CEYLON ASSOCIATION
FOR THE ADVANCEMENT OF SCIENCE

Proceedings of the Twentythird Annual Session

19th-22nd December 1967

PART I

SECTIONAL PROGRAMMES AND ABSTRACTS

COLOMBO 1967

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PART I

SECTIONAL PROGRAMMES AND ABSTRACTS

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SECTION A: MEDICAL AND VETERINARY SCIENCES

(*Physics Theatre*)

Tuesday, 19th December:

2.00 .. Evaluation of drugs in whipworm infestation—E. H. Mirando and N. D. W. Lionel.

2.20 .. Furozolidone in typhoid and paratyphoid fever—M. R. I. Salgado and N. D. W. Lionel.

2.40 .. Oestrogenic activity in *Peucedanum graveolens*—K. Jayasena and H. O. I. Fernando.

3.00 .. A study of malignant tumours of synovial origin—M. Nagendra.

Wednesday, 20th December:

The chemistry and pharmacology of *Thespesia populnea:*

8.30 .. Part I. Optically active Gossypol from *Thespesia populnea*—L. B. de Silva, J. J. King and R. M. Dharmatilleke (jointly with Section E—abstract in Section E).

8.50 .. Part II. Pharmacological studies on Gossypol—K. Jayasena (jointly with Section E).

9.15 .. Oculo-toxic effects of prolonged Chlorpromazine Therapy—Indra Sri Skanda Rajah Sivayoham.

9.35 .. Mitomycin-C in the treatment of squamous carcinoma of the head and neck—R. R. Cooke and N. D. W. Lionel.

9.55 .. Methods of reducing the Hydrocyanic acid content of Manioc for safe consumption—M. R. D. Piyasena and B. A. V. Perera.

10.15 .. Tea.

10.30 .. Polycystic Disease of the Kidneys—Professor Sir Max Rosenheim, P.R.C.P.

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11.30 .. Presidential Address—"The proper study of Mankind....."—A. S. Dissanaike (*Physics Theatre*).

1.15 .. Visit to Glaxo-Allenburys (Ceylon) Ltd.

Thursday, 21st December:

8.30 .. Studies on the duration of the egg laying cycle and dispersal habits of the mosquito *Culex pipiens fatigans* (Wiedmann) by means of mark-release-recapture experiments using poster paint and ^{32}P—W. A. Samarawickrema (jointly with Section D—abstract in Section D).

9.00 .. Further studies of anaemias in women—Beatrice V. de Mel and W. D. Ratnavale.

9.20 .. Study of milk foods in the management of diarrhoeas—Priyani E. Soysa and F. Peiris.

9.40 .. UNESCO-CAAS AWARD FOR SCIENTIST OF THE YEAR—Presentation addresses.

(i) The effect of ischaemia on the excitability of human sensory nerve—K. N. Seneviratne and O. A. Peiris.

10.00 .. (ii) The effect of ischemia on the excitability of sensory nerves in subjects with diabetes mellitus—O. A. Peiris and K. N. Seneviratne.

10.15 .. Tea.

10.50 .. The role of non-agglutinable vibrios in diarrhoeal diseases—L. B. T. Jayasundera, T. Velaudapillai, C. M. Livera and N. M. P. Mendis.

11.10 .. Study of an outbreak of Staphylococcal infection in the maternity ward of the Ratnapura hospital —N. M. P. Mendis, K. Nityananda, T. Velaudapillai, Yvette Hermon and K. Kuganesan.

1.30 .. The Rate of Mortality in the First Year of Life in Ceylon for the period 1953-62—M. K. D. Patel. (Jointly with Section F—abstract in Section F).

2.00 .. Salmonellae, Shigellae and enteropathogenic *E.coli* in uncooked food—T. Velaudapillai, G. R. Niles and W. Nagaratnam.

2.20 .. Semen characteristics and fertility of bulls used in artificial insemination—R. Nadarajah.

2.40 .. Histology of the ox pineal gland—A. D. P. Jayatilaka.

3.00 .. Arachnoid granulations and arachnoid villi in mammals—A. D. P. Jayatilaka.

Friday, 22nd December:

8.00 .. Water vapour pressure in expired air—M. S. Nesarajah.

8.20 .. Aflatoxins I. A new method for the bio-assay of aflatoxins—S. N. Arsecularatne, S. Wijesundera, G. E. Tennekoon, K. Balasubramaniam and L. M. de Silva.

8.40 .. Aflatoxins II. The effect of aflatoxins on rat liver lysosomes—K. Balasubramaniam, S. N. Arsecularatne, S. Wijesundera and G. E. Tennekoon.

9.00 .. Histochemical demonstration of enzymes in brown fat—R. G. Panabokke.

9.20 .. Histochemical demonstration of mucin in freeze dried formalin vapour fixed tissue using fluorrescent and other newer methods—R. G. Panabokke.

9.40 .. Survey of serum calcium levels of some residents in Kandy district and of the students in the Faculty of Medicine, Peradeniya—C. C. Balasubramaniam and L. J. Perera.

10.00 .. Poisoning by chlorinated hydrocarbon insecticides —N. Kodagoda and S. Sivaloganathan.

10.15 .. Tea.

10.45 .. Business Meeting.

ABSTRACTS

EVALUATION OF DRUGS IN WHIPWORM INFESTATION

E. H. MIRANDO

(*Lady Ridgeway Hospital for Children, Colombo*)

AND

N. D. W. LIONEL

(*Department of Pharmacology, University of Ceylon, Colombo*)

The usual method of evaluting the efficacy of drugs in whipworm infestation is to determine the faecal egg count on a single

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day before and after treatment and to express the results as a percentage reduction in the egg count. In the present study the egg counts were determined daily for 7 days in 25 children admitted to a paediatric ward with whipworm infestation, before administering any treatment. It was observed that in the majority of cases there was a wide variation in the egg count from day to day. These findings indicate that unless anthelmintics reduce the egg count to nil after treatment, individual daily variation in egg counts must be taken into account in assessing the percentage reduction in egg count after treatment.

The efficacy of dithiazanine in whipworm infestation was reassessed taking into account the daily variation in egg count. The results are discussed.

FURAZOLIDONE IN TYPHOID AND PARATYPHOID FEVER

M. R. I. Salgado
(*Fever Hospital, Angoda*)
AND
N. D. W. Lionel
(*Department of Pharmacology, University of Ceylon, Colombo*)

Furazolidone is a nitrofurantoin derivative which has been recently reported to be effective in the treatment of typhoid and paratyphoid fever. Initially furazolidone was tried on two patients who had relapsed after a course of chloramphenicol therapy. In view of the good results obtained it was decided to administer furazolidone to untreated patients with typhoid and paratyphoid fever and compare the results with those obtained with chloramphenicol therapy, the allocation to the two treatment groups being made randomly.

