

BOSE RESEARCH INSTITUTE

ANNUAL REPORT
and
ACCOUNTS

For the Year 1943-44

Scanned by Lib. GmL

REPORT OF THE GOVERNING BODY OF THE BOSE INSTITUTE FOR THE YEAR 1943-44.

Governing Body—During the past year two valued members of the Governing Body passed away. Sir Nilratan Sircar was a foundation member of the Governing Body and a life long friend of the founder of the Institute. His great attainments and wide experiences were of invaluable service in the conduct of the affairs of the Institute.

Mr. Ranajit Ray was the youngest member of the Governing Body. During the short period of his membership he had greatly assisted in the deliberations of the Governing Body by his practical ability and judgement.

Mr. Surendra Mohan Bose of the Bengal Waterproof & Co. has been elected a member of the Governing Body.

Four meetings of the Governing Body were held during the year. As a result of negotiations with the Central Government agreement has been reached on the conditions under which a Government grant will be available and also on the amount of the grant. The draft Regulations and Bye laws which were sent to the Department of Education, Health and Lands in December 1942 are still under the consideration of the Government of India.

Lectures—The fifth Sir J. C. Bose Memorial Lecture was delivered by Sir Cyril Fox, late Director, Geological Survey of India, on November 30th, 1943. The subject of his lecture was 'The Scientific and Industrial Response in our Fossil Flora'.

Prof. A. V. Hill, Secretary, Royal Society delivered a lecture 'On the measurement of heat developed in muscles and nerves' in the hall of the Institute, under the auspices of the Physiological Society of India. Prof. Hill also visited the laboratories of the Institute on another afternoon and met the members of the Governing Body and the Staff of the Institute at tea.

Outside schemes of research—The following schemes of research are being undertaken from grants received from outside bodies:

I. Under grants received from the B.S.I.R. (i) On the setting up of a powerful generator of ultrasonic waves and (ii) On the testing and cutting of quartz plates for the radio industry.

II. Under grants received from the Bengal Immunity Co. Ltd. (i) Applied research in Microbiology and (ii) Research on the vernalization of Paddy in Bengal.

The second scheme of research subsidized by the Bengal Immunity Co. is entirely for the purpose of public utility. The public spirit shown by the Company is highly to be commended.

Research Projects—A scheme of research, on the breeding of long stapled cotton suited for growth in the deltaic areas of Bengal, which was sent to the Provincial Cotton Subcommittee, Bengal, has been forwarded by them

Staff—The following changes in the research staff have occurred during the past year.

Dr. H. K. Banerjee, Research Fellow in Biochemistry has been appointed Industrial Planning officer, Government Medical Stores, Bombay.

Mr. A. K. Pain, Research Scholar in Biochemistry has been appointed Biochemist, Central Sericulture Research Station, Berhampore.

Mr. M. S. Sinha, Research Scholar in Physics has been awarded a Studentship in the Indian Institute of Science, Cosmic Ray Unit, Bangalore.

The section of Theoretical Physics was closed down and a new one in Microbiology opened during the past year.

Dr. H. K. Baruah, PH.D. (Cantab), has been appointed Research Fellow in Microbiology.

Nripendra Nath Pal, M.Sc. and P. C. Mukherji, M.Sc., P.R.S. were appointed Research Assistants under the B.S.I.R. Research Scheme.

P. N. Nandi, M.Sc., Bibhuti Bhushan Sen Gupta, M.Sc. and Arun Bikash Bose, M.Sc. have been appointed as Supervisor, Research Assistant and Scholar under the Bengal Immunity Research Scheme.

Dr. Basudev Banerjee, PH.D. (Munich) continues to work as Sir J. C. Bose Research Fellow of the Calcutta University.

Amiya Kumar Adhikary, M.Sc. and Jayanta Kumar Ganguly, M.Sc. were appointed Sir J. C. Bose Research Scholars.

Prof. Haraprasad De, M.Sc., P.R.S. of Vidyasagar College, Dr. J. K. Choudhury, PH.D. of Bethune College, Mrs. Parukutti Baruah, M.Sc. and Miss Tharakan, M.Sc. of the Lady Brabourne College continue to work as Honorary Research workers.

War Emergency Measures—Dearness allowances amounting to about Rs. 950/- have been granted to the subordinate and menial staff of the Institute, and approximately Rs. 3,000/- has been spent in supplying foodstuff at reduced rates to members of the staff.

