is broken down in presence of vegetable enzyme systems forming

14. Mechanism of synthesis of Amino acids in plants. By N. B. DAS.

In presence of isolated vegetable enzyme systems glutaminic and aspartic acids have been found to donate their amino groups to α -ketonic acids synthesising corresponding α -amino acids, while ketoglutaric and oxalacetic acids respectively are formed. This reaction occurs in different organs of the plant, such as, in the root, stem and leaves and in most cases glutaminic acid is more active than aspartic acid. Asparagine also caused this reaction in some cases, probably due to the presence of asparaginase in those enzyme preparations.

As it is known that only glutaminic and aspartic acids are synthesised by reductive fixation of ammonia on to α -ketoglutaric and oxalacetic acids respectively and they have been found to donate their amino groups to α -ketonic acids, formed in the course of metabolism, it is concluded that this is a general mechanism of synthesis of amino acids in plants when nitrogen is available in the form of ammonia.

15. Researches on filarial tissue. By N. B. DAS.

Catalase content of filarial tissue seems to be less than that of normal-tissue which might suggest some pathological complications. Phosphatases are also present in filarial tissue but no aminating enzyme seems to occur. A rich pinkish yellow colouring matter has been isolated from filarial tissue and attempts are being made to isolate it.

Erythrocytes of both filarial and normal blood attack β glycerophosphate liberating inorganic phosphate. In case of filarial erythrocytes the optimum alkaline hydrogen ion concentration seems to have shifted to more alkaline side, that is, from pH 8.3 to pH 9.3.

16. A study of the changes of nitrogen and other minerals in the paddy soil at Falta. By A. K. PAIN.

A change of nitrogen content in the soil of the paddy field at Falta was noticed from time to time. The present investigation was started with a view to study the actual process of the changes of nitrogen in the soil.

Rice was cultivated in three experimental plots adding green manure (Dhanicha plant) in one and Ganges water and silt in the second; the third was kept as control and rice grown without adding anything. Soil samples were taken out from each plot at regular intervals and organic and inorganic nitrogen was estimated. This was continued till the land become dry after harvest.

control. The chemical analysis of the universal contents of the soil was carried out during the growth.

17. Some feeding experiments with Mutur (*Pisum Sativum*). By A. K. PAIN.

In a previous paper (Nag and Pain, 'Nutrition Experiment with the Indian foodstuff *Pisum sativum*. Trans. Bose Res. Inst., Vol. XI, 1935-36) it has been shown that rat fed on Mutur diet are unable to discharge the function of procreation. This present investigation was taken up to find out whether the function of procreation in rats permanently stopped when fed with Mutur. Several rats were given diet of Mutur and Milk. It was found that rats gave birth to young ones in the normal course with this diet but young rats did not survive more than three weeks after their birth. The cause of death might be due to the presence of some toxic substance in Mutur. Attempts have been made to separate the toxic principle with several organic solvents. No definite results have yet been obtained and the problem is under further experimental observation.

18. Some field experiments with "Kala Nunia", Gauhati and Brimful paddy and wheat. By A. K. PAIN.

Kala Nunia rice is a black, fine, scented variety of rice which grow in the Jalpaiguri district. We cultivated this rice in the Falta Agriculture field station and got satisfactory results in yield and quality. This had grown so very well that it attracted the attention of local cultivators, several of whom took samples of this rice for cultivation in their lands. Chemical analyses of the soil and rice were carried out.

Two varieties of rice from Gauhati were cultivated at Falta. Both the varieties are hardy and can grow with little moisture in the land. The results of yield and quality are satisfactory. Chemical analyses of soil and rice were carried out.

Brimful rice was cultivated from the seeds obtained from the Falta grown paddy of 1939. The plants thrive well and the quality remained like the original Darjeeling rice.

In the 24-Perganas the rice fields are left fallow for 6-7 months in the year after the harvesting of rice. Attempt has been made during the last two years to grow in such fields in the Falta Agricultural station, a wheat crop after the rice has been harvested. The wheat takes four months to ripen

C. *Department of Physics.*

19. On the colour of paramagnetic ions in solutions. II. Fine structure of the absorption bands. By D. M. BOSE and P. C. MUKHERJI.
(Indian Journal of Physics XIII, 1939).

