

BOSE RESEARCH INSTITUTE

ANNUAL REPORT

For the year 1945-46

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REPORT OF THE GOVERNING BODY OF THE BOSE RESEARCH INSTITUTE FOR 1945-46.

Governing Body—Five ordinary meetings of the Governing Body were held during the year. The draft Regulations and Bylaws of the Bose Institute, which were finally passed by the Governing Body on March 1, 1945, were with the consent of the Central Government further amended at a meeting held on May 5, 1945. The revised Regulations and Bylaws as finally approved by the Central Government have now been printed.

In accordance with the provisions of Regulation 12(a), the Governing Body, on January 29, 1946, elected seven of its members as representatives on the newly-to-be-constituted Council. At the same meeting, the Director was authorised to insert advertisements in four provincial newspapers inviting applications for the filling up of vacancies and of new posts created according to the new Regulations. In spite of repeated requests, the Central Government have not yet communicated the names of (i) their nominee on the Council, (ii) of the member of the Central Legislative Assembly elected to the Council, and (iii) of two outside scientists nominated to the Council by the Central Government.

Mr. P. C. Chowdhury, Accountant General, Bengal, has been nominated as representative of the Central Government on the Finance Committee.

In absence of the nomination and election of four outside members, the Council, the Finance Committee and the Selection Committees cannot be formed. This delay on the part of the Central Government is seriously handicapping the activities of the Institute.

The Governing Body suffered a severe loss by the passing away, on January 24, 1946, of one of its senior members Mr. Jatindra Nath Basu, who was universally respected as a man of sterling character and high sense of public duty. Mr. Basu was a member of the Governing Body since March 1929, and he had rendered valuable services to the Bose Institute during his seventeen years' membership.

Sir J. C. Bose Memorial Lecture—The seventh lecture of the series was delivered by Dr. P. Parija, M.A., D.Sc., Vice-Chancellor, Utkal University on November 30, 1945; the subject of his lecture was "Induced Adaptability of Plants."

In his report presented to the anniversary meeting, the Director mentioned that Sir J. C. Bose's first scientific publication appeared more than fifty years ago in the proceedings of the Asiatic Society of Bengal (May 1895); it was entitled 'On the polarisation of electric rays by double refraction crystals.' The bearing of this and other investigations of Sir J. C. Bose with short electric waves, of wavelengths of the order of a centimeter, on the recent application of such waves to the development of Radar was discussed by the Director, who

I. C.S.I.R. Grants : (i) Setting up of a powerful Ultrasonic Generator, (ii) Setting up of a medium voltage positive ray apparatus for production of neutrons..

II. Bengal Immunity Grants : (i) Investigations on the vernalization of paddy, (ii) Production of desirable strains of yeast by selection and hybridisation.

III. Raymus Corporation : Investigations on Glass production.

IV. Bengal Government Grant : (i) Investigations on the breeding of longstapled disease resistant cotton, (ii) Investigations on bioelectric potentials developed in plant seeds. etc.

V. Indian Central Jute Committee : Productions of new mutants of jute by irradiation with X-rays, γ -rays and neutrons.

VI. Government of India : (i) Systematic investigations on the physiology of cinchona plants, (ii) Cytological investigations on cinchona plants.

An air-conditioned glass house, in which both humidity and temperature can be controlled independently within ranges suitable for the growth of temperate climate plants like cinchona, is in course of erection. The construction is being delayed by the difficulty in obtaining a suitable refrigerating unit for the glass house.

Four bighas of land adjoining the Falta Experimental Farm has been taken on lease to provide additional land for grant-in-aid investigations.

Staff—Miss Bibha Chowdhury, Research Scholar in Physics, has joined Prof. Blackett's laboratory in Manchester to work on Cosmic Rays, Mr. P. Nandi, Adair Dutt research scholar in Microbiology, has joined Prof. Raystrick's laboratory in the Imperial College of Science, London, Mr. Paresh Ch. Sen Chowdhury, Research Scholar in Physics has been appointed Assistant Physicist in the Tata Memorial Hospital, Bombay. Mr. Jayanta Kumar Ganguli has received an appointment in the Indian Forest Service and Miss Mridula Dutt has been appointed Sir J. C. Bose Research Scholar in Botany in his place, Dr. Nepal Chandra Dey has been appointed Research Fellow in Microbiology.