Patients with typhoid and paratyphoid fever showing typhoid bacilli in the stools at the end of chloramphenicol therapy were treated with a 5-day course of furazolidone therapy to eliminate typhoid bacilli in the stools and the effects compared with those obtained with a 5-day course of chloramphenicol therapy. The results are discussed.

OESTROGENIC ACTIVITY IN *Peucedanum graveolens*

K. Jayasena and H. O. I. Fernando
(*Medical Research Institute, Colombo*)

The seeds of *Peucedanum graveolens* (Sin: Satakuppa., Tamil: Satakuppi-virai) are used by indigenous practitioners in the treatment of amenorrhoea.

In preliminary tests, aqueous extracts of the seeds have been shown to possess oestrogenic activity when tested by the rat uterus method of Hisaw (1959). The extracts also have the ability to cause maturation of ovarian follicles in immature mice and rats.

It is possible that extracts of the seed cause "oestrogen-withdrawal bleeding" in some women with amenorrhoea.

Reference

Hisaw, F. L. (1959), Comparative effectiveness of oestrogens on fluid imbibition and growth of the rat's uterus. Endocrinology, **64**, 276–289.

A STUDY OF MALIGNANT TUMOURS OF SYNOVIAL ORIGIN

M. Nagendra
(*Department of Pathology, University of Ceylon, Colombo*)

The recognition of these malignant tumours as a definite entity is of recent origin. Formerly most of them were designated as sarcomas. This paper is based on a study of 66 such tumours received for examination at the histopathological laboratory of the University of Ceylon, Colombo during the eleven year period 1955-65.

These tumours were broadly classified into two major histological types viz. a giant cell type, and a non-giant cell type. There were only 8 (12%) of the former type, the majority viz. 58 (88%) being of the latter type. The incidence of giant cell type tumours is a little higher than what has been reported in the literature.

The commonest site of origin was the lower limb viz. 38 out of a total of 66 tumours arising in this situation. The remaining tumours were distributed over the upper limbs and a few over the rest of the body. In the other series reported in the literature the distribution was the same except that only one tumour was found in a site other than the limbs.

Sex incidence did not show any significant variation.

Out of the 13 cases followed up five patients were still living in August 1966, two having survived for seven years and one for five years.

The histology of the tumours did not differ from what has been reported in the literature. The histological features are illustrated and discussed.

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THE CHEMISTRY AND PHARMACOLOGY OF *Thespesia populnea*

Part (ii) Pharmacological Studies on Gossypol

K. JAYASENA
(*Medical Research Institute, Colombo*)

Pharmacological studies on Gossypol have revealed that the compound possesses the following actions.

1. Sympathomimetic action: The compound appears to have the ability to act both on α and β types of adrenergic receptors. The increase in blood pressure produced by gossypol is of two types depending on the dose used—large doses cause a sustained rise while smaller doses produce a transient rise of blood pressure.

2. Antihistaminic action: When tested on the isolated guinea pig ileum, gossypol shows antihistaminic activity in concentrations of 2—4 μg/ml. A parallel shift in the dose-response curve is produced indicating that the antagonism is of a competitive nature.

3. Anti—5-Hydroxytryptamine action.

The Pharmacological studies were done with both optically active and inactive forms of gossypol.

These actions of gossypol may explain the use of Thespesia preparations by indigenous practitioners in the treatment of bronchial asthma and skin diseases.

OCULO-TOXIC EFFECTS OF PROLONGED CHLORPROMAZINE THERAPY

INDRA SRI SKANDA RAJAH SIVAYOHAM
(*Victoria Memorial Eye Hospital, Colombo*)

The tranquilising effect of chlorpromazine has been long recognised. It has been used extensively as long term therapy for mental disorders and short term therapy for transient anxiety states and as premedication for anaesthesia.

Of abiding interest is the effect on the eye of prolonged chlorpromazine therapy which has been recognised and reported within the last two to three years. All the investigations appear to have been done on subjects in Western countries.

An analysis of changes seen in the eyes of a series of Ceylonese subjects on prolonged chlorpromazine therapy is here reported. Although the dosage—toxic effect relationship does not appear to

be different, the pattern of distribution of the pigmentary deposits seems to be different from that reported in subjects in Western countries. The significance of the different patterns of distribution of the deposits found in the lens and cornea is discussed. An attempt is made to correlate the changes found with the degree of visual impairment and dosage.

MITOMYCIN-C IN THE TREATMENT OF SQUAMOUS CARCINOMA OF THE HEAD AND NECK

R. R. COOKE
(*Cancer Institute, Maharagama*)

AND

N. D. W. LIONEL
(*Department of Pharmacology, University of Ceylon, Colombo*)

Mitomycin-C is an antitumour antibiotic used extensively in Japan in the treatment of various types of malignant disease. In this study Mitomycin-C was administered by continuous intra-arterial infusion to 30 patients with inoperable squamous carcinoma of the head and neck. Significant pain relief and regression of the tumour was obtained in 50 per cent of patients. Side effects occurring during treatment, were noted.

METHODS OF REDUCING THE HYDROCYANIC ACID CONTENT OF MANIOC FOR SAFE CONSUMPTION

M. R. D. PIYASENA AND B. A. V. PERERA
(*Department of Pharmacology, Medical Research Institute, Colombo*)

Manioc, though a common item of food, does sometimes cause poisoning which may be fatal. The toxic effects are thought to be due to the liberation in the body of hydrocyanic acid from a precursor in the tuber. (Charavanapavan 1944). There is a controversy as to whether it is safer to eat only the fresh, undamaged tubers or whether the yams should be damaged and exposed to the air for a few days before use. Several workers in Ceylon (Joachim and Panditteseka ra 1944, Charavanapavan 1944, Nicholls 1963) have recommended that only the fresh undamaged tubers be used for eating, whilst others (Nijholt 1964) advocate the use of damaged and exposed tubers for human consumption. In the present work, this problem has been investigated by estimating the HCN content of the fresh undamaged tubers and comparing it with that of tubers damaged and stored for varying lengths of time.

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Although cooking in an open vessel removes much of the HCN in manioc, there is still a considerable amount left behind, which has been removed in the laboratory by acid hydrolysis. This procedure, apart from rendering the manioc unpalatable, is not of much practical use. Attempts have been made to reduce the bound fraction of HCN by pretreatment of manioc tubers with common spices such as ginger, garlic, tamarind etc., and the results will be discussed.

References

1. Charavanapavan, C., (1944). Studies in Manioc and Lima beans with special reference to their utilization as harmless food. Trop. Agriculturist. **100.** 164.
2. Joachim, A. W. R. and Panditteseker̀a. D. G. (1944). Investigations of the Hydrocyanic Acid content of Manioc. Trop. Agriculturist. **100,** 150.
3. Nicholls, L., (1963). *Tropical Nutrition and Dietetics* Vth edition. London. Balliere, Tindall and Cox.
4. Nijholt, J. A., (1964). Report of the survey on Cassava production and processing in Ceylon. p 6–7. Rome. Food and Agriculture Organisation publication.