A scheme of dearness allowances to members of the staff drawing salaries upto Rs. 150/- per month and on the scale sanctioned by the Government has been approved by the Governing Body. The additional cost involved will come upto about Rs. 5,400/- per annum, and the scheme will be put into effect after it has been ascertained that the Central Government will make a suitable contribution towards its cost.

The house which was taken on lease in Santipore, for the storing of valuable apparatus and the library of the Institute, will be given up when the present lease expires on May 31st, 1944. Arrangements have been made for bringing back the stored articles.

Research activities—The work of the Institute, like that of other research institutions, is being greatly hampered by the growing difficulty in securing photographic materials, glass goods and chemicals, chiefly organic chemicals. Attempts are being made to prepare some of the chemicals required for biological investigations from simpler starting materials, from directions given in scientific literature. Many of the organic solvents necessary are either

Institute. Some photographs of special interest, obtained during the course of this investigation, have been published in the 'Physical Review' and in 'Nature'. Recently Heitler, Hamilton and Peng have published a comprehensive theory of the origin of the cosmic ray meson spectra. The theory proposes to give a connected account of cosmic ray and nuclear phenomena. For this purpose they select the theory of Möller and Rosenfeld, in which it is assumed that vector and pseudoscalar mesons exist and also neutral mesons.

Some of the results obtained in this laboratory are found to agree with the predictions of the theory. These include (i) the occurrence of a maximum in the multiple spectra produced in photographic plates for a multiplicity of $n=3$, corresponding to a total meson energy $\epsilon=3 \cdot 10^8$ eV, (ii) the intimate correlation which exists between the multiple meson spectra in photographic emulsion, which cease for $n>7$, and the maximum frequency of single meson spectra for $\epsilon=8 \cdot 10^8$ eV, in Wilson chamber meson tracks. This indicates that single high energy meson can produce multiple mesons by nuclear scattering, and the probability of occurrence is vanishingly small for $n>7$; (iii) occurrence of cascade production of mesons and (iv) the occurrence of burst in air.

The investigations with the Wilson chamber photographs are being continued, to verify and extend the results obtained with lead absorbers, with other absorbers like iron, carbon etc.

Difficulty is being met with in obtaining photographic plates from England suited for cosmic ray investigations. A second batch of plates exposed under different thicknesses of Pb. to cosmic rays at Sandakphu are now being examined. Another batch of plates has been sent to Sandakphu for exposure under carbon. It is expected that a comparison of the absorption of the primary effective cosmic rays under equivalent thicknesses of air, water, paraffin, carbon and lead, will provide valuable data on the mechanism of the production of the heavily ionising particles recorded on photographic plates.

The average masses of particles producing single heavy ionisation tracks in plates exposed to cosmic rays under air, paraffin, water and lead have been measured and are in course of publication. It is found that the average mass of the ionising particle falls within the accepted range of values for meson mass, when the plates are exposed under air. In other plates exposed under lead, water and paraffin, the average mass has higher values, showing that the primary rays produce proton in the absorbing layers. The mechanism of production of these protons are different in lead, and in paraffin and water. In the former case photons are responsible for proton production, and in the latter case nuclear collision is probably responsible for these protons. It has been found that the mass of the ionising particles depends to a certain extent on their energies. A search through the literature of meson mass determination shows a large variation in the measured values of the meson mass; an attempt is being made to find out whether such mass variations can be correlated with the energy of the particles and to the characteristics of the absorbing medium traversed by the particles.

An apparatus consisting of a proportional counter coated inside with boron

cosmic ray. It is proposed to set up the apparatus in Darjeeling, where the cosmic ray intensity is several times greater.

b. *Nuclear fission*—With the recently constructed ionisation chamber and oscillograph, the problem of induced and spontaneous fission of the Uranium nucleus is being investigated. In agreement with the results obtained by Russian investigators, it has been found that spontaneous fission of Uranium nucleus, which is not due to atmospheric neutron, occurs, and that the mean life time of such fission is of the order of 3×10^{16} years, as against the predicted value of 10^{22} years obtained by Bohr and Wheeler. Some very old Uranium mineral has been examined for the presence of stable products of Uranian fission. There is some indication of the presence of such products. Examination with a much larger quantity of such minerals, at present not available, is necessary before a definite conclusion can be drawn. The chemical portion of the investigation has been undertaken in collaboration with Dr. P. B. Sarker of the University College of Science.

c. *Nuclear isomerism of Br^{80}* —Using neutrons of different energies from a Ra-Be source, it has been found that the ratio of the initial β -activity of 18 min. and 4.4 hr. Br^{80} isomers, is the same in every case *i.e.* about 2.2:1. The absorption of the β -rays is also identical in both the cases, the energy being 2.07 m.e.v. This supports the findings of Devault & Libby, who, as a result of chemical experiments, stated that the upper state does not emit β -rays at all and that the apparent 4.4 hours. β -decay of Br^{80} is due to the equilibrium between the upper state and its short lived β -active daughter substance.