The following research assistants were appointed under the different grant-in-aid schemes :—

C.S.I.R. : Messrs. Mriganka Sekhar Sinha, Indralal Chakravorty, Amalendu Narayan Banerji.

Jute : Kantilal Chowdhury and Sudhir Ranjan Das.

Cotton : Amiya Kumar Adhikary, Amarendramohan Naha.

Cinchona : Sudhir Kumar Banerji.

Donations—The Trustees of Sir J. C. Bose Trust No. 1, have granted Rs. 12,000/- for the publication of the Life and Collected Works of Sir J. C. Bose.

Messrs. Raymus Corporation Rs. 3,000/- and His Eminence Sayed Burhamuddin Sahib Rs. 1,000/-.

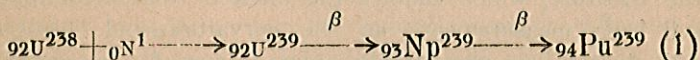
Selection Committees have not been constituted. By the time the Selection Committees are constituted these candidates may no longer be available. Planned and uniform advances will not be possible until the Heads of Departments are appointed and the vacant Research Fellowships and Scholarships are filled up. In this connection the Director desires to point out that, the scales of pay offered to Scholars, Fellows and Heads of Department under the scheme sanctioned by the Central Government, on the recommendations of the Reviewing Committee appointed in January 1940, are very inadequate in comparison to the remunerations offered at present by Government and other research grant-in-aid organisations; e.g., while the scale of remuneration of research scholars is fixed from Rs. 50—100/-, the minimum pay on which M.Sc. graduates with no research experience are being recruited by the Institute for such grant-in-aid schemes, vary from Rs. 125/- to Rs. 150/-. Two research assistants of the Institute who are candidates for research fellowships (Rs. 200/- to Rs. 350/-) have been recommended by the Atomic Research Committee for appointment in the Institute on a starting pay of Rs. 350/- per month. If the Central Government do not see their way to revise the scales of remuneration sanctioned by them for the Bose Institute, and bring them up to those prevailing at the present time elsewhere, the Institute may sometimes recruit qualified candidates for its permanent cadre, but with little hopes of retaining them.

A summary of the investigations carried out in the different departments of the Institute is given in the following sections:

A. PHYSICS

(a) *Spontaneous fission of Uranium nucleus*—It was mentioned in last year's report that investigations carried out in the Institute led to the conclusion that Uranium nucleus could, in addition to fission by absorption of neutrons, also break up spontaneously into smaller units. Further on the assumption that U^{238} nucleus undergoes spontaneous fission, the half life for such fission was found to be order of 10^{16} years, as against the theoretical estimate by Bohr and Wheeler of 10^{22} years. It has been found that 2.3 neutrons were emitted during each nuclear fission. Investigations carried out in other parts of the world and now released for publication after the termination of the war, indicate that similar estimates of half life of spontaneous fission have been obtained.

(b) *Transuranic elements*—Till very recent times little chemical evidence was available regarding the existence of elements heavier than Uranium i.e., with nuclear charge larger than 92. Fermi had shown that by absorption of neutron by uranium the following reaction was possible:



It was considered worth while to investigate for the presence of such transuranic elements in old Uranium and Thorium containing minerals: so far

i.e., it is assumed that U besides emitting α -particles can also emit, with lesser degree of probability, β -particles, and if these two processes occur independently then ${}_{93}\text{Np}$ isotope can be formed; (b) alternatively neutrons emitted during spontaneous fission of U nucleus can be absorbed by other U^{238} nuclei and thus give rise to the process given by equation (1). Methods used for chemical separation of the resulting transuranic elements will depend upon their valencies. The following two alternatives are possible:

(I) The elements ${}_{90}\text{Th}$, ${}_{91}\text{Pa}$, ${}_{92}\text{U}$, ${}_{93}\text{Np}$ lie in corresponding positions just below the sixth period transition elements viz. ${}_{72}\text{Hf}$, ${}_{73}\text{Ta}$, ${}_{74}\text{W}$, ${}_{75}\text{Re}$, ${}_{76}\text{Os}$ and have similar chemical properties.