FURTHER STUDIES OF ANAEMIAS IN WOMEN

(The effect of iron supplementation on the haemoglobin levels of young unmarried rural and urban girls)

BEATRICE V. DE MEL

(*Medical Research Institute, Colombo*)

AND

W. D. RATNAVALE

Previous work (de Mel, 1961; de Mel et al, 1966) has shown that iron deficiency anaemias are prevalent amongst adolescent and young unmarried girls especially of the lower income groups on their customary Cereal-Pulse Vegetable dietaries. These studies were made to determine the effect of iron supplementation on the haemoglobin levels of young unmarried girls on known dietaries in Institutions.

The haemoglobin levels of 60 lower income group rural girls in two batches attending a three-month resident course at the Lanka Mahila Samiti centre at Kaduwela were determined and found to be less than 13g/100ml. Haemoglobin levels of upper income adolescent girls were found to be 13.1 ± 1.11 g/100 ml. (de Mel et al 1966). The former were given a supplement of 60 mg of elemental iron per day for 2½ months. The iron was given in the form of a 3 grain ferrous sulphate tablet under the direct supervision of the staff at the Centre.

Thirty undergraduates of the lower income group resident in a Colombo Hostel were similarly studied. The haemoglobin levels of 30 upper income undergraduates were used as controls.

The dietaries of all girls studied being known, the effect of iron supplementation is discussed.

References

de Mel, B. V. (1961). Studies of anaemias in pregnant mothers. *Proc. Ceylon Ass. Advmt. Sci.*, 1, 9.

de Mel, B. V. and Sentheshanmuganathan, S. (1966). Further studies of Anaemias in Pregnant Mothers. *Proc. Ceylon Ass. Advmt. Sci.* 1, 17,

STUDY OF MILK FOODS IN THE MANAGEMENT OF DIARRHOEAS

PRIYANI E. SOYSA AND F. PEIRIS

(*Department of Paediatrics, University of Ceylon, Colombo*)

It has been a clinical impression in the minds of most practitioners that a period of starvation and a reduction of the fat content of milk are important in the management of diarrhoeas.

Recent studies by various workers have however shown that neither a period of starvation nor a reduction of the fat content of milk has any influence on the course of diarrhoeas other than in the sprue syndrome.

This is a study based on about 90 cases of diarrhoea admitted to the Professorial Unit of the Children's Hospital, Colombo between January and June 1967.

Children under the age of 5 years were included in the study. Prematures were excluded. The majority were children under one year of age. They were randomly divided into three groups. One group received full cream milk, the second half-cream milk and the third skimmed milk.

The analysis is in respect of age, course of the disease and the rapidity of improvement.

The conclusion is that there is no significant difference between the groups as regards the course of the illness and its final outcome.

THE EFFECT OF ISCHAEMIA ON THE EXCITABILITY OF HUMAN SENSORY NERVE

K. N. SENEVIRATNE AND O. A. PEIRIS

(*Departments of Physiology and Medicine, Faculty of Medicine, University of Ceylon, Colombo*)

A technique has been developed for recording the sensory nerve potential evoked in the median nerve of human subjects by an

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electrical stimulus applied simultaneously to the digital nerves of the thumb and first three fingers of the hand. The reliability of the method has been established by measuring the level of constancy of the response to a stimulus applied at intervals of one minute for periods upto one hour, in a series of forty control subjects who were healthy males between 15 and 35 years of age.

Changes in the excitability of the sensory nerve were investigated by studying the variation in size of the evoked response during a 30 minute period of complete vascular occlusion applied to the arm and during the 30-minute period following the restoration of the circulation.

The results indicate that in control subjects the response pattern is a remarkably constant one and that the characteristic features of this response are determined by the size of the electrical stimulus used. The difference in patterns produced by supra-maximal or submaximal stimuli has enabled an evaluation of the functional state of the different fibre groups of the compound nerve to be made.

These results are discussed with reference to the site, nature and mode of production of the nerve impulses which are responsible for the subjective "pins and needles" sensation.

THE EFFECT OF ISCHAEMIA ON THE EXCITABILITY OF SENSORY NERVES IN SUBJECTS WITH DIABETES MELLITUS

O. A. Peiris and K. N. Seneviratne

(*Departments of Medicine and Physiology, Faculty of Medicine, University of Ceylon, Colombo*)

The effect of ischaemia on the excitability of sensory nerves in diabetic subjects has been studied by the evoked potential technique. 12 subjects between the ages of 15 and 45 have been studied in this series. Six of them had no evidence of a peripheral neuropathy as determined by clinical and conventional electro-diagnostic procedures, while six of a comparable age group had evidence of a neuropathy.

All 12 patients studied showed a common response pattern when their upper limbs were subjected to ischaemia. This pattern was very different to that of normal healthy subjects and was characterized by a relative constancy of the size, latency and duration of a response during the half hour of complete vascular occlusion.

The results of this study provide clear evidence that objective changes of sensory nerve function can be demonstrated at a very early stage of the diabetic process—well before the conventional electro-diagnostic and clinical techniques are capable of demonstrating such changes.

THE ROLE OF NON-AGGLUTINABLE VIBRIOS IN DIARRHOEAL DISEASES

L. B. T. Jayasundera, T. Velaudapillai, C. M. Livera

(*Medical Research Institute, Colombo*)

and

N. M. P. Mendis

(*Epidemiological Unit, Health Department, Colombo*)

1. Non-agglutinable vibrios were isolated from diarrhoeal cases. Most of the isolations were from elderly people.

2. *V. cholerae* biotype *El Tor* was isolated from a diarrhoeal case who was continuously residing in Ceylon.

3. All the vibrios isolated were from people residing in the northern coastal towns of Kayts, Mannar and Mullaitivu.

4. The majority of the strains of NAG vibrios were not pathogenic to adult rabbits.

STUDY OF AN OUTBREAK OF STAPHYLOCOCCAL INFECTION IN THE MATERNITY WARD OF THE RATNAPURA HOSPITAL

N. M. P. Mendis, K. Nityananda, T. Velaudapillai, Yvette Hermon and K. Kuganesan

(*Medical Research Institute, Colombo*)

An increasing incidence of Staphylococcal sepsis amongst the newborn babies in the Maternity Unit of Ratnapura Hospital was reported during the first quarter of 1967.

Investigations revealed that the Staphylococcal carrier rate amongst the nursing staff of the Unit was 15%. The infants were found to be rapidly colonized—33% in 24 hours and 62% in 72 hours after delivery.

Environmental contamination was heavy, particularly in the post-natal section of the Unit where almost 70% of the beds were contaminated.

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Phage typing of the strains isolated showed that 94% of the Staphylococci belonged to lytic group III and the predominant phage pattern was 6/54.