In a previous paper the number and positions of the principal absorption bands of paramagnetic ions in solution were found to be capable of being accounted for by means of an empirical formula proposed by the authors.

Most of the bands were found to consist of doublets, whose frequency difference was of the order of 2000 cm^{-1} for the D-ions and of the order of 750 cm^{-1} for the F-ions.

In the present paper the doublet structure is accounted for as due to the presence of a superposed field of trigonal symmetry round the paramagnetic ions which is supposed to be due to the directed positions of the anions with respect to the cations in solution.

The splitting is found to be of the same order of magnitude as that calculated by Van Vleck for the D- and F-ions due to a trigonal field present in the alums containing these ions.

20. Origin of the crystalline field acting on paramagnetic ions in hydrated crystals and aqueous solution. By D. M. BOSE (Trans. Bose Institute Vol. XIII).

In this paper is discussed the assumptions about the origin of the crystalline field proposed respectively by Van Vleck and by the present writer, to account for the magnetic and optical properties of hydrated crystals and solutions containing paramagnetic ions, with incomplete 'd' shells.

The advantages and drawbacks of Van Vleck's theory are discussed. The cubic field assumed by the former to be acting on the paramagnetic ion is due primarily to the complete orientation of the six dipole water molecules; this effect is assumed to be independent of the ionic charges. This assumption is shown to ignore the equally important contribution to the field due to the induced polarisation of these molecules which is proportional to the ionic charge. Further in this theory the orbital number L of the ion ceases to be a significant quantum number in the cubic field.

In the model proposed by the writer the field acting on the ion is due both to the orientation and induced polarisation of the association molecules. In such a field the degenerate electric moment of the ion is split up into $L+1$ levels, transitions between the ground and the excited levels give rise

frequencies of the ion associated with water and ammonia molecules to a fair degree of approximation.

21. Origin of colour of paramagnetic salts and solutions.

Presidential address delivered by Dr. D. M. Bose at the 6th Annual Meeting of the Indian Physical Society published in *Indian Journal of Physics*, Vol. XIII, Part VI.

22. Photographic plates as detectors of Mesotron showers. By D. M. BOSE and B. CHOWDHURY.

During the last two years a series of investigations have been undertaken on the effect of cosmic radiation on treated and untreated photographic plates. In a paper which will appear shortly, is reported the results obtained by exposing to cosmic rays for five months untreated Ilford New Halftone plates kept at Sandakphu Dak Bungalow (12000 ft. elevation) and at Darjeeling (Mayapuri Research station 7000 ft.). Many single and multiple star like tracks were obtained. It is shown that the observed effect can be satisfactorily explained on the assumption that these tracks are due to secondary mesotrons produced by the close inter-action of primary cosmic ray entities with nuclear protons and neutrons.

23. The Radioactivity of Na^{22} from Fluorine bombarded by Polonium particles. By N. K. SAHA.

A polonium source of α -particles has been prepared from some spent radon tubes by the method of purely chemical deposition with chemical purification. Radioactive Na^{22} has been produced by irradiation of a Fluorspar crystal by means of the Po- α -particles. Using a carefully set up and calibrated point-counter the half life of the positron activity of Na^{22} has been estimated at 2.8 ± 0.5 years. By means of absorption methods the maximum energy of the positrons from Na^{22} has been determined to be 0.61 ± 0.03 M.e.v.

From a plot of the relevant Sargent curve the spin change in the positron transition of Na^{22} is obtained as 2. Importance of this finding in relation to K-capture in Na^{22} is discussed. The absolute positron yield of Na^{22} is calculated and its significance in relation to the branched reactions (α, p), (α, n) of Fluorine is discussed.