(II) These elements at the end of the periodic table form a rare earth series starting with ${}_{89}\text{Ac}$. Chemical methods which cause the precipitation of elements belonging to groups (I) and (II) were used and the examination of the precipitates obtained for radio activity, show that Ppt. I was slightly radioactive, while Ppt. II was highly radioactive. Repeated precipitation was carried out in both cases. With Ppt. II, the ionisation effect observed was due to both α particles and fission particles. Further purification of the precipitates is being undertaken. The range of the α -particles emitted from Ppt. II is being measured from track photographs in a Wilson Chamber; if it is found that the latter is different from those due to α -particles from possible radioactive contaminants, then it is very probable that a new radioactive element with fissionable nucleus ${}_{94}\text{Pu}$ has been obtained.

(c) *Nuclear chain reactions*—The importance of the induced nuclear fission process has been strikingly brought before the public notice by the announcement that the atomic bombs dropped on Hiroshima and Nagasaki were due to chain reactions induced in purified masses of the isotopes U^{235} and Pu^{239} , by neutron absorption. The utility of such reactions both for war purposes and as source of industrial power has been attracting attention all over the world. An Atomic Research Committee has recently been formed by the Council of Scientific and Industrial Research, India, and it is expected that the Bose Institute will take an important part in investigations sponsored by the Committee.

(d) *Cosmic rays*—The Wilson Chamber investigations of Cosmic rays have been temporarily closed due to the departure of both the workers-in-charge, Miss Bibha Chowdhury and Mr. Paresh Kishore Sen Chowdhury. It is planned to start this line of investigations, again next year.

(e) Results obtained recently on the mass of the meson as determined from observations on Wilson Chamber meson tracks, show that the latter is not constant; the usually accepted values of meson mass vary from about 130 to 250 electron mass. As stated in previous reports, a method has been worked out in the Institute, which enables the mass of the meson particles to be determined from measurements on the curvature and mean grain spacing along their tracks, on photographic plates exposed to cosmic ray mesons. The results obtained indicate that the average mass of the mesons vary between the limits of 150 to 250 electron mass. It is further found that the latter varies as some function of the energy of these particles. Fresh batches of photographic plates, suited for Cosmic ray investigations, have been sent up to Sandakphu and Darjeeling, for further study of the variation in mass of the meson particles, and for absorption measurements in Carbon and Paraffin and Air.

(f) *Supersonic wave generator*—A push pull circuit consisting of a pair of demountable valves evacuated with oil diffusion pumps with tank coil and condensers has been constructed and assembled together. Each of the tube has been found to oscillate with frequencies between 200 to 1200 k.c. per second. R.F. current exceeding 4 Amp. has been obtained for an anode plate current of 50 mA. Different X cut quartz crystal plates could be made to oscillate at resonance frequencies. Attempt was made to obtain resonance oscillations in mosaic crystal plate made up of for matched quartz plates of thickness 2 mm and total area 16 cm² cemented to steel electrodes of thickness 4 mm. While a flat resonance oscillation was obtained corresponding to the thickness of the quartz plates, no resonance was obtained for the mosaic oscillator system. The oscillator was dismantled and from inspection it was concluded that the failure of the mosaic to oscillate as a whole, was due to defect in cementing. New cements and better technique for cementing are being investigated.

(g). *Neutron generator*—The work on the construction of a medium voltage positive ray discharge tube mentioned in previous reports has been renewed on receipt of a grant from the C.S.I.R. A positive ray tube has been assembled and its capacity (as a proton discharge tube) has been tested. The apparatus is circulated with hydrogen gas which, in the arc formed between an activated hot cathode and the surrounding anode, dissociate into protons, while some molecule ions are also formed. These ions are accelerated in a field of 75 kV and strike against an earthed target. The proton current delivered at the target is found to be very dependent on the strength of the magnetic field produced inside the solenoid volume where the arc is formed. With a solenoid current rising from 5 to 15 Amp. the proton current is increased from 45 micro A to 250 micro A which is near the saturation value. The apparatus is now being circulated with a deuteron current produced by the electrolysis of heavy water; the accelerated deuterons are made to impinge on a target containing a heavy hydrogen compound. At present the compound used is DPO₃.

At the same time an apparatus for the detection of neutrons is being constructed. This is based upon the observation that a silver plate exposed to slow neutrons get activated emitting electrons, of periods 22 seconds and 2.3 mts. A β ray counting arrangement is being assembled for the purpose.

(h) *Bioelectric potentials*—A valve tube arrangement for the amplification and detection of feeble bioelectric potentials has been constructed. Bioelectric potentials of germinating seeds are being measured for different strains of pure and hybrid seeds, with a view to finding out, whether (i) corresponding to each seed variety a definite value of bioelectric potential can be associated and (ii) the value of the bioelectric potential so obtained can be used as a measure to test the hybrid vigour in different plants like maize, cotton, etc. At present investigations are confined to maize seeds on which similar investigations have been undertaken in the U.S.A. by Burr.