A systematic study of the energy distribution in the disintegration products of the reaction $\text{B}^{10} + \text{n}^1 \rightarrow$ has been completed. The results obtained are: (i) there is no evidence of a low energy proton product as found by Fisk and Maurer, (ii) the α -particle energy distribution curve agree more with that found by Wilson than that given by the first named investigators; (iii) the effect of the time constants of the condenser circuits used, in distorting the distribution curve has been studied in detail. An explanation has been suggested as to the origin of the low energy maximum found by Fisk and Maurer, and attributed by them to protons.

d. *Neutron generator*—An apparatus for the generation of neutrons by the impact of deuterons accelerated in a field of 70 kV on a heavy water target has been set up. Before circulating heavy hydrogen, produced by the electrolysis of heavy water through the apparatus, the latter is being tested as to its efficiency for the production of α -particles by the bombardment of a lithium target with protons. Attempt has been made to detect the α -particles produced by scintillations on a Zinc sulphide screen. Due to the luminosity of the screen under scattered proton bombardment, this method has not proved feasible. An α -particle point-counter tube has been constructed; the work has been temporarily interrupted due to the worker in charge being employed in other physical investigations.

e. *Ultra sonic generator*—The apparatus has been assembled and the

A number of such oscillators have been supplied to different investigators including the Assistant Director of Scientific and Industrial Research.

For the generation of ultra sonic waves of low frequency and large output, single quartz crystals are not suitable. A mosaic of such plates cemented between steel plates of suitable thicknesses is used for such purpose. One such mosaic plate has been supplied to the Scientific and Industrial Research Laboratory ; it has been reported that the cementing of the plates to the steel electrodes was not satisfactory. Another such mosaic plate is being prepared for use with our push pull circuit. The frequency of oscillation of the component quartz plates are being matched to an accuracy of one part in a thousand and different types of cements are being tested as to their suitability. Once the ultra sonic generator is in a working condition, many important investigations can be taken up.

f. *Biophysics*—A valve tube amplifier circuit has been assembled for the measurement of bio-electric potentials set up in plant tissues either spontaneously or under stimulation. The transmission of excitation in *Nitella* and in *Chara* is being studied.

X-ray apparatus has been set up for the study of the structure of starch like and glycogen like substances which have been produced in vitro in the biochemical laboratory.

A systematic investigation has been undertaken on the effect of different dosages of X-rays, γ -rays and neutrons, on seeds of different plants.

B. *Chemistry*.

a. *Biochemistry*—An important part of the activity of this department is the preparation of biologically active compounds required for plant physiological and microbiological studies. Such substances are glucose-1-phosphate, adenylic and nucleic acid, cis- and transcrocin dimethyl ester, crocin and picrocrocin. Under the present conditions due to shortage and abnormal rise in prices of the essential chemicals and due to other unavoidable technical difficulties, progress of work has been much hampered.

Different methods of preparation of glucose-1-phosphate have been tried with a view to obtain pure samples suited for biological work. An enzyme system, isolated from potato according to the method of Hanes, was found to have both phosphorylysing and phosphate splitting activities. On fractionating by Alumina C γ , three components were obtained, two of which are phosphorylysing, yielding glucose-1-phosphate both with starch and glycogen, while the third fraction is a phosphatase, liberating free P from glycerophosphate and hexose phosphate substrates. Progress of work has been retarded for want of a cold temperature room, which is indispensable for separation of such enzymes.

An assay is being made for the presence of glycogen in higher plants. Along with this a study of the degradation products of starch is also in progress. Some difficulty has been met in chemically distinguishing glycogen from the complex dextrans. It is expected that with the recently completed X-ray apparatus, it will be possible to distinguish the two by means of

Till recently there was no method given in literature of preparing this substance, and it appears that the so called α -aceto bromo glucose is of the β -form. The literature which gives the preparation of this variety is not available locally at present.