SALMONELLAE, SHIGELLAE AND ENTEROPATHOGENIC *E.coli* IN UNCOOKED FOOD

T. Velaudapillai, G. R. Niles and W. Nagaratnam
(*Medical Research Institute, Colombo*)

1. Centrifuged deposits of washings of vegetables and fruits were plated on S.S., desoxycholate citrate and MacConkey agar for evidence of salmonellae, shigellae and enteropathogenic *E.coli*.

2. Vegetables like beans, carrots, cabbage, celery, elabatu, leeks, lettuce, kankun, pumpkin, spinnach etc., were found to be contaminated with salmonellae, shigellae and enteropathogenic *E.coli*. The extent of contamination of the vegetables which grew to a height of about a foot above the ground was greater than that of the taller varieties.

3. The rate of contamination of fruits was almost negligible.

4. The results are discussed.

SEMEN CHARACTERISTICS AND FERTILITY OF BULLS USED IN ARTIFICIAL INSEMINATION

R. Nadarajah
(*Central Artificial Insemination Station, Kundasale*)

A study has been made of certain semen characteristics, age and fertility of bulls used in artificial insemination. Thirty-nine ejaculates from eleven bulls of the three dairy breeds (Jersey, Ayrshire and Friesian) used were examined. The following semen characteristics were studied:

Volume of ejaculate,
Concentration of spermatozoa,
Proportion of dead spermatozoa,
Proportion of morphologically abnormal spermatozoa,
Motility of spermatozoa.

The mean volume of ejaculates is higher than that observed by Bishop et al (1954). Significant differences between the Jersey and Ayrshire breeds were observed for concentration of spermatozoa

($P<0.05$) and motility ($P<0.05$). The mean concentration of spermatozoa is less than that reported by Bishop et al (1954). It was also observed that the mean proportion of dead spermatozoa is very much lower than that reported by Lasley and Bogart (1943) and Bishop et al (1954). No significant differences in fertility were observed between bulls or between breeds as reported by other workers. In this study there was no evidence of a direct relationship between age of bull and ejaculate volume as reported by Bishop et al (1954); Anderson (1945) and others. A positive correlation ($P<0.05$) was however observed between 'initial motility' and fertility. Cupps et al (1953); Cheng et al (1949); Lasley and Bogart (1943) have reported negative or indefinite results in their correlation studies.

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Bishop, M. W. H., Campbell, R. C., Hancock, J. L. and Walton, A. (1954). Semen characteristics and fertility in bull. *J. Agri. Sci.* **44**, 227.

Cheng, P., Cassida, L. E. and Barrett, G. R. (1949). Effects of dilution on motility of bull spermatazoa and the relation between motilily in high dilution and fertility *J. Anim. Sci.* **8**, 81.

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Lasley, J. F. and Bogart, I. (1943). Some factors influencing reproductive efficiency of range cattle under artificial and natural breeding conditions. *Res. Bull. Mo. Agric. Exp. Std. No.* 376. 56.

HISTOLOGY OF THE OX PINEAL GLAND

A. D. P. Jayatilaka
(*Department of Anatomy, University of Ceylon, Peradeniya*)

In comparative studies of the pineal gland or epiphysis cerebri in mammals, only passing reference is made to the cells present in the ox pineal. This study was undertaken to investigate the histology of the ox pineal in greater detail. Paraffin and frozen sections were stained by the standard histological methods for nerve tissue.

The ox pineal could be roughly divided into a thin outer cortex and a central medullary region. The characteristic cells of the medulla are the parenchymal cells or pineocytes, which are arranged in follicles or as solid structures. These cells are aldehyde-fuchsin positive suggesting that they are of a secretory nature.

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The thin outer cortex is made up chiefly of astroglia, forming a peripheral network and are inter-connected with the astroglia found diffusely in the medulla. Oligodendroglia and microglia are found scattered irregularly in the cortex with a greater accumulation of these cells at the apex of the gland.

No nerve cells are observed. However, a large number of nerve fibres are present in the organ and these enter the epiphysis from the habenular and posterior commissures. There are numerous end formations of the nerves which can frequently be traced to the surface of parenchymal cells and to blood vessels.

ARACHNOID GRANULATIONS AND ARACHNOID VILLI IN MAMMALS

A. D. P. Jayatilaka

(*Department of Anatomy, University of Ceylon, Peradeniya*)

There is no general agreement regarding the presence of arachnoid villi in mammals. This seems to have arisen from the fact that various authors have used different criteria in distinguishing between the two terms 'Arachnoid granulation' and 'arachnoid villus'. The term 'granulation' has been used to denote structures which are visible to the unaided eye while structures very similar in morphology but only observed with the aid of a microscope are called 'villi' (Jayatilaka, 1965). A survey was carried out to determine the presence of granulations and villi in Man and a few mammals.

Granulations are present in the adult human, in the dog and cattle while villi are found in the human neonatus, in the cat, in the guinea pig and the rabbit. In the rat, there are no intra-cranial villi, but structures resembling villi are found in the thoracic spinal region, at the point of exit of spinal nerves.

The possibility that the presence of arachnoid granulations or villi in an animal may be in some way related to either its posture or its size is discussed.

Reference

Jayatilaka, A. D. P. (1965). Arachnoid granulations in sheep. *J. Anat. Lond.* **99**, 315-327.

WATER VAPOUR PRESSURE IN EXPIRED AIR

M. S. Nesarajah

(*Department of Physiology, University of Ceylon, Colombo*)

A method for the direct and continuous breath by breath measurement of the partial pressure of water vapour in expired air using a Respiratory Mass Spectrometer is described.

Measurements have been made at the lips and in the oral cavity in normal subjects and in patients with chronic obstructive airways disease.

In the normal subjects the intra-oral values were found to be significantly higher ($P<0.001$) than the values obtained at the lips. Both sets of values were however consistent with those obtained using indirect methods by earlier workers.

The pattern of values obtained in the patients was similar to that in normal subjects although the values in the patients were slightly lower.

AFLATOXINS I

A NEW METHOD FOR THE BIOASSAY OF AFLATOXINS

S. N. Arseculeratne, S. Wijesundera, G. E. Tennekoon, K. Balasubramaniam and L. M. de Silva

(*Department of Bacteriology, Biochemistry and Pathology, Univertisy of Ceylon, Peradeniya*)

Aflatoxins are a recently discovered group of fungal metabolites which are lethal, hepatotoxic and potent liver carcinogenic agents. Aflatoxicosis in farm and laboratory animals has been extensively studied while human cases of aflatoxicosis have been recorded. Aflatoxin contamination of animal and human foodstuffs has been reported. Current field research is directed towards detecting and the assay of aflatoxin contamination and a study of the toxigenicity of fungal isolates. The methods available at present for the bioassay of aflatoxins are reviewed and a new method is presented which is based on lethality of aflatoxin to tadpoles of *Bufo melanostictus* (Schneider) and *Rhacophorus leucomystax maculatus* (Gray).