A new phenomenon of enzyme activation by very small electric current has been observed. Investigations are being continued to standardise the necessary experimental conditions.

C. BIOLOGY

Plant Physiology—(a) *Dual mechanism of transmission of excitation in Mimosa*—A large number of investigations undertaken by Sir J. C. Bose led him to the conclusion that in *Mimosa Pudica*, stimulation of a part of the stem was transmitted to the pulvinus and the pinnules in the form of an excitation current, resulting in mechanical response shown by the dropping of the pulvinus and the closure of the leaves; in fact a stem with pulvinus and leaf, behave in many respects like a nerve muscle preparation and obey similar laws of response to stimulation e.g. electrotonus, blocking of the passage of stimulation effect by physiological means, etc. On the other hand, investigations originating with Ricca, Snow and others make it appear that a chemical substance released at the place of stimulation and carried along with the plant sap by means of transpiration current to the pulvinus can also originate motor response. At one time it appeared as if only one of the two modes of transmission of excitation, the physical or the chemical, could be true. This controversy is now placed on a different footing by the discovery of a similar dualism in the transmission of excitation in a nerve muscle unit, based upon the discovery by Lowi of a substance like Acetylcholine, which acts as chemical mediator viz. the excitation traversing a motor nerve releases this substance at the nerve muscle junction. Injection of dilute solutions of acetylcholine under controlled conditions produce multiple contractions both in smooth and in skeletal muscles i.e. this substance is neuromimetic.

Investigations have been commenced in the Institute to isolate, purify and determine the chemical structure of this so-called irritability substance. In the last Report it was stated that the so-called active substance Crocin, found in the pulvinus of motile plants like *Mimosa pudica*, in solution does not produce any irritability effect when cut stems of Mimosa plants are dipped in it. Following Ricca's experiments attempts have been made in Germany to isolate this substance. For this purpose Haberlandt, Jenny Renz and others have collected the liquid oozing out of the cut stems of Mimosa, from which a fairly soluble and easily crystallisable substance can be isolated. This substance has been named Mimosin, and its probable constitution has been found to be a pyridin ring to which two hydroxyl and an alanin residue are attached. Jenny Renz found that Mimosin gave the mimosa test, but its activity was about 1/20 of the activity found by Fitting for some of the amino acids. The latter, after a detailed examination of about 1500 chemical substances which usually occur in plants, found that only a few amino acids like Alanine, Serin, Glycocol, Amino-s-butyric acid, l-Asparagin produce irritability effect. Both he and Umrath attempted to isolate the irritability substance from hot aqueous infusions of fresh *M. pudica* leaves. Fitting concluded that the irritability substance was an organic substance of a highly complex nature. Umrath working with *Neptunia* isolated a substance which resisted all attempts at crystallisation, which he believed to be an organic oxy-acid containing nitrogen.

Due to the availability of Mimosa plants in this part of the country, attempt is being made in this Institute to follow up this line of investigation

on a large scale. First, a reliable physiological test has been developed in this laboratory, for detection of this irritability substance. Due to the variability in response of *Mimosa* plants, depending on its tonic condition, light, moisture content of the atmosphere etc., it is difficult to obtain precise quantitative estimates by the physiological method. Our preliminary observations with the solid isolated from sap collected from cut ends of *Mimosa* stems, did not give any *Mimosa* effect; thus we could not confirm the observations of Jenny Renz. Next the procedure of hot water extraction of *Mimosa* leaves, and its successive purification has been undertaken. Two methods of purification have been followed; in the first, successive steps involved the separation of different organic constituents by using different organic solvents.

The final mother liquor, which was found to be active, gave indication of the presence of a phenolic hydroxylic group and also of the presence of a glucoside. It is not yet established whether the glucoside group forms part of the irritability compound, or is present as an impurity.

The other method used was successive precipitation by the lead method. As a final end product an aqueous solution has been obtained which is highly active. Attempt is being made to obtain crystals from the solution, and to test their activity. The investigations is being continued.

In connection with the theory of dual transmission of stimulation, large number of investigations have been undertaken to find out the conditions under which stimulation is transmitted between the cut ends of two leaf systems belonging to two different *Mimosa* plants which are connected together either by means of a water-filled tube or (ii) the leaf systems of the two were joined by means of cotton threads dipped in normal saline solution. The former would favour chemical mode and the latter electrical mode of transmission. The results are not yet of sufficient significance to be published.