24. A note on the Relative Stability of ${}^1\text{H}^3$ and ${}^2\text{He}^3$. By N. K. Saha and R. C. Majumdar.

It is shown that the usual criteria for the relative stability of neighbour-

neutron being heavier than the proton) and hence a relative instability. Whereas, the presence of two protons in ${}^3_2\text{He}$ brings into play a Coulomb repulsion force in ${}^3_2\text{He}$ and makes it unstable. These two competing factors almost balance each other in this pair and makes it probable that both of these are stable nuclei. A scrutiny of nuclear mass data shows that this is almost a unique situation for ${}^3_1\text{H}$ and ${}^3_2\text{He}$.

25. Nuclear Isomerism of Br^{80} . By N. K. Saha.

The two isomers (18 mn. and 4.2 hrs.) of Br^{80} have been produced by slow neutrons bombardment of Bromine. The active residue has been concentrated by chemical method. The limits of the β -ray spectrum of the two isomers are being studied, which will throw light on the nature of the Br-isomers.

By using neutrons of different energies for the activation of the isomers, the genetic relation between the two isomers, as foreshadowed by the chemical methods of Segre, will be studied.

A 'Zaponised' thin walled Aluminium tube counter is being used for this purpose, which is proving satisfactory.

26. On the Interpretation of $\beta\gamma$ -ray Coupling of Radioactive ${}^{76}_{33}\text{As}$ and the Nature of β -ray Disintegration. By N. K. Saha. (*Trans. Bose Inst.*, Vol. XIII.)

The β -ray spectrum of As^{76} as observed by Harteck, Knauer and Schaeffer is analysed according to the Fermi-theory of disintegration. The analysis shows that the spectrum is a composite of three elementary partial spectra with upper limits at 0.8; 1.7 and 2.5 Mev, the first two being due to the transitions of As^{76} to two excited states of Se^{76} and the third to its ground state. The two excited states of Se^{76} arrived at in this way explain successfully the results of Norling on the $\beta\gamma$ -coupling in radioactive As^{76} and also the latest cloud-chamber observations of Schaeffer and Harteck on this. The standing difficulty of reconciling these results with the one excited level picture of Se^{76} as obtained from the Konopinski-Uhlenbeck analysis of As^{76} spectrum is thus removed.

27. The meson and its transformation into heavy particle. By R. C. Majumdar and D. S. Kothari. (*Nature* 143, 796, 1939.)

28. On the equilibrium of dense stars. By R. C. Majumdar. (*Comm. Inst. Sci.*)

29. On the Theory and Properties of Mesotron. By R. C. Majumdar.
(*Trans. Bose Res. Inst.*, Vol. XIII).

An elementary analysis of the theory and properties of meson is given. In the first part the theory of meson and its bearing on nuclear physics are discussed. In the second part the various effects produced by meson in passing through matter are discussed in reference to cosmic ray observations.

30. On the second maximum of the Rossi curve. By A. K. Dutta. (Will appear in the next issue of the *Indian Journal of Physics*).

This paper deals with the experimental observation that while the second maximum of Rossi's curve has been observed by most workers using the threefold coincidence system of counting, it has not been clearly observed in a fourfold counting system. These results have been explained on the geometrical considerations of the threefold and fourfold coincidence systems. The main points suggested in the paper has been recently corroborated by a recent experimental work on the second maximum of the Rossi curve by P. N. De Voss.

31. Dispersion of supersonic waves in water and salt solutions. By A. K. Dutta and B. B. Ghose.

As a result of experimental investigations by one of us carried out in Germany it was suggested that supersonic waves are dispersed in water. Since then some other workers have reported that they could not detect the dispersion. With a view finally to decide the question, the experiment has been repeated in the Institute with all possible precautions. The results so far obtained definitely show the dispersion of the waves in water, the amount of dispersion agreeing with the value obtained in Germany. Study of the change of the dispersion effect with temperature is in project, and will be undertaken soon. Such investigation will likely place the ultra sonic dispersion effect on surer and undisputable grounds.

A programme of work on the dispersion of supersonic waves in salt solutions is being carried out at present. From the meagre amount of data so far obtained the results appear to be very interesting. It lends support to the view that there exists a dispersion in the case of pure water which is affected by the presence of salt in the solution.