The tadpole test is a cheap, easily handled, reproducible biological test which provides accurate quantitation. The specificity of death is confirmed by histological examination of the liver. The effects of aflatoxin on the histology of the liver and on metamorphosis are described.

AFLATOXINS II

THE EFFECT OF AFLATOXINS ON RAT LIVER LYSOSOMES

K. Balasubramaniam, S. N. Arseculeratne, S. Wijesundera and G. E. Tennekoon

(*Departments of Biochemistry, Bacteriology and Pathology, University of Ceylon, Peradeniya*)

One of the current views on the mechanism of the action of toxins and carcinogens is that they affect the integrity of the lysosomal membrane leading to cell necrosis or to tumour formation.

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As far as we know there is no record of the effect of aflatoxin on lysosomes. We have therefore carried out investigations to determine whether aflatoxins exert such an effect on the lysosomes of rat liver.

Young rats weighing approximately 50g were administered sublethal doses of aflatoxin intraperitoneally and the amount of acid phosphatase released from the liver lysosomes into the cytoplasm was measured using the method of King and King (1954). There was no difference in the amount of acid phosphatase released, between the control and the aflatoxin treated rats. Histological appearance of the livers of aflatoxin treated rats however showed signs of cell damage. Similar results were obtained in *in vitro* experiments in which normal rat liver lysosomes were incubated with aflatoxin.

These experiments indicate that the aflatoxins do not act on the lysosomes but on the nucleus of the cell. The results are in agreement with those of Clifford and Rees (1967) who suggest that aflatoxin probably causes necrosis by interacting with the cell DNA.

References

King, P. R. N. and King, E. J. (1954) Estimation of plasma phosphatase by determination of hydrolysed phenol with amino-antipyrine. *J. clin. Path.*, **7**, 322.

Clifford, J. I. and Rees, K. R. (1967) Action of Aflatoxin B1 on the rat liver. *Biochem. J.*, **102**, 65.

HISTOCHEMICAL DEMONSTRATION OF ENZYMES IN BROWN FAT

R. G. Panabokke

(*Department of Pathology, University of Ceylon, Peradeniya*)

Attempts were made to demonstrate enzymes in brown fat taken from the interscapular region of albino rats. The investigation was directed at ascertaining the feasibility of using histochemical techniques in order to determine enzyme alterations in pathological lesions of fatty tissue.

Enzymes such as acid phosphatase, esterase, lipase, adenosine triphosphatase, cytochrome oxidase, glycerophosphate dehydrogenase, succinic dehydrogenase, DPN diaphorase, malate dehydrogenase and glucose 6-dehydrogenase were successfully demonstrated in brown fat.

HISTOCHEMICAL DEMONSTRATION OF MUCIN IN FREEZE DRIED FORMALIN VAPOUR FIXED TISSUE USING FLUORESCENT AND OTHER NEWER METHODS

R. G. Panabokke

(*Department of Pathology, University of Ceylon, Peradeniya*)

In order to minimize diffusion and loss of tissue components which accompany chemical fixation with liquid fixatives, Pearse and Tock (1965) employed a process of freeze drying followed by immediate treatment of tissue with fixative vapours. They found that mucins were better preserved, and stained more intensely and sharply, with formalin vapour treatment after freeze drying.

In the present study, the suitability of applying this technique of preparation of tissue for staining mucin, with fluorescent dyes like acriflavine, coriophosphine and salicyloyl hydrazide were tested on rat tissues. Along with this, a new method for staining mucin designed by Pearse (1967) and Pearse and Stoward (1967) using tetrazotised dimethoxybenzidine fluoroborate (T.D.M.B.F.) was tried out on freeze dried formalin vapour fixed tissue.

Results are presented showing that mucin could be demonstrated by the above methods.

References

Pearse, A. G. E. (1967). Personal communication.

Pearse, A. G. E. and Tock, E. C. P. (1965). Preservation of tissue mucins by freeze drying and vapour fixation. *J.Roy. Microsc. Soc.* 84, 398.

Pearse, A. G. E. and Stoward, P. J. (1967). Personal communication from Professor A. G. E. Pearse.

SURVEY OF SERUM CALCIUM LEVELS OF SOME RESIDENTS IN KANDY DISTRICT AND OF STUDENTS IN THE FACULTY OF MEDICINE, PERADENIYA

C. C. Balasubramaniam and L. J. Perera.

(*Department of Pathology, General Hospital, Kandy*)

It was repeatedly observed that serum calcium levels for the students specially from the Northern and the Southern provinces were high. This survey was therefore done mainly to compare the serum calcium levels of those students and of residents of Kandy District. This was done first on Medical students from the Northern and the Southern provinces. Both males and females between the ages of 18-30 years were selected. This was followed by another series of investigations on residents in Kandy District. Blood was

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collected from blood donors at the Blood Bank, General Hospital, Kandy. All these donors were healthy subjects, both males and females, aged between 18 and 35 years. The results show that the serum calcium levels of those from Northern and Southern provinces are significantly high as compared to the serum calcium levels of those in Kandy District and this difference is discussed.

POISONING BY CHLORINATED HYDROCARBON INSECTICIDES

N. KODAGODA AND S. SIVALOGANATHAN

(*Department of Forensic Medicine, University of Ceylon, Colombo*)

Chlorinated hydrocarbon poisoning appears to be a growing hazard in Ceylon. This necessitates laying down of adequate criteria for diagnosis, both in the living as well as in the dead. Apparently, only a limited number of cases of death have been analysed in this country. The position even elsewhere in the world appears to be similar.

A series of cases of death following chlorinated hydrocarbon poisoning has been analysed with regard to the post-mortem findings. An attempt is made to build a characteristic autopsy picture. Difficulties in distinguishing this form of insecticide poisoning from organophosphate poisoning are pointed out.

It is possible that the solvent used in chlorinated hydrocarbon insecticide preparations is at least as toxic as some of the solute itself. The importance of exploring this aspect of the problem is stressed.

SECTION B: AGRICULTURE AND FORESTRY

(*Chemistry Theatre*)

Tuesday, 19th December:

1.30 .. A technique for the laboratory culture of the paddy gall fly, *Pachydiplosis oryzae* (Wood Mason) —Nalini Perera and H. E. Fernando.

2.00 .. The Biology and Control of Rice field Mole Rat, *Gunomys gracilis* (Nehring)—H. E. Fernando, N. Kawamoto and Nalini Perera.

2.30 .. Further observations on the tolerance and susceptibility of Tea clones to shot-hole borer infestations—K. Thirugnanasuntheran and D. Calnaido.

3.00 .. Preliminary investigations on the leaf scorch decline of coconut palms—O. S. Peries and J. K. T. Kirthisinghe (jointly with Section D).

Wednesday, 20th December:

8.00 .. Assessments of crop losses caused by the blister blight fungus of Tea, *Exobasidium vexans* Massee —R. L. de Silva.

8.20 .. Clonal resistance and variation in pathogenicity between isolates of *Phomopsis theae* to canker development in young tea—N. Shanmuganathan and W. R. F. Rodrigo.