(b) *Anatomical study of leaf pulvinus system of Mimosa pudica*—If the upper half of the pulvinus of *M. pudica* is removed, the petiole with the leaves comes up and never goes down, in spite of further stimulations. If the lower half of the pulvinus is removed, the petiole goes down and never comes up despite recovery.

A special type of hairs, bulbous in shape, are present on petioles and leaflets of *M. pudica*. Woody portions of stems are free of these hairs. They are present only in parts sensitive to touch.

The base of the pulvinus consists of a cushion of soft-walled cells which are elastic. The elements of xylem passing through this region have spiral thickenings on their walls which render them capable of extension as in a spring. The whole cortical layer is aerenchymatous i.e., the cells form a series of strands strung on loosely, together with plenty of air-space in between. The inner cortices, next to the vascular bundles, are not aerenchymatous but solid throughout. The innermost limiting layer of the cortex, next to the vascular bundles, is different from the rest of the tissue. It consists of a single layer of cells each of which contains rhombohedral crystal. This layer surrounds the

up the cellulose stain. This shows that they have been insufficiently lignified and this is perhaps another feature which facilitates bending.

Other parts which also show an affinity for lignin stains without being lignified are the tips of emergences, tips of bulbous hairs, and contents of epidermal cells. The other cellulose portions such as the inner cortex of the pulvinus, parenchyma of the stem etc., do not take up the lignin stain. The lignified portions except those on the outside take up lignin stains ununiformly.

The provision for air spaces in the anatomy of *Mimosa* is suggestive. The aerenchyma passes up everywhere, into the middle of petiole, the cortices of the secondary pulvini, the pinna and the rachises and dwindle towards the tip.

(c) *Investigations on the ascent of sap by radio active phosphorous*—This experiment is being attempted in collaboration with S. Chatterji of the Physics Department. A pin point counter has been constructed for the observation. The radio-active element is being prepared and when it is available in sufficient amounts experiments on the following lines will be started: (i) Investigation on the velocity of the ascent of sap. (ii) Investigation on the channel of the ascent of sap.

(d) *Growth of Cinchona Plant*—In an attempt to acclimatize cinchona plants in lower Bengal, study of its growth in the conditions of Calcutta has been undertaken. Growth and its diurnal variations are being studied with an automatic 24-hours recorder, constructed in the Institute. Simultaneously with the growth records the diurnal variations of temperature is also being taken with a similar recorder. The results so far obtained indicate that longitudinal growth has a distinct diurnal periodicity. Most of the growth takes place at night with the fall of temperature and during the day, when the temperature is higher, the growth stops and in most cases actual contraction takes place. The growth is limited to the upper internodes; the topmost internode bearing the terminal bud is the most rapid growing region and the growth rate progressively diminishes in the subsequent internodes. The opening of the terminal bud has been found to exert great influence on the growth. It has been found that the growth of the terminal internode which was not so rapid during the development of the bud, increased greatly for two to three days with the opening of the bud, after which the rate gradually fell down. The growth of the second internode from the top, which was almost nil during the development of the terminal bud, increased suddenly for a time with the opening of the bud. Further investigations are in progress.

(e) *Mineral nutrition of plants*—A part of the systematic grant-in-aid investigations on the physiology of cinchona plants will consist in the study of the mineral requirements of the plant using sand culture method. As the air-conditioned room in which such investigations will be carried out is not yet ready, it was considered worth while to carry out a trial investigation on the Nitrogen, Phosphorous, and Potash requirements of a typical plant like Sunflower, which can grow easily in an ordinary glass house. Eight sets of sunflower plants were grown in tubs 10" in diameter, of which one was filled with ordinary garden soil manured with leaf mold and cowdung, the remaining seven sets were each filled with 4" of gravel from the bottom and above it with coarse sand. There was arrangement for draining away the excess of

nutrients accumulated above the gravel layer, and for periodic washing of the sand and gravel in the tubs with water. One set of plants was grown with a complete Hoagland and Aron nutrient solution. The other six sets were divided in pairs in each of which there was a deficiency or total lack of one of the essential elements N, K and P. The plants react very characteristically to a deficiency of Nitrogen but not so clearly to deficiencies in the other two nutrients. They have reached the flowering stage and a complete report will be published after the plants have been measured, harvested, and chemically analysed.