32. Measurement of the intensity of thermal neutrons in the atmosphere at the sea-level. By S. D. Chatterjee.

The intensity has been measured by means of boron-lined proportional counter tubes and also with tubes filled with a mixture of BF_3 and Argon.

Darjeeling, in order to determine the variation of the neutron component of the cosmic rays with altitude.

33. Preparation of Radioactive organic Bromo-compounds. By S. D. Chatterjee.

Recently attention has been drawn to the preparation of radioactive organic Bromo-compounds by Friedmann and others, which can be used in biological experiments. With a similar aim in view the following experiments have been done

(1) Synthesis of radioactive

(a) Dibromo-oleic acid

(b) Bromo-anisole

(c) p-bromo acetanilide.

The first technique involves the addition of bromine to a double bond while in the others substitution products are obtained. All the compounds have therapeutic values.

(2) Attempts have been made by Brejueva, Roginsky and Schilinsky for introducing radioactive halogen into organic halides by the reaction of organic halides with radioactive aluminium bromide well-known as a halogen catalyst.

We have found that highly enriched radioactive halides can be made directly from the alcohols by using phosphorus tribromide or pentabromide. The latter in its turn is made highly radioactive by shaking it with activated ethyl bromide and then distilling. This is a general method for preparing any kind of radioactive alkyl bromide.

34. Nature of chemical exchange in inorganic compounds. By S. D. Chatterjee.

An attempt to examine the nature of chemical exchange among inorganic compounds by means of radioactive indicator atoms has been made. In the first series of experiments with radioactive iodine, it has been found that complete exchange occurs among ionic inorganic iodides. In some cases, however concentration of activity has been observed. Several chemical exchanges have been studied already. The isotopic distribution is now being studied with special attention to the corrections to be introduced due to absorption etc.

Another experiment has been performed, to show that the bromine atoms in PBr_5 are not equally reactive. Starting with radioactive PBr_5 , decomposition was effected at about 100° when PBr_3 was formed and Br_2

quantity of inactive Br_2 . The net result of these steps indicate that the last added Br_2 does not exchange with the Bromine atoms of PBr_3

35. Study of Cosmic Rays. By M. S. Sinha.

In continuaiton of the previous work on cosmic-rays in a Wilson Cloud chamber, a triple coincidence circuit after Neher's model has been constructed. A stabilizer giving the required counter-voltage has also been prepared according to Neher's method. These can be utilised to operate the cloud chamber, or to study only cosmic ray coincidences at different altitudes.

D. Department of Anthropology. Report of work done by Mr. S. S. Sarkar.

The first few months of the year under review were spent in the Kaiser Wilhelm Institut fur Anthropologie, Berlin, where investigations carried out on the hereditary variations of the last finger phalanx, including the nails and the finger prints, on 100 pairs of German twins and 13 pairs of twin embryos.

After return to India in August 1939 a scheme of work was submitted to the Director suggesting that the activities of this section may be extended to the study of Human Heredity, in addition to the previous programme of studying the dying races of Indian aborigines. The scheme was approved by the Director and preliminary work in this connection is already in progress. A number of pedigrees showing the hereditary abnormalities have been collected and a twin register has been opened. Informations regarding 21 pairs of twins, 2 pairs of triplets and a sextuplet have been gathered.

Papers.

36. A paper "on the Osteology of the Malers" has been completed and will be sent to the press within a few days.
39. The statistical analysis of the Anthropometric data of the Santhals has been completed and the paper is in the process of being written up.
38. The Director of the Kaiser Wilhelm Institut fur Anthropologie has permitted the publication of the paper on the German twins in English and the paper will be ready in course of a few months.

Investigations started.

(1) The collection of the pedigrees of various abnormalities in man has been commenced.

(2) A statistics of twin births, twins, and multiple births is being maintained.