8.40 .. The Biology and Control of the Twig caterpillar (*Ectropis bhurmitra* Wlk.) on Tea—W. Danthanarayana.

9.00 .. Experimentally induced nutrient deficiency symptoms in Tea—U. Pethiyagoda, S. Nagarajah and S. Krishnapillai.

9.30 .. Blue-green algae and soil fertility—Prof. G. E. Fogg, F.R.S. (jointly with Section D).

10.15 .. Tea.

10.30 .. Pre-emergence herbicide experiments on ground nut (*Arachis hypogea*) and sorghum (*Sorghum vulgare*)—V. Velmurugu.

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10.50 .. Cotoran—A Promising Dimethylurea compound—as a Pre-emergence Herbicide on Cotton (*Gossypium sp.*)—I. P. S. Dias.

11.10 .. The influence of green chilli demand on dry chilli production—T. Sivalingam.

1.30 .. Induced mutation studies in *Brachiaria brizantha* with Cobalt 60 gamma irradiation—G. W. E. Fernando and P. Ganeshan.

2.00 .. Studies on Ceylon Cocoas I: The sugars in finished cocoa powders—C. V. Pasupathy, U. M. Senanayake and R. O. B. Wijesekera (jointly with Section E—abstract in Section E).

2.30 .. Studies on Ceylon Cocoas II: Assay of Purine bases in cocoa products—C. V. Pasupathy, U. M. Senanayake and R. O. B. Wijesekera (jointly with Section E—abstract in Section E).

3.00 .. Some Agro—Industrial crops of the unirrigable Highlands of the Dry Zone—G. W. E. Fernando and L. J. Fernando.

3.30 .. Presidential Address—"The Economics of Plant Disease Control"—O. S. Peries (*Physics Theatre*).

Thursday, 21st December:

8.30—11.30 Symposium: "Future of plantation crops."

1.30—3.30 Symposium: "Future of plantation crops" (contd.)

Friday, 22nd December:

8.30 .. The Rice soils of Amparai district—A preliminary report—M. W. Thenabadu and B. L. Fernando.

8.50 .. Use of bone meal manure on rice—D. M. Rodrigo.

9.10 .. Performance of granular-compound-fertilizers on Rice in the Wet Zone of Ceylon—M. W. Thenabadu, K. Wickremasinghe and T. B. Perera.

9.30 .. The effect of puddling on the water stability of soil aggregates and changes in pore space distribution—M. W. Thenabadu.

9.50 .. A new approach to rice production—Minimum cultivation technique—M. K. Mittra.

10.15 .. Tea.

10.30 .. Business meeting.

A TECHNIQUE FOR THE LABORATORY CULTURE OF THE PADDY GALL FLY, *Pachydiplosis oryzae* (WOOD-MASON)

NALINI PERERA AND H. E. FERNANDO

(*Division of Entomology, Central Agricultural Research Institute, Peradeniya*)

The paddy gall fly, *Pachydiplosis oryzae* is of great economic importance both in Ceylon and in the greater part of the rice bowl of Asia where this insect is known to be one of the major pests of paddy. Many high yielding varieties, particularly the hybrid H4 which is being used extensively in Ceylon's drive towards self-sufficiency in rice is very susceptible to attack by this pest, suggesting that the potential yields from this hybrid can be far greater if the gall fly can be effectively controlled. Probably one of the most important limiting factors to progress in studies on the control of this pest has been the want of a suitable technique for the large scale culture of this insect in the laboratory.

Our studies have resulted in the development of such a technique. The gravid females were caged for oviposition in chambers of a particular design. Optimal oviposition was found to result when the gravid females were presented with muslin moistened either with distilled water or paddy leaf extract, the latter being superior. Under these conditions each female laid about 200 eggs. The eggs hatched 3 days after oviposition and maximum hatch was recorded when eggs were placed on moist filter paper in closed Petri dishes at a room temperature of 26°C–29°C. Hatching reached a peak during the period 6 p.m.–9 p.m. The larvae were noted to be active when in contact with moisture and sluggish if not so. Immersion for 24 hours either in distilled water or 0.01%–0.1% Teepol spreader sticker solutions of 2-3 day old eggs and freshly hatched larvae indicated that neither of the treatments had any adverse effect on the hatching of eggs and larval survival. The hatchability of eggs when sprayed through a simple spraying device either in distilled water or in Teepol solutions of varying strengths showed no difference.

Several methods of infestations were investigated of which the more successful were, the spraying of a suspension of freshly hatched larvae or 2-3 day old eggs on to the ligular region of plants and the pipetting in, either of the above suspensions on to the bases of paddy seedlings. Humidity was found to be an essential factor for a high degree of infestation.

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THE BIOLOGY AND CONTROL OF THE RICE FIELD MOLE RAT, *Gunomys gracilis* (NEHRING)

H. E. Fernando, Noburu Kawamoto and Nalini Perera

(*Central Agricultural Research Institute, Peradeniya*)

Field rats attacking the standing crop have in recent years assumed the status of major rice pests in most of the rice-growing countries of Asia and Tropical America. Destruction of rat predators, such as snakes, through the use of certain potent organochlopine insecticides in rice fields has been the reason most commonly ascribed for this upsurgence of rice field rat populations. Standard methods of rat control such as poison-baiting and trapping have proved inadequate for the control of these pests. This paper reports the results of studies of the biology and the development of an efficient new method of control of the rice field mole rat of Ceylon, *Gunomys gracilis* (Nehring).

This pest is found throughout Ceylon and, in certain areas, causes very heavy damage to the rice crop by cutting down maturing rice plants and feeding upon the developing earhead primordia and later stages and also by removing mature earheads from the field to be stored for off-season feeding in its burrows in rice field bunds. Biological observations of special significance to the control measures devised against this pest are the findings that (1) *Gunomys* populations are concentrated in burrows in rice field bunds about the time of earhead primordium initiation and immediately thereafter, (2) mature female *Gunomys* are all either nesting or tending litters within these burrows at and after the earhead primordium initiation stage and (3) before the first litter of about 12 young is fully weaned these females are gravid once again and produce an equally large second litter. Reproductive activity of the pest is therefore at its height at this stage and within the restricted environment of rice field bunds.

Simple techniques for rendering the burrows gas-proof are described and the results of ten test fumigations of these burrows with phosphene gas generated from a formulation of aluminium phosphide (Phostoxin, Degesch) are presented. The use of 1.5 grammes of the aluminium phosphide formulation to fumigate the burrows in every 7 to 10 feet of rice field bund colonized by the pest, when the crop is maturing, has given almost 100% control of the pest.