Adenylic Acid—As previously reported it is planned to make a comparative study of the nucleic and adenylic acids isolated from *Desmodium* leaflets and from *Mimosa pulvinus*, with those obtained from yeast and from animal sources.

An attempt is being made to prepare pure samples of adenylic acid from yeast, with which it will be possible to compare the physiological activities of similar compounds obtained from actively motile plant tissues. ⑥

The usual methods of chemical preparation of adenylic acid, starting from yeast nucleic acid are not feasible ; it is due to high costs and low yield of the non-specific methods employed for the isolation. The method recently described by Buell has been tried, leading to the production and isolation of adenine nucleotide as aluminium picrate complex. The separation of adenine compound from the complex requires the use of Morpholine and Acetone as solvents. These are not either available or prohibitive in cost. Other organic solvents are being tested.

The interest in carotenoid compounds have been recently revived due to the discovery by Mowes and Kuhn, of the important physiological role played by some of them, the production of motility by crocin, and the sex determining properties of the cis and transmethyl esters of crocetin, on the alga *Chlamydomonas eugametos*. Kuhn and Karrer have isolated these compounds from saffron obtained from Spain, South of France and Asia Minor.

It has been possible to isolate cis and trans crocetin dimethyl ester, crocin and saffranol from saffron obtained from Kashmir. It is interesting to note that the yield of these compounds from the Indian variety is higher than those obtained by Kuhn and Karrer from their specimens. The physiological activities of these products are being tested. Recently it has been found in this Institute that the pulvinus of *Mimosa pudica* contains a high concentration of a carotenoid compound. The relation of this high concentration of carotenoid to the motility of the organs in which they occur is discussed elsewhere in this report. It is proposed to extract this carotenoid compound from *mimosa pulvinus* and determine its nature.

b. *Agricultural Chemistry*—During the last two years a series of manurial experiments has been conducted with jute plants. In the first year experiments were undertaken with the variety D154 on the effect of given doses of manures like cowdung, mixtures of calcium phosphate, ammonium sulphate and potassium chloride. Treatment with cowdung was found to be highly significant, and almost equally effective was a mixture of the three inorganic fertilisers. The effect of a mixture of ammonium sulphate and potassium chloride was less favourable, while those of calcium phosphate in combination with

at 1% level, but the block effect is not significant. The best yield was obtained with 3 lbs. of ammonium sulphate per plot of 12' x 6'.

Next year it is planned to find the effect of manurial treatment of different doses of nitrogen and phosphorus on both varieties of jute—*C. capsularis* and *C. olitorius*.

Effect of soil pH on the growth of jute plants—In continuation of work previously reported, on the effect of pH values of the nutrient solutions used for the growth of jute plants on the die back effect, further investigations have been completed on the effect of the pH of composted soil on the growth of jute. For pH values ranging from 4.6 to 8.8, it has been found that the heights, appearance and growth measurements of these plants are almost identical in the respective pH ranges in solution and in soil cultures. Growth and development are best in soil at pH 6.1. At the natural pH of the soil 7.6, the growth rate is fairly good. At high alkaline range viz. pH 8.8, the rate of growth though not satisfactory, the plants however survive till the end of the investigation. For pH 4.6, toxicity symptoms develop in the plants after 40 days of growth and nearly all of them succumbed between 50-60 days.

The effect of soil moisture content on the production of die back effect is being next investigated. For this purpose a physical method of determining the moisture content of the soil, by conductivity measurements *in situ* is being developed.

C. Biology.

a. *Plant Physiology. Desmodium gyrans*—In previous reports it was mentioned that the pulsatory activity of the motile leaflets of *Desmodium gyrans* is maintained by the oxidation of carbohydrates produced by photosynthesis in the plant leaflets. In dark such pulsations could be maintained if the stem is dipped in one per cent glucose solution in place of tap water.

An apparatus has been constructed which enables the simultaneous recording of the pulsatory and the respiratory activities of a leaflet on an oscillating plate recorder. The following results have been obtained.

(i) When the petiole is dipped in tap water, the respiration of normal leaflets are of a pulsatory character of approximately the same period as the mechanical response, the upward movement of the latter is associated with an increase of respiration above the average rate, which either becomes zero or decreases below the normal during the down movement of the leaf. When the pulsatory movement of the leaflet is stopped by some mechanical constraint, the pulsation in the respiration also disappears.