E. Department of Zoology.

39. The Bat-eating spider of Bengal (*Heteropoda venatoria*, Linn). By G. C. Bhattacharyya.

Accidentally a big house spider (*Heteropoda venatoria*, Linn) was observed to be preying upon a small bat, the Indian pipistrelle (*Vesperugo abramus*). This species of spiders generally prey upon cockroaches, (*Blatta orientalis*), crickets and other spiders. The preying, cocooning and fightning habits with scorpions and other spiders have been observed. The aeronautic habits of their young ones have also been studied.

40. Drowning experiments on the air breathing fishes. By G. C. Bhattacharyya.

Experiments on drowning of the air-breathing fishes such as Kai and Singhi were carried out in the laboratory. The specimens were kept under water in two experimental jars through one of which air or oxygen was being pumped. The fishes were prevented access to atmospheric air by means of a wire gauze diaphragm. Starving specimens of Kai collected from the market (which are not kept submerged in water) generally become asphyxiated within 15 to 30 minutes when put under wire gauze while the market Singhi gets drowned within about one to two hours. Normal specimens taken from reservoirs take much longer period to be asphyxiated under similar treatment. Normal Kai taken from reservoir showed signs of excitement after 20 to 30 minutes and succumbed within an hour or more. Singhi is much more resistant than Kai in any condition. Normal Kai and market Kai can sustain their lives in aerated or oxygenated water for about 2 to 3 hours under the wire gauze. Shinghi taken both from market and reservoirs generally showed no signs of excitement even after 4 days. But some of them died within 5 to 6 hours. For further investigations specimens of Kai and Singhi are being reared under different conditions.

41. Development of polymorphism in red ants, (*Ecophylla smaragdina* Fabr.) By G. C. Bhattacharyya.

Different authors have framed very different conceptions of the polymorphism of worker caste of ants. Although the conception of the worker phase as the result of imperfect nutrition is supported by a considerable number of authors, still it is very difficult to understand how this result can take on so highly adaptive a character. However to determine the real cause of polymorphism and the exact role played by the worker ants, entire colonies of aggressive red ants (*Ecophylla smaragdina*, Fabr.) are

seen. It has been observed that the worker ants are reproduced throughout the year in a colony even when in a particular season not a single male or queen could be found in them. With the advent of summer, inspite of the absence of queen, the larvæ of queens begin to appear. Moreover, by dissecting a considerable number of workers, in most cases well-developed ovaries laden with eggs were found. Further investigations are being carried on for the proper elucidation of the fact.

Fish spawn collected from Rupnarayan river and Shirajgunj last year are also being reared and their habits studied.

F. Report of work carried out by Dr. B. K. Bagchi, Sir J. C. Bose Research Fellow in Biophysics of the Calcutta University.

Following are the items of work completed during 1939-1940 in connection with the first project of human electroencephalography inaugurated in this country :—

1. The building of a semi-sound proof, electrically shielded room (8"×8"×8").
2. The building of a suitable one-channel brain potential recording machinery including a four-stage push-pull balanced input, low frequency, high amplification voltage amplifier, a power amplifier and a dynamic ink-writing recorder.
3. The building of a switch board, an intercommunicative system, stimulating devices and some other attachments.
4. The publication of a note in *Science and Culture*, 5, March, 1940, embodying a preliminary report on the alpha index form of Indians, on the effect of light on brain potentials, on the relationship between the latent period and the recovery time, on the evidence of a delayed effect of a lesser stimulus in the presence of a higher excitation level of the brain, and on abnormal brain wave patterns.
5. The publication of a note in *Science and Culture*, 5, September, 1939, pointing out the necessity of the formulation of a third view on the "Origin of Cortical Potentials."
6. The publication of an article, "The Origin and Nature of the Brain Rhythm" in the *Calcutta Medical Journal*, 36, 1939, 334-345, reviewing up to date the status of the whole question mentioned in the title.
7. Up till now over 10,00 ft. of records have been taken off 35 human subjects.
8. Results of research were reported before three scientific bodies.
9. Two articles are in press.

- (b) Electroencephalography and Psychology (*Indian Journal of Psychology* published by the Calcutta University).

