

BOSE RESEARCH INSTITUTE

ANNUAL REPORT

For the year 1944-45

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REPORT OF THE GOVERNING BODY OF THE BOSE RESEARCH INSTITUTE FOR 1944-45

Governing Body—Five ordinary and two special meetings of the Governing Body were held during the year. The most important matter which came up for consideration was the revised Regulations and Bylaws of the Bose Institute, which were received back from the Central Government on 15th July 1944. The original draft as prepared by the Governing Body was forwarded on the 18th of December, 1942. In view of several important alterations introduced in the draft it was necessary to consider them at several meetings.

The Regulations and Bylaws as finally agreed upon were adopted at two special meetings of the Governing Body held on 1st March, 1945.

Prof. N. C. Nag's period of appointment as honorary Assistant Director of the Bose Institute expired on 30th September, 1944. He was elected a member of the Governing Body.

Lectures etc.—The sixth Sir J. C. Bose Memorial Lecture was delivered on 30th November, 1944, by Dr. K. P. Biswas, Superintendent, Royal Botanical Garden, Calcutta ; the subject of his lecture being 'The Evolution of Life Form in Plants.'

The Industrial Research Planning Committee visited the laboratories of the Bose Institute in February, 1945.

Profs. R. A. Fisher, Bazett, Mr. L. K. Elmhirst and several distinguished scientists from China visited the Institute laboratories during the year.

Outside Research Schemes—The following series of investigations were undertaken under grants received from outside bodies.

I. B. S. I. R. grants : (i) Setting up of a generator of powerful ultrasonic waves ; (ii) Cutting and testing of quartz plates for the radio industry.

II. Bengal Immunity Co. Grants : (i) Applied researches in Microbiology ; (ii) Investigations on Vernalization of Paddy, (iii) Production of desirable strains of Yeast by selection and hybridisation.

III. Raymas Corporation—Investigations on Glass production.

Research Projects—The following schemes of investigations (i) On the breeding of long stapled disease resistant cotton suited for cultivation in Bengal ; (ii) On the production of new mutants of Jute by irradiation with X-rays, γ -rays and neutrons, have been forwarded to the Department of Agriculture, Bengal and to the All India Central Jute Committee respectively. The schemes are under consideration by the relevant authorities.

On the suggestion of the Principal Cinchona Officer, Government of India, the following investigations on (i) nutritional requirements of cinchona plants, (ii) on the possibility of acclimatising cinchona plants for growth in the humid tropical plains of India, are being undertaken. At the same time a scheme for investigations

Mr. Nripendranath Pal, Research Assistant in Physics has received an appointment as Technical Assistant, in a Government Scientific Department.

Messrs. Amiya Kumar Adhikary, Paresh Chandra Bose have been appointed research assistants in connections with schemes of investigations financed by the Bengal Immunity Company.

Messrs. Jayantakumar Ganguly, Chittaranjan Das and Amiya Kumar Dutt were appointed Sir J. C. Bose Research Scholars in Botany.

Dr. Basudeb Banerji, Sir J. C. Bose Research Fellow of the Calcutta University continues to work in the Institute.

Honorary workers—Prof. H. P. De of Vidyasagar College, Dr. J. K. Chowdhury of Bethune College, Mrs. Parukutty Baruah and Miss Tharakan of Lady Brabourne College continue their valuable investigations in the Institute as honorary workers.

War Emergency Measures—The house rented in Santipore, for the storing of library books and journals and valuable apparatus and machinery, was vacated towards the end of May, 1944.

A stock-taking of the books and journals was undertaken with the help of an outside librarian. The historical collection of Sir J. C. Bose's instruments is still kept in Mayapuri, Darjeeling.

Dearness Allowances on approved scales have been paid to employees of the Bose Institute drawing salaries up to Rs. 150/- per month. The additional cost involved was about Rs. 5,000/- of which it is expected the Central Government will contribute one half.