(f) *Investigations on Potato*—The efficiency of sprouting of growth and of yield of 'detached eyes' were tested by removing the eyes from the mother tuber fortnightly, beginning from freshly harvested tubers in March and continuing up to October, the next sowing season. All the detached eyes were sterilized, and the cut surfaces were sealed by a special sealing mixture. All the different samples thus collected from time to time and preserved under cold temperature were sown against control in October. All the detached eyes from different samples showed active viability and sprouting efficiency. This shows the possibility of storing "detached-eyes", instead of whole tubers. Further work on different aspects is still in progress.

Investigations on the breaking up of dormancy of potato tubers were carried out during last year. The effect of different chemicals and gas mixtures on the breaking up of dormancies of both Darjeeling and Nainital varieties were investigated. Imported tubers were procured from market and experiments were conducted on half pieces. Some of the treatments greatly shortened the time of sprouting over that of the control. In immature tubers formed in those plants, the period of dormancy was found to be much shorter when planted in halves. This year the work is being further continued, particularly with a view to find out whether dormancy of the potato is in any way dependent on the maturity of the tuber. The tubers have been collected from a local field under different age variations of the plants. The specimens collected at different times of the season were similarly treated with different chemicals and gas mixtures. Most of the experiments this year were conducted on whole tubers instead of halves; some of the experiments were also performed on half pieces. The experiment is still underway and the results will be summarized when it has been completed.

(g) *Vernalization and phasic development of crops cultivated in India*—Further experiments on pre-sowing cold temperature and post-sowing photo-periodic treatments on the time of the initiation of the reproductive stage were continued with other new varieties of wheat as I.P. 52, I.P. 125, I.P. 114, Pb. 8A, Pb. C591 and two English variety of wheat viz. Yeoman II and Little Joss kindly sent by Dr. Pal, the Imperial Economic Botanist, New Delhi. It was found that cold temperature treatment effect was of varietal nature and brought about an earliness of 5 days in I.P. 125, of 9 days in I.P. 114; of 8 days in Pb. 8A and of 5 days in Pb. C. 591 in time of ear-emergence as compared to the untreated controls, when both were grown under the local photo-

quent photostage. When once the photostage was made to pass under required light periods, it behaved independent of light periods.

In the case of English wheats, it was found that both the varieties failed to produce any ear in vernalized or controlled sets when sown in the normal season in November. But the vernalized set when grown subsequently in long day conditions (14 hrs. light period) produced ears after 110 days. These investigations are being continued during summer months at Kalimpong—a hill station, to find the effect of natural photoperiods of long day lengths.

(h) *Investigations on Aus and Amon paddy*—Preliminary results have already been reported. The experiments were continued under field conditions at Falta. *Dharial* showed better response to high temperature treatment than *Kataktara*. The same earliness of 7-9 days was noted in *Dharial* as reported before. The stand and tiller output was better in treated seedlings as compared to control. The cold temperature treatment produced delaying effect. *Kataktara* and *Dharial*, both the Aus varieties, showed an earliness in ear-emergence under conditions verging towards long day periods. The short day conditions of 8 hours showed no effect towards earliness and the effect was the same as that of the control.

Experiments were continued with the following Amon varieties: *Bhasamanik*, *Latisail*, *Patnai*, *Jhingasail*, *Chinsura II*, *Badkalamkati*, *Nagra*, and *Tilakkacheri*. The results already obtained and reported previously were further supplemented by this year's investigations. The response of these varieties to short day lengths in inducing earliness was utilized this year in producing earliness in crops under field conditions. This was obtained by covering the seed beds (before transplantation) with baskets made up of Palm leaves and Ula grass (*Imperata arundinacea*) thus allowing only 8-9 hours light period. The treated seedlings were then transplanted as usual. An earliness of average 20 to 25 days was obtained in *Bhasamanik*, *Latisail*, and *Patnai* as a result of 15 days covering of the seed-beds.

The photoperiodic treatments confirmed the results obtained last year. Further investigations will be carried this season also.

D. PLANT BREEDING AND CYTOGENETICS

(a) *Breeding investigations in long stapled cotton*—This is a scheme financed by the Government of Bengal for a period of three years and was put into operation on the 1st August 1945. The object of the scheme is to breed suitable disease resistant and long stapled cotton for cultivation in the tracts around Falta. During the year under report, 18 parent types, 26 F_1 's; 29 F_2 's and 12 F_3 's were grown and studied in the field in addition to 5 cyclic F_1 crosses and F_2 's. Multiple crossings of the previous year were also continued. In addition 5 new economic types and 3 wild types were also introduced.