The work which is in progress:—

Records are being taken now from the brains of normal and abnormal human beings in connection with the following problems:—

- (a) Alpha index norm from the occiput of human beings (continuation of a previous problem).
- (b) Comparison of per-cent-time-alpha between three regions of the brain.
- (c) The determination of the base line shift index and its implications.
- (d) Evidence of the existence of different excitation levels of the brain as determined by controlled presentations of strong and weak, white and colored lights.
- (e) Certain startle stimuli and E. E. G.
- (f) The effect of denial of a mental choice on E. E. G.
- (g) Brain wave patterns of abnormal cases such as epileptics, insanes, etc.

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APPENDIX II.

List of Journals Subscribed.

1. Current Science.
2. Nature.
3. Science Progress.
4. Physical Review.
5. Reviews of Modern Physics.
6. Review of Scientific Instruments.
7. Journal of Chemical Physics.
8. Journal of Research of National Bureau of Standard.
9. Annals of Botany.
10. American Journal of Physical Anthropology.
11. Biochemical Journal.
12. Journal of Biological Chemistry.
13. Plant Physiology.
14. Biological Abstracts.
15. Man.
16. Science Abstract (A).
17. Zeitschrift fur Physik.
18. Naturwissenschaften.
19. Annals of Eugenics.
20. Botanical Gazette.
21. Indian Journal of Medical Research.
22. Hereditas.
23. Cytologia.
24. Genetics.
25. American Journal of Botany.
26. Physikalische Zeitschrift.
27. New Phytologist.
28. Chemical Abstracts.
29. Journal of Heredity.
30. Journal of Neurophysiology.
31. Zeitschrift fur Rassenkunde.

List of Journals obtained Free or in Exchange.

1. Welsh Journal of Agriculture.

4. Proceedings of Royal Society (B).
5. Journal of Agricultural Research.
6. Journal of General Physiology.
7. Journal of the Franklin Institute.
8. Transactions of the Royal Society (A).
9. Transactions of the Royal Society (B).
10. Science and Culture.
11. Indian Journal of Agriculture Science.
12. Indian Journal of Veterinary Science and Animal Husbandry.
13. Bulletin du Museum National D'Histoire Naturelle, Paris.
14. Lavori del R. Istituto Botanico di Palermo.
15. Annual Reports of the Smithsonian Institute.
16. Journal of the Indian Chemical Society.
17. Journal of the Annamali University.
18. Annals of the Royal Botanic Gardens, Calcutta.

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APPENDIX III.

PHYSICS SEMINAR

Astrophysics.

1. Russell-Diagram and the Chemical composition of stars Dr. R. C. Majumdar.
2. Interstellar matter Prof. M. N. Saha.
3. Thermoneuclear reaction and energy of stars Dr. K. M. Basu.
4. Milkyway and extragalactic Nebulae .. Prof. N. R. Sen.
5. Nova and Supernova Prof. M. N. Saha.
6. Stellar Evolution Dr. R. C. Majumdar.

Cosmic Radiation.

7. Upper air investigation of Cosmic ray intensities Dr. H. V. Neher and
Dr. W. H. Pickering,
California Institute
of Technology.
8. Lecture on Cosmic Rays Prof. R. A. Millikan,
California Institute
of Technology.

Hard Cosmic Ray Showers.

9. The second maximum in the Rossi Transition curve Dr. N. K. Saha.
10. On the nature of shower producing rays .. Dr. N. Das Gupta.
11. Shower secondaries produced by mesotron .. Mr. M. S. Sinha.
12. The theory of Cosmic ray showers produced by electrons and photons (with special reference to counter experiments Prof. M. N. Saha.
13. Influence of geometrical configuration on coincidence numbers and their absorption .. Dr. D. P. Roy-
Chowdhury.
14. Large showers and Cosmic ray Bursts .. Dr. S. C. Sircar.
15. Cloud chamber studies of mesotron .. Mr. K. Mukherjee.
16. Slow mesotron and mesotron pairs .. Dr. A. K. Dutta.
17. Theory of Cosmic ray showers produced by mesotron Dr. R. C. Majumdar.