
REPORT AND ACCOUNTS
OF
BOSE RESEARCH INSTITUTE
1935

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ANNUAL REPORT
OF
BOSE RESEARCH INSTITUTE
1934-35.

DURING the course of the last year various investigations have been carried out in different branches of biophysics, in anthropology and in advanced physics.

The effect of modification of diverse internal activities in the plant in consequence of inflorescence has been studied in the case of *Mimosa pudica*. The changes of internal activity have been measured in their various aspects from the exact determination of the induced variations: in the moto-excitability of the pulvinus; in the latent period; in the apex time; in the amplitude of response as well as in the velocity of transmission of excitation in the conducting tissue of the plant. The various organs were, for this purpose, subjected to a testing stimulus of constant intensity at different periods before and after the appearance of inflorescence. It was thus found that the appearance of inflorescence induces a depression of the moto-excitability of the pulvinus. The fact that the depression is due to the presence of inflorescence is conclusively proved by the restoration to normal moto-excitability of the pulvinus after the removal of flowers. Similarly the latent period, the apex time and the amplitude of response are appropriately modified by the appearance and removal of inflorescence. In regard to the velocity of excitatory impulse in certain conducting tissue in the petiole, quantitative determinations carried out prove that the power of conduction, as measured by the velocity of transmission of excitatory impulse, becomes depressed on the appearance of flowers, the removal of which is followed by restoration of the normal velocity of transmission. It was discovered that the revival of normal activity after removal of inflorescence is not an instantaneous process, but that it attains a maximum value after a certain interval of time. It has also been found that the

bear a relation to the quantity of inflorescence that is formed and removed.

Another series of investigations were carried out to discover the characteristic variation of growth during the life-cycle of a plant. In order to determine the total growth of a plant at any period, it is necessary to determine, not only the longitudinal, but also the diametric rate of growth. It has not hitherto been possible to make simultaneous determinations of these two factors. The difficulties have been removed by the invention of special devices for continuous and automatic records of the two components of growth which are simultaneously obtained. The continuous automatic record reveals the pulsatory nature of longitudinal growth, and its periodic variation in the course of the day and night. This is also true of diametric growth. In taking complete account of the two constituent components of growth, it is found that the activity exhibits a series of growth-waves, the peaks of longitudinal and of diametric growth being more or less coincident.

A very difficult problem is the determination of the actual moment when germination commences inside a seed, as well as the measurement of the rate of growth of the embryonic radicle. This latter, though entirely invisible from outside, has nevertheless been detected and automatically recorded, and the influence of external change on the rate of growth in the interior of the seed exactly determined. The special apparatus devised for the purpose consists of a contrivance for properly holding the seed, a balanced aluminium pan, and an arrangement for recording the movement of growth. In obtaining true record of growth the element of physical expansion of the seed by absorption of water of irrigation has to be eliminated. This difficulty has been successfully overcome. The period of physical expansion or swelling due to absorption of water has been found to last about 2 hours. After the complete cessation of the swelling there is a stationary period which lasts for a little more than an hour, the embryonic growth having not yet been initiated. The actual embryonic growth of the radicle inside the seed is commenced about 3 hours after irrigation and persists at a slow rate for about 10 hours. There is then an abrupt enhancement of the rate of growth of the radicle, this being due to the sudden bursting of the lower end of the seed-coat by the expansive force of growth inside the seed. The removal

about 5 hours. This prolongation is mainly due to the fall of temperature. The process of germination is also found to be attended by changes in the rate of respiration as determined by a specially constructed automatic recorder. The results obtained show that the respiratory activity is absent during the swelling of the seed caused by irrigation, but that it commences at the initiation of germination inside the seed.

Other investigations have been carried out with flowers, with germinating seeds and with a number of animals, for the study of the respiratory process which accompanies the active life-reactions. A special Respirograph has been constructed for this purpose, giving automatic records of the rate of oxygen consumption associated with respiration. This apparatus has been constructed on the principle of the 'Photosynthetic Bubbler' previously devised for certain investigations on carbon assimilation by plants that have been carried out at the Institute. The Respirograph consists of a Respiratory Chamber, a Bubbler, an Oxygen Container and an Automatic Apparatus for record of oxygen consumption for respiration. The decrease of pressure in the Respiratory Chamber, due to absorption of the oxygen for respiration, causes the lifting of a mercury valve, allowing accession of a number of bubbles of oxygen into the chamber the volume of each of which is constant. The rate of passage of successive bubbles of oxygen measures the respiratory activity of the specimen. The Bubbler, provided with an electro-magnetic device, automatically records on a revolving drum the rate of oxygen consumption for respiration. The advantages of the new method are found from the facts: that the respiratory activity is measured directly from the rate of oxygen consumption without the lengthy and labourious process of chemical analysis; that there is a circulatory arrangement by which the percentage of oxygen in the Respiratory Chamber is maintained constant; that provisions are made for ensuring normal pressure in the Respiratory Chamber; that on account of the method being automatic all personal errors of observation are eliminated; that since a relatively short time is required for a complete experiment during which external conditions are maintained constant, the necessity for employment of numerous corrections is rendered quite unnecessary.