A number of early types were selected from the cultures, which will be tested during the next season.

Hybridization as per programme was also continued during the year under report.

It may be mentioned that a single plant from the F_3 of a cross between Co_2 and 4F was found to be completely naked. The other plants in the culture were fuzzy and linted. It appears, therefore, that this is a mutation with certain economic advantages.

(b) *Investigations on Cinchona* : This scheme was started on 1st November 1945, the objects being :

(i) To study the cytology of *C. ledgeriana* and *C. succirubus* and the F_1 hybrid.

(ii) To induce economic mutations, if possible, by different kinds of radiations.

The Cytologist employed in the scheme went on tour to Mungpoo during the period under report, to collect and fix the root tips of all types for cytological study.

The seeds of the above types were also germinated in specially prepared seed beds at the Bose Institute and also in petrie dishes in moist cotton, with certain modifications.

From a study of the germination period, it was observed that there was a progressive reduction in the number of days required for germination, from January to April. Probably it can be correlated with the increase in temperature and relative humidity.

The $2n$ chromosome number of *C. ledgeriana* was found to be 34. In this connection, it may be mentioned that Mendes has also reported the same chromosome number in the same species from Bolivia, while Fagerlind find $2n$ to be 40.

The details of the chromosome constitution are under investigation and also the maximum numbers of nucleoli formed at telophase, with a view to tracing the phylogeny and inter-relationships.

(c) *Yeast Breeding Scheme*—This is a scheme financed by the Bengal Immunity Co., Ltd., and the following were the main lines of investigations :

(i) Hybridization of the different species and strains of *Saccharomyces*, with a view to evolve suitable high yielding types.

(ii) Critical studies on the external morphology and the nature of the vacuoles as an aid in the classification.

(iii) Cytological investigations in some strains of yeast with a view to formulate the breeding technique.

Three strains of *S. cerevisiae*, 2 strains of *S. ellipsoideus* and one strain of *S. sake* were used in the experiments in addition to 4 strains of *Torulopsis utilis*.

Repeated single cell cultures were made before sporulation was attempted in the sporulating yeasts. The usual methods for inducing ascospore formation were tried with several modifications, but without much success. Best results were obtained when over sterilized wort agar media were used and this method with certain modifications was used subsequently.

Out of a total of 34 combinations attempted, only 6 proved successful including a single case of intergeneric cross. The probable causes for this high percentage of failure are given elsewhere.

The importance of hybridization in producing new ultimate characters may be seen from the reported chemical behaviour of the following crosses. While *S. cerevisiae* 918 does not utilise either nitrates or alcohol, and *S. cere-*

Morphological and vacuolar studies were made in some of the parents and the hybrids and interesting results have been obtained. The details are included in the full report.

The generation time in the pure types and the hybrids was also studied. It was seen that some of the hybrids had a lower generation time than that of the parents.

Certain cytological investigations were also made in some of the pure types and hybrids and the details are included in the full report.

(d) *Studies in Jute*—Irradiation experiments were continued with the seeds of D. 154 and D. 386 of *Corchorus Capsularies* and C.G. and R. 26 of *C. Olitorius*.

This is a scheme financed by the Indian Central Jute Committee for 3 years, the object being to induce hereditary changes in the jute seeds by subjecting them to neutrons, gamma and X-rays. The scheme was put into operation on August 1st 1945.

During the year under report, the following doses were given : X-rays—3, 4, 5, and 6 hours on all the above types of jute. Gamma rays—72 hours in the dry and moist states in D. 154 only.

The plants were grown at Falta in three replications and before harvesting the total height, the height up to the forking and the basal diameters of all the plants in one replication were taken.

In general, it was found that the treated plants attained a greater height and basal diameter than the controls. Selections were made on the above basis which will be tried in the field during the next season.

The plants treated with gamma rays were found to be much more branched which is not an economic character, unless the branching is from the base, in which case each branch can be treated as a single plant for purpose of retting. Several such plants have been selected and their performance will be studied during the next year. The cytological examination of all the treated and control plants are also being undertaken.