Research Activities—The research activities of the Institute have been hampered by the prevailing war conditions leading to shortage of materials and high prices ; continuity of work is hampered by the continuous migrations of qualified fellows and assistants to better paid services elsewhere. Further due to uncertainty as to the outcome of the negotiations with the Central Government on the question of the payment of recurring grants and the conditions attached to them, several important research posts have not been filled up. Under the circumstance planned and uniform advances in all the departments have not been possible. In spite of these difficulties satisfactory progress in the research activities of the Institute has been maintained. A summary of the investigations undertaken during the year is given in the following sections :

A. PHYSICS.

(a) *Spontaneous nuclear fission*—One of the important discoveries of recent years was made by Hahn and Strassmann when they showed that Uranium nucleus when bombarded with neutrons broke up into two lighter nuclei like Ba and Kr. The latter being unstable give rise to a number of radioactive isotopes, of which a fair number have been isolated. Bohr and Wheeler have used a liquid drop model of the nucleus to explain the observed effect. The stability of such nuclei against small deformations diminish with increasing atomic number. The compound nucleus formed by neutron absorption has an excitation energy of the order of 6.8 Mev above the ground state, and if this is a greater than its energy of fission, fission will occur. The resulting nuclei are unstable and, after a series of transformations resulting in the emission of α , γ rays and neutrons end in stable isotopes. These

phenomenon by three independent methods *viz* (i) by counting the number of primary fission particles emitted per unit time by a thin layer of uranium oxide spread on the inner side of an ionisation counter, precaution being taken to suppress the ionisation effects due to emission of α particles, (ii) by counting the number of neutrons emitted by a large mass of uranium oxide surrounding a large proportional counter filled with BF_3 and also with its innerside lined with a thin layer of Boron.

The mean life time obtained by (i) is of the order of 1.3×10^{16} years; by (ii) on the assumption that each fission is accompanied by the emission of one neutron, is of the order 3.8×10^{15} years. The two mean lifetimes become of the same order if it is assumed that each nuclear fission is accompanied by the emission of 2.3 neutrons, which is of the order found for fission induced by neutron bombardments. Further improvements of the at present crude methods are being undertaken. (iii) Chemicals and spectroscopic methods—The stable isotopes which are the end products can be detected by delicate chemical and spectroscopic test. For this purpose an old mineral Uraninite rich in Uranium has been analysed. While a number of the expected stable end product elements have been detected qualitatively, a much larger quantity of the mineral than was available will be required for a quantitative verification. This will consist in finding out whether the most probable end products of nuclear fission are obtained from the mineral in amounts proportional to their atomic weights.

(b) *Nuclear isomerism of Br^{80}* —Further studies have been made of the life periods and energies of β and γ rays emitted from different isomers of Br^{80} produced by neutron bombardment. A tentative scheme of the metastable energy levels of Br^{80} nucleus has been proposed, which appear to account for in a fairly satisfactory manner the results obtained with Br^{80} isomers produced by different experimental methods.

(c) *Cosmic Rays—Wilson Chamber*—Emission of penetrating secondary particles in different thicknesses of lead studied by means of a counter-controlled Wilson Chamber has been previously reported. At present production of such particles in various absorbers is under investigation. The first maximum and minimum for such production has been found for approximately 5 cm and 10 cm of iron. The investigation is being continued.

Photographic Plate—Absorption of the primary component of cosmic rays responsible for the production of meson multiples in different materials has been recently undertaken by keeping special photographic plates at high altitudes under different thicknesses of absorbing materials. Investigations previously reported indicate that the multiple tracks produced in these plates are due principally to multiple meson production in the photographic emulsion. The absorption per primary particle of average energy 10^9 eV per cm in air, water, paraffin and lead has been measured. The results obtained are (i) the absorption per cm length in a medium varies inversely as the average atomic weight of the medium; being the largest in water and lowest in lead. This can be explained on the assumption that the primary particle is a nucleon (proton/neutron), and that the energy loss

created during collisions suffered by a high energy nucleon against a stationary nucleon, when a portion of the bound meson field of the former is radiated away as mesons. For protons of energy 10^9 eV the ratio of the energy loss due to meson production will be of the order of ten times that due to ionization. This prediction appears to be in fair agreement with the results given above. The additional loss suffered by passage through hydrogenous material appears to be due to the production of recoil protons by the high energy primary nucleons.