characteristic of Vitamin A. Special physiological investigations were also carried out on the propagation of colonies of rats by feeding them with normal *Kabuli chhola meal* and with that from which the oil had been extracted. Under the latter condition, devitaminisation process rapidly sets in culminating in death. But if the deficiency diet be given for not too long a period, then particular doses of *chhola* oil bring about recovery. The effect of different oils in bringing about a cure was also studied and it was found that *Kabuli chhola oil* approaches in vitamin efficiency *Cod Liver Oil* of approved quality. Additional experiments were carried out to find the minimum amount of *Kabuli chhola meal* to prevent deficiency disease in rats. This minimum was determined with considerable accuracy and found to be about 20 per cent. The presence of the antirachitic factor Vitamin D has also been found in *chhola oil*. This was accomplished by giving the experimental rats rachito-genetic diet in which Vitamin D is absent, and then curing the disease by feeding them on *Kabuli chhola wholemeal* or daily doses of *Kabuli chhola oil*. Chemical examination of the bones as well as X-ray photographs afforded satisfactory proof of the efficiency of *Kabuli chhola* in the cure of rachitis. In addition to Vitamin D, the presence of the reproductive factor Vitamin E has also been found in *Kabuli chhola*.

Investigations on the specific bacterial action on saccharine solution of *Gur* have yielded some interesting results. When this solution is inoculated with certain organisms, it becomes converted into a strongly acidic product without any gaseous evolution. A cartilaginous scum is also formed in layers on the surface of the solution. The results of experiments showed that the particular organisms directly produce in the *Gur* solution, Acetic Acid, Lactic Acid, Formic Acid and Acetone without evolution of Carbonic Acid gas, the process being thus unlike that of ordinary fermentation. In regard to the solid film which grows on the surface of the liquid, it has been found to be a carbohydrate, though differing from ordinary cellulose. It has also been observed that the film cannot be formed in an atmosphere of carbon dioxide or of hydrogen. From results of chemical analysis an empirical formula of the substance of the film has been obtained. The particular organisms which bring about the specific reactions are of an aerobic character. By their morphological characteristics and growth in various cultural media, they appear to be very

The Anthropological investigations have been extended in regard to the determination of racial characteristics of the Dravidian-speaking Oraons. The subject has been approached not only through a study of the cranial materials at present available but also through the field study of the characteristic customs, the Oraon women are fond of tatooing, and the men have a series of cicatrization of 'Sika' marks on their left forearm. The Oraons are generally longheaded and found to be more Akrocephalic than the Mundas. In regard to the relation of the Preauricular development of the head with the Postauricular one, as determined by the Meatal Position Index, the Preauricular portion of the head is more developed in the Oraons than in the Mundas; in this respect they differ significantly from the Proto-Australoid type found in the early site of Mohanjodaro. A significant difference between the two tribes is found in the Coefficient of Racial Likeness, due more to marked differences in the face than in the form of the head, as well as in stature. By these characteristic differences an observer is able to distinguish the Oraons from the Mundas.

In the Department of Physics investigations have been carried out on the continuous emission spectra of hydrogen halides and of the flame spectrum of hydrogen. The emission of hydrogen halides has been photographed and found to be continuous with a fixed long wave limit. The predominant continuous regions, which have been ascribed to the normal hydrogen halides do not correspond to dissociation into normal atoms or one normal and one excited atom. Two states of electronic configurations have been obtained and it is shown that while the configuration corresponding to the lower state is stable, that for the higher state is unstable. In regard to the study of the flame spectrum of HCl, it was photographed during the process of burning hydrogen and chlorine. It was observed that this exhibited two sets of continuous spectra which are likely to afford material in accepting one or other of the theories of chain reaction systems proposed by various workers.

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J. C. Bose.

BOSE

INCOME AND

For the year ended

INCOME.		
	Rs. A. P.	Rs. A. P.
A. INCOME ON GOVERNMENT GRANT ACCOUNT—		
Amount of grant from the Government of India for 1934-35—		
For Research Work (including Government Pension of Sir J. C. Bose)	50,000 0 0	
For Publication	3,000 0 0	53,000 0 0
B. INCOME ON TRUST FUND ACCOUNT—		
Interest <i>less</i> Income Tax	50,699 6 3	
Dividend <i>less</i> Income Tax	1,246 1 6	
Refund of Income Tax	13,128 10 0	
House Rent	2,420 0 0	
Ground Rent	1,560 0 0	69,054 1 9

1,22,054 1 9

Central Bank Buildings,
100, Clive Street,
Calcutta.
The 10th April, 1935.

Examined and found correct.

Sd/- P. K. GHOSH,
B.Sc., R.A., F.S.A.A. (Lond.),
Incorporated Accountant,
Auditor.

INSTITUTE

EXPENDITURE ACCOUNT

31st March, 1935.