FURTHER OBSERVATIONS ON THE TOLERANCE AND SUSCEPTIBILITY OF TEA CLONES TO SHOT-HOLE BORER INFESTATIONS

K. Thirugnanasuntharan and D. Calnaido

(*Tea Research Institute, Mid-Country Station, Kandy*)

This paper deals with the continuation of research on clonal selection for Shot-hole Borer, initiated by Calnaido, and Kanapathipillai, (1967). These authors evaluated the borer infestation of 31 clones and 1 seedling selection on the clonal proving trial MVP 1 (1961). By applying the same proven techniques, we have evaluated the borer infestations of 16 additional clones of clonal trial MVP 2 (1962) and compared their performances with the results obtained from MVP 1 (1961).

Of the 16 new clones tested OT 5/8 was the best clone as regards borer tolerance, although it was a very poor yielder (with less than 200 pounds made tea/acre/year). Two Passara district clones MPA 1 and NK 4B/29 were found to be moderately good as regards Shot-hole Borer tolerance and also when the characters of yield and drought resistance were taken into consideration. However, the quality of made tea of these two clones is not yet known, and their acceptance as suitable clones will have to await this information. Clones H6A1, TRI 2016 and TRI 2024 were found to be very susceptible to borer infestation. Clone H6A1 has been so severely attacked by Shot-hole Borer that it has failed to build up into a bush even at five years after planting.

The 16 clones of MVP 2 (1962) are compared with the 32 clones of MVP 1 (1961) as regards Shot-hole Borer tolerance and also taking the desirable characteristics of yield, drought resistance and the quality of made tea into consideration. The 16 clones of MVP 2 (1962) were relatively low yielders and none of them were better than TRI 2023 and GD 39 as regards their suitability for Mid-Country propagation.

Reference

Calnaido, D. and Kanapathipillai, P. (1967). Tolerance and susceptibility of tea clones to Shot-hole Borer infestation. *Tea Quart.*, **38**, (in press.)

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PRELIMINARY INVESTIGATIONS ON THE LEAF SCORCH DECLINE OF COCONUT PALMS

O. S. Peries
(*Chemical Industries (Colombo) Ltd.*)
AND
J. K. T. Kirthisinghe
(*Coconut Research Institute, Lunuwila*)

This paper describes the symptoms of the disorder and gives a brief account of the investigations that have been carried out to establish its cause.

The results of early investigations, consisting of empirical trials with foliar sprays of micro-nutrients and fungicides, followed by the injection of micro-nutrients into the trunk of affected palms, are summarised.

Long term investigations carried out to ascertain whether the disorder is of nematological or fungal origin, have shown that although some spear-bearing nematodes and plant parasitic fungi have been isolated from the soil around and/or the roots of affected palms, this association is not consistent.

One full-scale nutrient study is being carried out, with a range of micro-nutrients applied to the soil. This experiment, which is still in progress, is also described.

The paper also collates the data from observations made on plots maintained in the affected area, to study the mode of spread and to gather further information on the nature of this decline. Results of statistical surveys being carried out annually to ascertain the prevalence of the disorder and mortality resulting from it are also referred to.

The view is expressed that, perhaps undue alarm has been caused by this disorder, because its symptoms are spectacular and the affected palms often die. But surveys have shown that the rate of mortality is not high. It is concluded, however, that this is a problem worthy of serious investigation.

ASSESSMENTS OF CROP LOSSES CAUSED BY THE BLISTER BLIGHT FUNGUS OF TEA, *Exobasidium vexans* MASSEE

R. L. de Silva
(*Tea Research Institute of Ceylon, Talawakelle*)

Previous attempts to measure crop losses in tea caused by the blister blight fungus *Exobasidium vexans* Massee have been hampered by various difficulties. Some of these have been resolved,

and the significance of others is discussed. Relationships have been established for blister blight incidence, fungicide concentration, and crop losses in experiments conducted at St. Coombs Estate (elevation 4500 ft.). The possible effects of the presence of shade trees and other factors which affect infection and, therefore, crop are discussed. It seems that Ceylon tea estates could well reduce the dose of fungicide currently used for blister blight control and suffer no ill-effects or crop losses, and thereby effect considerable savings in costs of production and foreign expenditure.

CLONAL RESISTANCE AND VARIATION IN PATHOGENICITY BETWEEN ISOLATES OF *Phomopsis theae* TO CANKER DEVELOPMENT IN YOUNG TEA

N. Shanmuganathan and W. R. F. Rodrigo
(*Tea Research Institute of Ceylon, Talawakelle*)

The incidence of Collar and Branch Canker caused by the fungus, *Phomopsis theae* Petch was observed on more than fifty-five clones on several estates. There was a marked variation in the percentage of infection between the clones. On one estate there was a very high incidence of canker in the clones LD 502 (59%), LD 25 (41%), TRI 2024 (60%) and K 150 (52%). Clones GOR 7/4, LD 512 and WAL 26 from the same estate were completely free of the disease. In a field on St. Coombs Estate, clones NL 3/1, KEN 16/3, PO 26 and UH 9/3 were very badly affected while others like TRI 2023 and TRI 777 were unaffected. Observations made on three other estates revealed that the clones TRI 2023 and TRI 2026 were apparently resistant to the disease.

In the second experiment, 20 clones of 30 plants each were inoculated artificially with the fungus and the resulting cankers were measured. The clones NL 3/1, N 3, UH 9/3 and K 145 gave significantly larger cankers than clones TRI 2039 and DT 1.

In the last experiment, inoculations were made with five different isolates of the fungus on 20 clones of 50 plants each. As expected there was a significant variation in the size of canker formed between the clones, the most resistant clones being TRI 2023 and TRI 2026 and the least resistant being H6 A1. It is interesting to note that a highly significant variation existed between the various isolates in their degree of virulence. A highly significant interaction between clones and isolates was also observed.

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THE BIOLOGY AND CONTROL OF THE TWIG CATERPILLAR (*Ectropis bhurmitra* Wlk.) ON TEA

W. Danthanarayana

(*Tea Research Institute of Ceylon, Talawakelle*)

Twig caterpillar infestations are known to cause considerable damage to tea. There are reasons to believe that the outbreaks that occurred in Ceylon from 1963-1967 were a biological side effect of dieldrin spraying against the Shot-hole borer (*Xyleborus fornicatus* Eichh.) of tea. It was evident that dieldrin, in addition to controlling the Shot-hole Borer, also eliminated certain hymenopterous parasites of caterpillar pests, including the Ichnemonid parasite (Charops sp.) of the Twig Caterpillar. This caused the Twig Caterpillar to regain its status as an important pest of tea, but restrictions on dieldrin applications against Shot-hole Borer since the end of 1966 has reduced the potential of this caterpillar to assume the status of a major pest on tea.