(d) *Ultrasonic wave generator*—As reported previously we have assembled a powerful generator of electromagnetic oscillations, all of whose constituent parts were constructed in the Institute workshop. Using only one of the demountable valves of the push-pull circuit, we have been able to generate ultrasonic waves of different frequencies, using as generators (i) a quartz crystal plate 10 sq. cm area and 3 mm thick and (ii) a crystal mosaic plate consisting of 3 quartz plates each of thickness 2 mm of total area 16 sq. cm and imbedded between two steel plates each of thickness 4 mm. Ultrasonic waves of frequencies between 3 to 10×10^5 c.s. have been obtained. The energy output has been of the order of 0.7 kw. When the push-pull circuit is in efficient working condition, it is expected that there will be available about 2 kw of output energy. To produce ultrasonic waves of this order of energy output mosaic crystal plates of much larger areas will be necessary. Constructions of such plates are being undertaken.

B. BIOCHEMISTRY.

(a) *Mechanism of enzyme action*—A theory of enzyme action has recently been worked out based upon the assumption of differential catalysis for reversible enzymic processes i.e. the different ionic forms of the enzyme protein molecule catalysing the direct and inverse processes selectively. Available data on biochemical reactions activated by plants and animal phosphorylases have been found to be interpretable in terms of such a unified theory.

The preliminary indications reported last year on the possible existence of two different phosphorylases in potato has been confirmed. A method of separation and purification of the enzymes has been worked out. Investigations are being undertaken to study the synthesising activity of these two enzymes. Other enzymes are also being tried for the synthesis of higher carbohydrates.

(b) *Carotenoid Compounds*—As reported last year carotenoid compounds like crocin and cis and trans dimethyl esters of crocetin have been obtained in pure crystalline form from Indian Saffron. Crocin has been found by Kuhn and Moewus to be present in the motile flagella of *Chlamydomonas eugametos*, while mixture of the two dimethyl esters are responsible for the copulation of the male and female algae. It was further reported that using Molisch's test (No. 1), the presence of carotene compounds in the motile pulvini of the well-known plants *Mimosa pudica*, *Biophytum sensitivum*, *Desmodium gyrans* etc. have been established. The highly oxidisable unsaturated carbon compounds found in the pulvini of these plants by Sir J. C. Bose then appeared to belong to the carotene group. Further investi-

Having thus established the presence of crocetin in extracts from the pulvinus of *M. pudica*, it was thought desirable to devise a microchemical test for detection of the crystals in situ. For this purpose Molisch's test II was employed. The solution used is p-aminodimethyl benzaldehyde dissolved in sulphuric acid which when added to compounds of phloroglucin present in plant tissues gives it a deep red colouration. Molisch in 1928 tried the test on sections of the motile pulvini of different plants and had found the expected deep red colouration. He was therefore of opinion that the unsaturated compound found by Bose, to be compounds of phloroglucin. Molisch's test II was repeated by us recently and his observations were confirmed. But in addition it was noticed that in the portion of the liquid which flowed out of the treated tissue section crystals, identical in shape and colour to crystals of trans crocetin dimethyl ester prepared in the laboratory were present. Such crystals were found in the sections of pulvini of *M. pudica*, aquatic *Mimosa*, secondary pulvini of *M. Spegazzinni* and *Desmodium gyrans*. To test whether crocin reacted in vitro with Molisch's reagent II to produce crystals of transcrocetin dimethylester crystals, the reagents were added to crocin crystals placed on a glass slide, and rhombic shaped orange coloured crystals of transcrocetin dimethyl ester were observed. Thus it is established that Molisch's reagent II is a specific test for the presence of crocin in plant tissues; further the discovery of the presence of crocin in motile organs of higher plants is an important extension of Moewus and Kuhn's observation of its presence in the motile flagella of certain algae.