E MICROBIOLOGY

(a) *Fibre retting substances*—Bacteria responsible for retting have been isolated and the enzymes extracted. A comparative study has been made of the rates of activity of Hiparol and bacterial enzymes extracted from *T. paradoxa* and from bacteria. Both Hiparol and bacterial enzymes cause maceration of tissues by attacking the middle lamella and breaking down pectin by a sequence of changes, both physical and chemical, to reducing sugar, galacturonic acid and methyl alcohol.

The time required for retting of jute, coconut, ramie by Hiparol and by bacterial enzymes varies from 1-7 days, depending on the type of plant tissues used. Hiparol is more active as a retting reagent than the bacterial enzymes.

Samples of sacking cloth and jute carpets have been prepared from jute root cuttings, by "softening" and "clearing" by Hiparol and bacterial enzymes and processing in the mill. Samples of cloth prepared from jute root cuttings treated by Hiparol and bacterial enzymes show greater weights per square yard and higher tensile strength than standard mill quality samples ; the soft yarns being more compactly spun due to better softening of the treated cuttings, indicating no enhancement of the fibre slippage due to processing and no weakening effect of the treatment on the fibre. A saving in processing and

handling charges approximately 35-40 per cent per ton on a 50 per cent cuttings basis in the production of sack web is indicated. Jute root cuttings treated by Hiparol and bacterial enzymes can be successfully processed by eliminating Softners, one Teazer and one Drawing, or Softners and two Teazers and mineral oil. The possibilities of utilizing Ramie, Flax and Coconut in industry are now being investigated.

The process of recovering the end products formed, chiefly galacturonic acid, acetic acid, butyric acid, acetone, butyl alcohol, ethyl alcohol, during hydrolysis by Hiparol and bacterial enzymes is now being investigated.

The possibilities of utilising Hiparol as a source of diastase and as a desizing agent are being investigated and plans are now being made to produce Hiparol on a large scale.

(b) *Study of fungal infection—Rice*—The work on the parasitism of *H. Oryzae* on rice plant has been completed and given for publication under the heading "Experimental studies on the parasitism of rice by *H. Oryzae* Breda de Haen and its control in field and storage."

Potatoes—Investigations are being carried out to study the infections of potatoes in storage conditions. Different varieties of potatoes are being collected.

Five different types of fungi were isolated from infected potatoes. The extent of infection and range of pathogenicity of the organisms are being studied and an arbitrary classification based on the degree of virulence has been made,—aggressive and non-aggressive parasites.

Tobacco—The work has been undertaken with a view to determine the degree of resistance of different varieties of tobacco to infection. A few fungi have been isolated from the infected leaves of "Matihari" variety which are still unidentified. The effect of these fungi on tobacco leaf has not yet been studied.

Diseases of mangoes, pineapples, are being studied with special reference to the physiology of parasitism, mechanism of infection, and their control in storage and in field.

(c) *Effect of irradiation on the parasitic behaviour of fungi*—The biological effect of irradiation on the degree of virulence of fungi parasitic on plants is being studied with a view to find out if change could be induced in the degree of pathogenicity and physiological behaviour. *H. Oryzae* and *Fusarium* sp. have been exposed to γ -rays and neutrons from a Ra-Be source of Ra strength 60 millicuries, and exposure lasting for 28 days. The cultural behaviour of the fungi observed during the experiment is as follows:

Changes in H. Oryzae—There is a gradual increase in the rate of growth of colony, the maximum being reached after fourteen days' exposure; with further increase in the period of exposure there is a gradual decrease in the rate of spread.

There are distinct zonal changes in mycelial colour.

There is greater mycelial growth than in control.

KORWAS and CHEROS. The relationship of blood groups with the population, size and their breeding habits was particularly enquired. This work has to be continued further in order to arrive at a definite conclusion and also to obtain a statistically significant sample of each of the above peoples.

During this year the Imperial Serologist, Tropical School of Medicine, volunteered to defray the cost of immunization experiments in rabbits for the preparation of M and N sera. The N sera is prepared from the blood of the Research Fellow in Anthropology. The work was begun with 6 rabbits, all of which were kept in the Institute.

The Imperial Serologist was also kind enough to supply some Rh antisera which were tried in the field at Palamau. There are difficulties of trying Rh antisera in the field and this preliminary trial has pointed to the necessity of further improvement in technique.

Twins—During this year two pairs of twins were brought in the laboratory for detailed investigations.

Lectures—The annual D.P.H. classes were held as usual in the month of December 1945.