(ii) When the petiole is dipped in one per cent solution of glucose in tap water, the rate of respiration increases by about 200 per cent. The amplitude of mechanical pulsation is also increased. It has been previously reported that under such condition glucose (or one of its polymer) is stored in the cells of the leaflet.

Auxin Effect. Thimann and Commoner have found that coleoptile sections previously soaked in malate, produced a marked rise in respiration upon addition of an auxin in very low concentration. From this and other evidence it was concluded that the auxin must play the part of a catalyst or coenzyme in the Szent Gyorgy respiratory cycle. The inference has been drawn further that all physiological processes which are affected by auxin, are controlled by the latter's activity in the particular type of respiration. Other competent investigators take the view that the reported

Cum

increase in respiration is small, and that better proof is required before any generalisation is possible.

To test this point, the respiration of *Desmodium gyrans* leaflet and its pulsations were determined under the following conditions ; leaflets (a) dipped in tap water, (b) in tap water with 10^{-5} concentration of indole acetic acid, (c) in tap water with 0.05 per cent of sodium malate and (d) tap water with sodium malate and auxin in concentrations given in (b) and (c).

It was found that the respiration in (a) and (c) were the same, in (b) there was a slight though definite enhancement of respiration while in (d) there was a large increase in respiration ; no perceptible increase in the amplitude of pulsation in (d) was noticed. The specimens ceased to pulsate when kept over a few hours in either of the solutions (b) (c) and (d).

The conclusions which can be drawn from these preliminary investigations are (a) that at low concentrations this auxin is a respiratory catalyst for some substrates present in the cells of *Desmodium gyrans* and (b) malate is one of the substrate on which this auxin acts. Further investigation on this highly interesting line of work will show whether the auxin takes part in the Szent Gyorgy or in the Krebs-Johnson respiratory cycle.

Vegetative propagation of Cinchona ledgeriana from gootes (marcotte) and cuttings by treatment with auxins. Different concentrations of synthetic auxins were tried to produce roots in gootes and cuttings of Cinchona. Of all the different auxins tried, certain concentrations of indole butyric acid were found to be most effective in the formation of roots. In the gootes a treatment with 2% indole butyric acid in lanoline paste for twenty-four hours before dressing with bolls of earth, produced vigorous root formation in 88% of the specimens within 4 months. In the hard wood cuttings a treatment with .02% indole butyric acid in water solution for twenty-four hours before planting in the soil, produced roots in 20% within 4 months.

Investigation on the role of auxin on the growth of roots. The study on the growth of the root is being carried out by some automatic recording device previously constructed in the Institute. The primary root of germinating groundnut has been found to be suitable for the investigation. It has been found that decapitation of root by less than 1 mm. increases the growth by 60 to 250% of the normal growth within twenty-four hours. By decapitation of about 2 mm. the growth becomes arrested. By application of 0.1% indole acetic acid in lanoline paste near the tip, the growth is stopped ; when the same auxin is applied at the basal region of the root the growth is increased by 40 to 100% of the normal growth. The increase of growth by the basal application of auxin in the root indicates that withdrawal of hormone or of root growth substance has taken place from the growing apical region of the root. In the primary root of the groundnut it has been found that the growing zone is 2 mm. away from the tip and is extended only to a region of 2 mm. beyond that.

Plant tissue culture—It was previously reported that growth of root tips

Similar experiments with cambial tissues taken from other plants show the growth of the cambium plus medullary rays. The investigation is in progress.

Active substance in contractile tissues—In his book *Motor Mechanism of Plants* Sir J. C. Bose has reported on investigation on the nature of the motility shown by certain contractile plant organs. For a given plant organ, *e.g.*, the pulvinus of *mimosa pudica*, the contractility depends upon the tonic condition of the plant. In addition for different species of plants with contractile organs, the pulvinus show characteristic differences in their sensitiveness and as well as in the rate of response to stimulation and recovery. Bose classified the contractile organs in the following order:

Active.	Semi-active.	Feebly active.	Inactive.
<i>Mimosa pudica</i> . Primary pulvinus	<i>Averrhoa</i> Sp. Secondary pulvinus	<i>Mimosa</i> Spegazzinii Primary pulvinus	<i>Averrhoa</i> , Primary pulvinus

From staining experiments on the pulvinus of these plants, Bose has shown that the rapidity of contraction depends upon the presence of an active substance in these contractile cells. The density of distribution of this stainable substance has been found to be proportional to the rapidity of contraction of the organ. Inactive pulvinus contain no trace of the active substance. It has been further shown that the contractile reaction takes place in the presence of O_2 and becomes depressed in CO_2 . The oxidisable substance is not a fat nor a lipoid substance, but is some unsaturated carbon compound, with double or triple bond combinations.