C. BIOLOGY.

(a) *Plant physiology—Chemical transmission of stimulation*—According to Ricca, Snow and others, excitation from the stimulated stem to the responding leaf is due to the exudation of a specific substance in the stimulated region which is transmitted through the sap by diffusion or transpiration to the region of response. Sir J. C. Bose had shown conclusively that low intensity stimulation in *mimosa* is transmitted through the tissue as physiological excitation. Experiments were undertaken to find out whether a chemical mediator takes part in the process of transmission of stimulation, similar to the function of acetylcholine in the neuromuscular transmission of excitation in animal tissues. Cut ends of two branches of two *M. pudica* plants were joined together by means of a glass tube filled with water. When the plants had returned to their normal states, one of them was strongly electrothermally excited, and in 10 per cent of cases a leaflet of the other plant responded by drooping. The time interval between stimulation and response varied from 1 to 2 hours.

In view of the observation that crocin is always present in motile plant organs, it appeared worthwhile to find out whether introduction of a dilute solution of crocin to the cut end of a branch of *M. pudica* produced stimulation. Cut branches of *M. pudica* were kept with their cut ends in tap water till they were restored to a normal condition, when half of them were transferred to a dilute crocin solution, and the two sets were observed for five hours. If crocin solution acts as a stimulating agent, the leaflets of branches dipped in them would respond by a larger proportion of them drooping. So far no significant differences have been

additional light treatment of five hours at night. The growth and irritability of the treated plants were found to be much more vigorous than those in the untreated ones. Under Molisch reagent II, in the pulvini of treated plants a larger number of orange-coloured crystals were found than in the untreated ones. There was also a marked earliness of flowering in the treated plants. Further investigations are in progress to find out how far the observed effects were due to light treatment alone, and how far they are due to the slightly higher temperature prevalent in the light treatment room.

(b) *Jute—Effect of manurial treatment*—During the last three years a series of investigations on the effect of different manurial treatment on the growth of jute plants and yield of fibres has been undertaken. Results obtained in previous years have been summarised in last year's report. The investigations were carried out with the variety D 154. Last year similar investigations have been undertaken with two other varieties of jute *C. capsularis* and *C. olitorius*. Nitrogen was given in the form of sodium nitrate only. In addition superphosphate treatment either singly or in combinations with nitrates was tried. Weekly height measurements on about 500 plants and the final basal measurements of more than 1,000 plants were recorded for growth. Yield of fibre from all plants growing in the trial plots were obtained. The results obtained are being analysed statistically.

Water requirements of Jute plants—In previous reports it was surmised that the 'die back effect' observed in some experimental jute plants was due to shortage in the water content of the soil. To test this point jute plants were grown on soils under controlled conditions of watering. Jute seeds of D. 154 variety were sown on the 28th June in tubs each containing three plants. They were divided into four groups of ten tubs each and subjected to different watering treatments. In the first group denoted by 'C', the tops of the tubs were kept continuously filled with water and kept in the open. In group 'O' the plants were irrigated with a measured quantity of water once a week, and group 'T', twice a week. They were kept in a glass house sheltered from rain. Group 'W' received a fortnight's treatment similar to 'T' and then the tubs were submerged completely in water. The experiment was discontinued on 4th September, 1944. Measurements were made once a week on the growth of the plants, and the final measurements are given in the following table :

Type of Plants	Total Height in Cms.	% of H ₂ O in pots	Fresh weight of plants		Dry weight of plants	
			Tops	Roots	Tops	Roots
'C'	119.6	29.3	94.5	22.5	19.5	5.1
'O'	65.2	17.9	28.4	5.5	4.4	0.7
'T'	84.3	20.7	53.0	9.0	9.5	2.2
'W'	103.3	submerged	78.0	41.0	13.0	5.1

The best conditions for growth appears to be under conditions 'C', though the root growth is not so large as in 'W' when the tubs were submerged in water. The 'die back effect' did not appear in the 'C' and 'W' groups of plants, which shows

time of severance. (2) The relation of the eyes with the mother tuber was studied anatomically, and the extent of dependence of the eyes on the mother tuber for supply of its nutrient was studied in culture media. (3) The cut eyes were tried to be preserved and their viability tested by sealing the cut surface with different sealing mixtures, to prevent infection and at the same time dessication. It was found that sealed eyes could be kept for a considerable period up to 5 months and retained their viability and gave normal crop. The unsealed eyes dried up and lost their viability within 20 days. (4) Under controlled and identical conditions of cultivation and manuring the plants derived from the isolated eyes gave on average the same yield as those from the whole tubers when the yield was calculated on the basis of single plants.