EXPENDITURE.

A. EXPENDITURE ON GOVERNMENT GRANT ACCOUNT—				Rs.	A. P.	Rs.	A. P.
Scholarships and Allowances—							
Sir J. C. Bose (including Government							
Pension of Rs. 6,600/-)				18,000	0	0	
Staff				37,651	5	3	
				55,651	5	3	
Wages of Mistries and Menials				3,529	5	6	
Provident Fund Contributions				1,461	0	0	
Laboratory Expenses				9,690	14	9	
Purchases of Physical Apparatus				9,242	0	0	
Purchases of Books				2,568	12	9	
Purchases of Furniture				1,317	15	0	
General Charges (including Printing, Stationeries, Telephone, Electric, etc.)				1,681	2	9	
Travelling Expenses				431	15	6	
Rents, Rates and Taxes				2,044	1	6	
Repairs to Buildings				4,590	4	9	
Publication Expenses				3,000	0	0	
				95,208	13	9*	
Less Deficit transferred to Trust Fund Account as below				42,208	13	9	53,000 0 0
B. EXPENDITURE ON TRUST FUND ACCOUNT—							
Scholarships				1,392	0	0	
Legal Expenses				437	10	0	
Bank Charges, Renewal Fees, etc.				254	6	0	
Municipal Taxes				419	6	0	
Reserve for doubtful debt				1,250	0	0	
Depreciation				16,339	11	5	
Deficit on Government Grant Account as above, written off				42,208	13	9	
Less Capital Expenditure transferred to Balance Sheet				13,128	11	9	
				29,080	2	0	49,173 3 5
Balance carried to Balance Sheet							19,880 14 4
							1,22,054 1 9

* N. B.—As is evident from the above account, a sum of Rs. 42,208/13/9 had to be paid out of the Trust Fund to meet the Deficit on the Government Grant Account. The Trust Fund was created by the Founder, Sir J. C. Bose, to ensure the financial stability of the Institute. The condition laid down by him at the time of making over the Fund to the Governing Body of the Institute, was that the income of the Trust Fund should be accumulated until it totals up to a capital amount of Rupees Twenty Lacs as has previously been reported to the Government of India on several occasions.

I have examined the above Balance Sheet and beg to report that such Balance Sheet is correctly stated according to the best of my information and the explanations given to me

INSTITUTE

SHEET

31st March, 1935.

		ASSETS.		Rs. A. P.		Rs. A. P.	
FIXED ASSETS—							
Land							
at Calcutta	1,70,000	0	0				
at Darjeeling	16,000	0	0	1,86,000	0	0	
Buildings at cost less depreciation							
at Calcutta	2,69,020	0	0				
at Darjeeling	24,654	0	0				
at Falta	44,713	0	0	3,38,387	0	0	
Furniture at cost less depreciation					9,213	0	0
Apparatus at cost less breakage and depreciation					16,958	0	0
Physical Apparatus at cost less depreciation					12,074	0	0
(There is a large number of highly specialised instruments manufactured in the institute, the value of which cannot now be determined and is not, therefore, included in above.)							
Books at cost less depreciation					5,475	0	0
						5,68,107	0 0
FLOATING ASSETS—							
Investments (some at face values and others at cost)—							
Rs. 1,08,800 3½% G. P. Notes	1,08,800	0	0				
Rs. 8,40,400 3½% G. P. Notes	5,96,261	14	4				
Rs. 1,35,100 4% Loans	1,27,585	1	0				
Rs. 70,000 4½% Loans	66,450	12	6				
Rs. 1,28,800 5% Loans & Bonds	1,28,587	8	5				
Rs. 48,000 6½% Treas. Bonds	49,165	13	4				
Rs. 20,000 7½% Birla Jute Manufacturing Co. Preference Shares	20,000	0	0	10,96,851	1	7*	
Interest accrued on Investments					10,849	9	0
House and Ground Rents outstanding					1,720	0	0
Deposit for supply of Elec. current					50	0	0
CASH—							
Trust Fund Account at Bank	19,880	3	8				
Establishment Account in hand and at Bank	758	15	3	20,639	2	11	11,30,109 13 6
						16,98,216	13 6

* N. B.—The main source of income of the Trust Fund of the Institute is the Investments shown above. Unless it is possible to gradually increase the Investments, the future stability of the Institute cannot be assured.

Proceedings of the Annual Meeting of the Governing
Body of the Bose Institute, held on the 17th April, 1935,
at 6-30 P. M.

Present :

Sir J. C. Bose (in the chair)
Lady Abala Bose
Mr. K. C. Neogy
Dr. D. M. Bose
Prof. N. C. Nag
Mr. A. N. Mitter
Sir Nilratan Sircar
Mr. S. C. Mookerjee
Mr. J. N. Basu
Mr. S. M. Bose

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Mr. A. N. Mitter laid on the table the audited account for the year ending 31st March, 1935 and the Draft Budget for 1935-36. Resolved that the Account and the Budget as amended be approved and passed.

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