It has been previously reported that the investigations of Moweus and

Kuhn and others have shown that the motility of the flagella of several algæ like *Chlamydomonas eugametos* is due to the presence of a carotenoid substance like crocin which is a gentibiose glucoside of crocetin. As the carotenoid substance contain conjugated double bonds, it was thought worthwhile to find out whether the highly active oxidisable substance found by Bose was a carotenoid compound. Bose's staining technique was followed and the results obtained by him were confirmed. Next Mollisch's test for detecting the presence of carotenoid compounds in plant cells was employed. Carotene crystals were observed in the primary and secondary pulvinii of *Mimosa pudica*, *Mimosa* Spegazzinii, *Averrhoa*, the concentration being the highest in the first plant and none in the last. In fact the concentration of carotene was found to occur in roughly the same order in the pulvinii of the different plants, as the highly stainable substance found by Bose in them.

The nature of the carotenoid compound found in the pulvinus of *Mimosa pudica* is being investigated. If it is found to be a carotenoid glucoside compound, then the result will be an important generalisation of the observations of Kuhn, Moweus and other investigators, that not only in algæ, but also in higher plant organs the motility is dependent upon the presence of a carotenoid compound.

The sensitiveness of *Mimosa pudica* is appreciably diminished if kept in partial darkness. Investigations with coloured lights are in progress to find out whether the sensitiveness of the mimosa leaflets depend upon the absorption by the carotenoid compounds which have been found to be present in the pulvinus (see previous para).

b. *Plant Anatomy. Anatomical investigations on motile plant organs*—It is twenty years since Sir J. C. Bose had carried on some investigations on the anatomical structure of the leaflet pulvinus unit of *Mimosa pudica*, with a view to discovering the channel for the transmission of excitation under stimulation. There has been a considerable advance in the technique of such investigations, and a Sir J. C. Bose Research Scholar has been entrusted with this work under the guidance of Prof. G. P. Mazumdar of the Presidency College. It is proposed to carry on investigations on the various plant organs (i) pulvinus, (ii) the rachis, (iii) the leaflets, (iv) the stem and (v) the roots. The study of the pulvinus has been undertaken first. So far pronounced structural differences have been noticed in the upper and lower cortical cells. The upper cortical cells are thick-walled, the inter cellular spaces are small in number and size. The protoplasm in them are less deeply stained than the protoplasm on the lower side of the pulvinus. The lower cortical cells are comparatively thinwalled, the intercellular spaces are abundant and larger in size. A detailed account will be soon published.

Preliminary investigations have been carried out on the pulvinule of the *Desmodium gyrans* leaflet. Protoplasmic continuity exists, between contiguous cortical cells, which appear to be grouped round the central vascular bundle in such a manner, that the gyratory motion of the pulvinule tip can be accounted for, as due to the successive contraction of neighbouring cortical cells.

c. *Vernalization of Indian Crops*—Photostage in wheat (*Triticum vulgare*) and Oat (*Avena* sp.). It is found that an exposure of wheat (I.P. 4 & I.P. 52) to long days for a period of 15 days leads to an earliness in flowering of 24 days over the control. In oats (I.P. 1) similar treatment brought about an earliness of 43 days. In these cereals photostage begins with the sprouting of the seeds and even a limited number of long days during the proper photostage were instrumental in inducing a significant earliness. The nature of these cereals with reference to thermal and photophases was found to differ from the temperate or hard winter cereals.

Recently, through the courtesy of Dr. Pal of the Imperial Agricultural Institute, six late varieties of Punjab wheat have been obtained. It is proposed to carry on vernalization experiments with these seeds under conditions prevalent in temperate climates, viz., under long day and low temperature conditions. These experiments will be carried out in some suitable locality in the Darjeeling district.

Jute—The effect of presowing treatment, of alternate moistening and drying, and post sowing light treatment on drought resistance and earliness of flowering of two species into *C. catularis* (D. 154) and *C. Olitorius* (Chin-

Similar methods of presowing treatment brought about an earliness of flowering, on an average of 6 days over plants grown under normal condition.

A significant earliness of flowering was caused by regulating post-sowing photoperiods to short days. Jute has been found to be highly sensitive to change of day length treatment. It is proposed to investigate the critical light period and the physiological changes accompanying the change over from the vegetative to the reproductive phase.