Breaking down the dormancy of potato tubers—Investigations have been commenced with a view to shortening the period of dormancy of potato by chemical treatment. A reliable and inexpensive method may prove useful for the planting in plains of potato tubers grown in the hills immediately after their harvesting. This may help in getting over the troublesome and wasteful method of storing potatoes for seed purposes. In some treatments sprouting began within three weeks of treatment. Variations have been observed between two varieties, Nainital and Thickrey as regards their responses to similar treatments.

(d) *Vernalization and phasic development of Indian crops.*

Further investigations on the problem of vernalization and the phasic development of some Indian crops were continued. It has been found and reported previously that wheat varieties cultivated in India differ from their closely related temperate wheats in their response to the vernalization process. This difference in behaviour was tentatively attributed to the available post-sowing photoperiods of short day lengths of the tropics in contrast to the long day photoperiods of the temperate regions. In order to make detailed studies and to obtain a comprehensive idea of the differential behaviour of the Indian crops, fresh experiments were conducted with different varieties of paddy both 'aus' and 'amon' in addition to the crops as wheat, barley, oat and jute already taken in hand and being investigated. The results so far obtained on different varieties of paddy and on different wheat varieties have been summarised below :

I. *Preliminary investigations on few 'aus' varieties.*

Four var. of 'aus' paddy viz. Kaktara, Dharial, Saithe, and Kapilmoni were given (1) pre-sowing high temp. treatment 34-35°C for different periods of 3, 7 and 15 days, under conditions of sufficient moisture content and aeration; (2) post-sowing photoperiods of different day lengths. All the four varieties responded differently to the treatment with reference to their germination, tillering, growth, ear-emergence and yield. The rate of growth as indicated by height and tiller output was greatly increased in treated than in the untreated seedlings. The time

II. Preliminary investigations on 'amon' varieties.

Eight varieties of Amon paddy, viz. Bhasamanik, Latisail, Patnai, Jhingasail, Chinsura II, Badkalamkati, Nagra and Tilakkacheri were given pre-sowing treatment of (a) high temp. (34-35°C) for 3, 7 and 15 days by means of the vernalization apparatus; (b) cold temp. (6-8°C) for 15 and 30 days. Further the effects of different photoperiods of short day cycles (8 hrs. light period alternating with 16 hrs. dark period) and of long days (17 hrs. light period alternating with 7 hrs. dark period) and also of different combinations of the two cycles (long days short days) at different stages of the seedlings on growth, tiller output, initiation of flowering and yield were noted. The results indicated that pre-sowing temp. treatments either warm or cold are of varietal nature. Chinsura II, Badkalamkati and Tilakkacheri responded to high temp. treatment and showed an earliness of 18, 13 and 5 days respectively, while the other var. showed no appreciable earliness. No effect was also seen in the matter of earliness of flowering as a result of pre-sowing cold treatment.

The effects of post-sowing photoperiods showed a significant earliness under short days which indicated that (1) to pass the photostage of paddy short days are essential, (2) long days at photostage delayed the earing, (3) when once the photostage was passed under short day conditions even successive long days showed no delayed effect, (4) delaying effect induced by long days at photostage was not recovered by successive short days, (5) periods longer than 24 hrs. cycles showed delaying effect.

Vernalization of wheat.

It has been reported previously that wheat varieties I.P. 165, I.P. 4 and I.P. 52 showed significant earliness in ear-emergence when vernalized seeds were grown under long day conditions i.e. the available light period in the following photophase was in the range of 12 hrs. or more. Light period of short day lengths of less than 12 hrs. have delaying effect. It was concluded that the failure of vernalization to bring an earliness in these wheat varieties was due to the post-sowing environmental conditions of short day lengths and the effect of thermal phase is modified by the second phase (photophase).

Further results corroborating the above findings were obtained in the following investigations on the other varieties as Punjab C 591; Punjab 8A; I.P. 125 and I.P. 114. All these varieties responded to the pre-sowing cold temp. treatment inasmuch as to show an earliness from 2 to 11 days but when the vernalized seeds were grown under different cycles of light and dark period it was found that under the range of long day periods significant earliness in ear-emergence was induced while the short days retarded the same. It was therefore evident that cold temp. effect (vernalization) was associated with post-sowing long day periods and even a few days of long day periods at photostage induced a marked earliness. These long day wheat varieties however also respond to continuous light period without any alternating dark period.

(e) Plant breeding and cytogenetical investigations.

I. Breeding work on Cotton.

The following pure types of cotton from Coimbatore and Lyallpur were grown at Falta and systematic selection was resorted to CO₂, CO₃, CO₄, 4463, 920, 7727-G₃, 6097-C₆, 7070, 6113-F₂, 5286BVI, 7733-8, 7625-1, 7067, 7036, 7116, C-11-2, 4F, L.S.S., 289F/124 and 289F/43.

A large number of F₁S, F₂S are being grown at Falta.

The following Multiple crosses are also being grown :

$(C0_2 \times C0_3) \times (C0_3 \times 4F)$ and $(C0_3 \times 4463 \times C0_3 \times 4F)$

The behaviour of the above under field conditions was studied and the better plants in the population were selected for further work.

From a population of over 3,000 plants nearly 200 selections were made on the basis of lint length, yield and resistance to diseases. These will be tested in the field during the next season to study their behaviour.

II. *Jute* (i) Irradiation and cytological studies in Jute were continued. The seeds of *Corchorus capsularis* D 154 and D 386 and *C. olitorius*, Chinsurah green R. 26 were given the following treatments :

- (1) X-rays $\frac{1}{2}$ hrs., $\frac{3}{4}$ hrs., 1 hour and $1\frac{1}{4}$ hours.
- (2) Gamma rays : 24 hours, 32 hours, 40 hours and 48 hours.
- (3) Neutrons 15 days, 20 days.

In addition, the effect of centrifuging the seeds of D. 154 both in the dry and moist state at 3500-4500 revolutions per minute for $2\frac{1}{2}$ hrs. followed by X-rays in certain cases, was studied.

The following are some of the observations and inferences on the plants raised :

In general the controls are more uniform regarding the heights and the basal diameters than the treated plants and are much less branched. But some of the treated plants were devoid of branches having better heights and basal diameters and these were selected for further study. The heights at which the branches arise in the treated plants varied from 1" to 2.5' feet. In certain cases, branching was observed even under the ground. In a number of the treated plants, branches varying from 2 to 10 in number were observed starting from the base, each branch having a basal diameter of about 1.5". Such plants are economically advantageous in that a much greater yield can be obtained.

Bifurcations of the main stem at a height of 5 to 6 ft. as well as fasciations were also observed.

(ii) Cytological study of the treated materials showed the following peculiarities : (1) Cytomixis in all stages up to Metaphase II, leading to variations in the number of chromosomes in meiosis, (2) Presence of fragments, (3) Chromosome and chromatid bridges in Anaphase I and II, (4) Degeneration of pollen mother cells, tetrads and spores.

In general these abnormalities increased with increase in dosage.

Critical study of the morphology of the chromosomes in *C. capsularis* and *C. olitorius* revealed that the total number of secondary constrictions and satellites was at least 6 in the former and 8 in the latter as against Bhaduri's observations (Proc. Ind. Sci. Congress 1945) of 4 and 5 (probably 6) respectively.

Certain difference in the lustre of the fibres in the treated plants were noticed.

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(1)	Saccharomyces cerevisiae—B. I. Strain	
(2)	" "	2160
(3)	" "	918
(4)	Torulopsis utilis	Y 41
(5)	" "	3571
(6)	" "	3572
(7)	" "	Cawnpore strain
(8)	Saccharomyces ellipsoides	4097
(9)	" "	4108
(10)	" Sake	

The following crosses have been made and handed over to the B. I. Co. Ltd. for testing :

(1)	S. cerevisiae B. I. × S. cerevisiae	2160
(2)	S. " 2160 × S. "	B.I.
(3)	" " 918 × " "	B.I.

As per report of the Bengal Immunity Co. Ltd. 1st and 2nd crosses gave an yield of 7 to 8 % more than the parents. The cells were also bigger.