Paddy—Intensive investigations on warm temperature vernalization of a number of *aus* and *aman* varieties of paddy have been made possible by a grant from the Bengal Immunity Co. Ltd. The investigation is in progress in Falta and in Calcutta.

Preliminary investigations have been conducted on the propagation of potatoes from the 'severed eyes' only. It was found that the 'severed eyes' from the apical region of the tubers have better growth and yield. By this method 80% in weight of tubers used for seed purpose can be saved.

d. *Cytogenetic and breeding investigations.* Cotton—The breeding experiments with Coimbatore and Lyallpur cottons at Falta station have been continued. The former grow fairly well and give a good yield with good boll opening. The yield of these plants is not so high, it is about 70% of the yield obtained at Coimbatore. To improve the quality and yield, the better plants in the population are being selfed to serve as parents for the next season. These plants were grown in fields on which in previous years Dacca and Deshi cotton were grown. The latter were highly susceptible to diseases and the yield was poor. The Coimbatore varieties do not show any marked susceptibility to infection.

The Lyallpur types on the other hand do not grow well at Falta. Since the Punjab strains are longer stapled and better in quality than the Coimbatore strains in their usual environments, attempts are being made to hybridize the two types with a view to evolving a better biotype, combining the desirable characteristics of the two types. This year cyclic crossing and multiple crossing are being tried as well as back crossing.

Jute—Production of mutants by X-ray treatment of seeds.

The following varieties of jute seeds were subject to X-ray exposure.

- (i) *C. capsularis* var. D. 154, and D. 386,
- (ii) *C. oktorius* var. Chinsurah green, and R. 26.

The important morphological peculiarities noted in plants grown from treated seeds are:

- (a) Initiation and development of lateral primordia at various stages in the development of the plants—the number and positions of these vary in different plants.
- (b) Significant differences in the heights and basal diameters of some of the treated plants. The maximum height and basal diameters observed in the treated plants were 17 ft. and $2\frac{1}{2}$ inches respectively as against an average of 12 ft. in height and 1 inch in diameter in the control plants.

that the loss of 2 chromosomes is responsible for this peculiarity. Further investigations are being carried out

- (iii) Nucleolar studies in several species of Leguminosæ is being carried out, which is expected to throw some light on the evolution of this family.

e. Microbiology. Diseases of tropical fruits and vegetables—These are being undertaken with a view to find out (i) the nature of the relation between the parasite and its specific host, (ii) nature of infection, (iii) mechanism of rotting, (iv) factors influencing the susceptibility of fruits and (v) control of wastage.

The fruits under investigation are citrus fruits, mangoes, pineapples, bananas, tomatoes, and potatoes. Methods have been developed to detect invisible minute wounds on some of these fruits, and it is hoped that these methods could be successfully used in commerce to predict the storage lives of the fruits and to eliminate individual fruits susceptible to infection.

Infection of Rice of Helminthosporium oryzae and Fusarium sp.—The former causes extensive wastage of rice in field and in storage, and it is often associated with a species of *Fusarium*. The growth of the fungi is found to be influenced by the chemical composition of the plant and of the medium. The pH for optimum for growth is from 5.6 to 7.0.

The degree of resistance to infection in different plants has been found to depend on its variety, the vigour of the plant, and water content of the soil. Both the fungi were also isolated from various grasses in the rice fields and from samples of soil, and investigations are now being made on the mode of perennation of the fungi. The production of toxic substance by the fungus during its growth and the nature of the breakdown of the various constituents of the cell wall are also being investigated.

Retting of Jute and other fibres by Hiparol—A special retting substance named Hiparol has been discovered, which is capable of retting Jute, Coconut and other fibrous plants in 8-18 hours, where as in the natural process the time required for retting varies from 6-10 weeks. Fibres obtained by Hiparol are free from specks of adhering bark and possess good lustre. The nature of the breakdown products of the plant material is being investigated, and a method for determining the activity of Hiparol is being worked out.

Production of Penicillin—So far ten strains of various species of *Penicillium* have been isolated and their growth rates and rates of production of Penicillin were studied in modified Czapek Dox medium. The addition of small amounts of fruit juices, e.g., from apple and grape, and also of organic nitrogen increased somewhat the growth of the fungi and also of Penicillin. The production of the latter starts on the third day, and it is most actively secreted from the 5th to the 15th day, the activity of the extracts varying from 20,000 to 25,000 Oxford units. Five of the strains were found to be bacteriostatic to *Staphylococcus aureus*. The appearance of the antibacterial substance was found to be closely related to (a) the growth rate of the fungus.