The third cross resulted in a marked change in the chemical properties. The parents do not utilise nitrates and ferment alcohol. But the hybrid does both. The exact significance of this is being worked out.

(f) MICROBIOLOGY.

Fibre retting substances—As reported last year a fungal enzyme (Hiparol) has been isolated which has the property of retting a large variety of fibres. It has been shown that the enzyme system isolated from the fungus contains a pectinase and the retting action is due to the breakdown of the cementing pectin containing substance present in the fibre.

Similar enzyme systems have been isolated from certain fibre retting bacteria, and the conditions for the growth of these fungi and bacteria in artificial substrates have been worked out. The comparative efficiency of both these group of enzymes for retting purposes is being studied with reference to their utility in retting fine and coarse quality fibres. Recently at the request of the Ministry of Supplies, London, two pounds of these two retting substances have been sent of for investigations as to their suitability for the retting of flax fibres.

Production of Butanol and Acetone—It has been found that the enzyme complex Hiparol is also capable of producing Butanol and Acetone when mixed with suitable substrates. Industrial application of this result is being investigated.

Penicillin—A strain of *P. notatum* has been isolated from local garden soil ; it has been found to possess certain advantages over strains imported from abroad.

The fungus grows well in a suitably modified standard synthetic medium, and the secretion of antibacterial substance begins during the early stages of growth. The filtrate obtained by passing the crude substance through Seitz filter is stable at temperatures up to 40°C, and the potency remains unaltered when stored at room temperature for a long period. A large-scale production of the substance is being undertaken and attempt is being made to separate the active principle of the chemotherapeutic agent from the crude filtrate.

The latter is being used by eminent surgeons for purposes of surgical dressings in cases of Staphylococcus infection and very satisfactory results have already been reported. A list of cases when penicillin solutions supplied has been used successfully is given below :

(1) Infection after appendicitis operation, (2) ditto after operation for spinal caries, (3) sepsis after amputation of a leg, (4) ditto after operation of scrotal tumour, (5) ditto due to injury in leg resulting from an accident, (6) Middle ear suppuration, (7) Empyema, (8) Mastoid abscess, (9) Facial cellulitis and (10) Sycosis.

D ENTOMOLOGY

Mosquito—Cytological studies on the Mosquito pupae have been completed and results of great theoretical importance have been obtained. These are being made ready for publication in the form of a paper.

Acquatic plants as aids to mosquito control—The investigations reported last year is being continued.

In experimental tanks stocked with Hydrilla, Chara and Vallisneria and kept exposed to the sun, about 97% of the larvae of anopheles and culex were seen to die in 3 to 4 days. But when the experimental tank was kept in complete darkness or when the larvae were grown in a tank filled with water taken from a tank filled with aquatic plants, the mortality amongst the larvae was found to be very low. The cause of mortality in the larvae placed in tank stocked with aquatic plants exposed to sun is under investigation.

E ANTHROPOLOGY.

During the year under review the following paper was completed and is now in the press :

The Frequency of Plural and Multiple Births in India.

In the above paper an attempt has been made to find out correct frequencies of twins, triplets and quadruplets in this country. The data were collected during the last five years (1939-44) from the various Indian hospitals and maternity homes. The birth registers of some local hospitals were also consulted. The frequencies of twin, triplet and quadruplet births have been found to be 1 : 79, 1 ; (82.5)² and 1 : (59)³ respectively. The percentages of monozygotic and dizygotic twins as derived from Weinberg's differential rule are 35.3 and 64.7 respectively.

Twins.

The hospital data collected above are further being analysed together with the pedigree material, so far collected, in the light of other factors which appear to be correlated with twin births.

Blood Groups.

Systematic collection of data according to our card index system is going on. This is being done from the local population when a suitable group of blood donors

exact nature and cause of this depopulation certain demographic factors are very significant. The disturbance of sex-ratio, specially, the secondary sex ratio, is certainly indicative of dwindling populations. The high death rates of children, specially girls and women during their active reproductive period are also evident from our data. More data are required from other representative areas of this aboriginal people before we can arrive at a definite conclusion.

Lectures.

The annual D. P. H. classes on Twins were held on December, 5th, 6th, 8th and 9th.

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