Production of yeast food—Investigations are being carried out for the cheap production of medicinal yeast. Seven strains of yeast were isolated and are maintained in culture. Comparative studies on various strains regarding yield, physiological reactions have been made. Nutritive values of the yeast are being estimated biologically.

Fairly high yields have been obtained with different strains in medium containing molasses and inorganic salts under aeration processes. The addition of small amounts of plant extracts increases the production of yeast. Increase in production is also observed by the addition of small amounts of trace elements and of camphor. Experiments are now in progress to find out cheaper substrates and also to simplify conditions of maximum yield.

○ The investigations on Penicillin and yeast are being continued under a grant received from the Bengal Immunity Co. Ltd.

D. *Zoology*—Further investigations are being carried out on the caste determination in *Ecophylla smaragdina* Fabr. It has been previously reported that differentiation is mainly dependent on the nature of the diet administered to the ants.

Recently it has been claimed that the carotene compounds cis- and trans-crocetin dimethyl ester in certain proportion are responsible for the sex determination in the alga *Chlamydomonas eugametos*. These carotenoid compounds have been isolated in the chemical laboratory, and each of the two have been administered in high dilutions separately to the red ants. The trans compound has been observed to produce slight elongation of the body of the larvæ, as compared to the controls. The administration of the cis-compound produces no such change. Equal proportion of the cis- and trans compounds when administered to the larvæ resulted in the production of short statured workers. The effect of aphid secretions, with which the worker-ants feed the larvæ are also to be investigated by being given directly to the larvæ.

Aquatic plants as aids to mosquito control—There are published observations that aquatic plants like *Chara*, *Hydrilla*, *Vallisneria*, etc., are inimical to the breeding of mosquito larvæ. Experiments conducted in the Institute with larvæ of *Anopheles* and *Culex* have yielded some positive results. The nature of the larvicidal action of these plants is under investigation.

E. *Anthropology*—A paper 'On the finger nails and the nail phalanges of twins' will be published shortly in the Transactions of the National Institute of Sciences of India. It gives an elaborate treatment of the variability of the finger nails and the terminal phalanges, as revealed by X-rays, in 100 pairs of German twins. The value of the above characters in the diagnosis of the zygoticity of the twins, together with the relative influences of heredity and environment have been worked out and discussed. The different classes of twins and 14 twin embryos were employed as controls in the study.

Another paper on 'The Reproductive life of the Malarium' will be published.

Data on twin birth obtained from the various Indian hospitals is nearly completed. The data give the following information:

	Total births.	Twins.
Bengal ...	103,472	1,378
Other Provinces ...	188,509	2,452
	291,981	3,830

The above figures yield a ratio of 1:76. This is, however, an uncorrected ratio since the hospitals are not uniform in the matter of treating a case of abortion as a case of birth or pregnancy. As a matter of rule twin ratios are deduced not from the total number of births but from the total number of pregnancies. Efforts are being made to correct this ratio, as far as possible, through the published materials of the different hospitals.

Collections of individual twin data according to their zygoticity are also progressing. 2 pairs of twins could be brought during the winter of 1943 into the Laboratory for detailed study.

Collections of pedigrees of various hereditary traits and anomalies are also being made. Two albino families have been very recently traced and they will be taken up for study soon.

Blood grouping investigations are also being continued. How far incompatibility of blood groups of parents leads to abortions or still births is being investigated through the pedigree method of study.

Lectures—The annual D.P.H. classes were held this year during November last.

Grants—The Government of India grant of Rs. 50,000/- was received this year comparatively early. Additional grants of about Rs. 10,000/- from B.S.I.R. and about Rs. 12,000/- from the Bengal Immunity Co. were also received this year. The stipend and research grant for the Sir J. C. Bose Fellow of the Calcutta University represents a contribution of about Rs. 3,400/-, while the annual income from the Sir J. C. Bose Research Scholarship Fund (primarily for the benefit of students graduating from the Presidency College) is Rs. 1,750/-.

Investments—During the year with the approval of the Governing Body, 3½% G. P. Notes of face value of Rs. 25,000/- have been purchased. Out of this Rs. 10,000/- has been allocated to a Depreciation Fund and Rs. 15,000/- for post-war purchase of books, journals and apparatus.