The life history of Twig Caterpillar was studied under field conditions on an estate in Nawalapitiya. The complete life cycle from egg to egg lasts about ten weeks so that there are five to six generations of this insect in a year. The moths lay several hundreds of eggs in masses in the crevices of the bark on shade trees. After an incubation period of eight to nine days the eggs hatch and the minute first stage larvae that emerge are dispersed onto tea by wind. The larvae feed on the tea leaves and undergo five distinct larval stages within 4-5 weeks. The mature larvae descend to the soil beneath the tea bushes for pupation which takes place one or two inches below soil surface. The moths emerge in about three weeks. Copulation takes place soon after emergence and the moths die within three to five days once the oviposition is complete. Studies on the life-cycle indicate that the most appropriate time for chemical control measures is when the caterpillars are in the second and the third stages of their development, that is, during the fourth and the fifth week after the emergence of moths, or when the egg masses are first seen on shade trees.

During this investigation four experiments were carried out on chemical control methods, the results of which were also tested on the large scale. In the first two experiments carried out at Maha Uva estate, Harasbedde, of 17 different chemical treatments evaluated, only two gave significantly lower counts of caterpillars than the untreated, two weeks after treatment. DDT (18 or 25% EC) at the rate of six pints per acre and 'Sandoz' 6538 (25% EC) at the rate of one pint per acre proved to be effective. The control obtained

with 'Sandoz' 6538 appeared to be superior to that obtained with DDT. In the third experiment carried out at Pelmadulla Group, mixtures of DDT with each of the insecticides, parathion, methyl-parathion, endrin and 'Sandoz' 8538 gave better control than when these insecticides were used alone. This experiment was repeated in the laboratory by exposing known numbers of caterpillars to treated tea leaves and the results showed that the best kill was obtained by using either a mixture of DDT and methyl-parathion or a mixture of DDT and 'Sandoz' 6538. As 'Sandoz' 6538 is not yet obtainable on the market, it is concluded that for controlling Twig Caterpillar, DDT (18-25% EC) at the rate of six pints per acre or, for better control, a mixture of four pints of DDT (18-25% EC) and one pint of methyl-parathion (50% EC) can be provisionally recommended.

EXPERIMENTALLY INDUCED NUTRIENT DEFICIENCY SYMPTOMS IN TEA

U. Pethiyagoda, S. Nagarajah and S. Krishnapillai

(*Tea Research Institute, Talawakelle*)

The techniques for the successful management of tea plants in sand culture are briefly described.

By omission of single elements from a complete nutrient solution based on Hewitt's medium, foliar symptoms resulting from deficiencies of nitrogen, potassium, calcium, magnesium, sulphur and manganese have been induced and are described.

There is good agreement between the symptoms induced experimentally and those observed in the field. The possibility that clones may differ in the symptoms manifested is under test.

PRE-EMERGENCE HERBICIDE EXPERIMENTS ON GROUND NUT (*Arachis hypogea*) AND SORGHUM (*Sorghum vulgaro*)

V. Velmurugu

(*Agricultural Research Station, Maha Illuppallama*)

Ground nut is subject to heavy weed infestation during the entire period of its growth in the field. Early control of weeds becomes necessary and enables the crop to spread and cover the field so as to smother any subsequent wood growth.

In Sorghum weed control is often a serious problem and it reduces the yield considerably.

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Experiments with several herbicides as pre-emergence application were carried out on Ground nut and Sorghum at the Agricultural Research Station, Maha Illuppallama.

Amibon (3—Amino—2, 5—dichlorobenzoic acid), Lorox (3— (3, 4—dichloropheyl)—I-Methoxy—I—methylurea) and PCP (Pentachlorophenol) appeared safe at the rates used on Ground nut, while Eptam (Ethyl di-n-propylthiolcarbamato) suppressed the yields.

Of the chemicals tested on Sorghum, Prometryne (4, 6-bisisopropyl amine—2 methylthio 1, 3, 5 triazine), Propazine (2—chloro—4, 6—bisiopropylamino 1, 3, 5 triazine) and Ramrod (Chloro-N—isopropyl acetanilide) appeared promising.

COTORAN—A PROMISING DIMETHYLUREA COMPOUND—AS A PRE-EMERGENCE HERBICIDE ON COTTON (*Gossypium sp.*)

I. P. S. Dias

(*Department of Agriculture, Peradeniya*)

Two seasons' work with a new herbicidal compound-Cotoran-on Cotton (*Gossypium sp.*), is reported in this paper.

In the first season—Maha 1965/66, this compound at 1 and 2 pounds active ingredient per acre were tested against Diuron and Simazine at 2 and 4 pounds active ingredient per acre. All these were used as pre-emergence herbicides. In addition cultural practices such as different mulches were also evaluated against the chemical treatments. Hand weeded plots and unweeded plots served as controls in a replicated randomised block field trial.

In this trial conducted on rainfed cotton at the Cotton Experiment Station, Hambantota, both levels of Cotoran proved significantly superior to all other treatments with the exception of the hand weeded plots. In addition to its efficacy as a pre-emergence weed-killer, Cotoran also appeared to have a wide latitude in its phytotoxic effects on cotton. In contrast, both levels of Diuron and Simazine proved quite phytotoxic to cotton, with attendant drastic reduction of yields.

The effects of Cotoran were so dramatic that in the following Maha season—1966/67—Cotoran by itself was subject to further investigation. Three levels of Cotoran—0.5, 1.0 and 2.0 pounds active ingredient per acre—were tried out again on a pre-emergence

basis, using hand-weeded and unweeded plots as controls. These five treatments were used as sub-treatments in a split plot design having three levels of fertiliser—NPK—as main treatments, in order to investigate fertiliser herbicide interactions, if any.

The pre-emergence herbicidal properties of Cotoran were evident in this season too. The higher rates of 1.0 and 2.0 pounds active ingredient per acre gave yields comparable to the clean weeded plot and these three treatments were significantly superior to the lowest level which in turn proved superior to the unweeded control. No fertiliser herbicide interactions were evident.

At the 10th week stage of the crop a quantitative assessment of the weed fall was made by actually weeding all the plots at this stage. This data also demonstrates the efficacy of the higher levels of Cotoran in the suppression of weeds.

In spite of the weed free state of the crop from the 10th week the yield differences demonstrate the importance of effective elimination of weed competition in the early phases of the crop.

THE INFLUENCE OF GREEN CHILLI DEMAND ON DRY CHILLI PRODUCTION

T. Sivalingam

(*Agricultural Research Station, Maha Illuppallama*)

Chilli is used as a condiment both in dry and green forms. The bulk of the country's production is consumed as green chillies. The production of green chillies has always been sufficient to satisfy demand. The increase in the demand of this produce offsets the production of dry chillies.

The producer is always guided by the net return of his produce. The trend of the market in green chillies in the principal towns indicate that the price of green chillies has been always above the guaranteed price offered to dry chillies on a conversion basis, except for two to three months of the year, where the price is just below the guaranteed price. Hence, it has been profitable for the producer to produce green chillies during the major part of the year.

Other factors such as climate, varieties, cultivation practices and disease hazards also influence the productive efficiency of chillies both in green and dry forms. These are discussed in the light of recent research findings.

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INDUCED MUTATION STUDIES IN *Brachiaria brizantha* WITH COBALT 60 GAMMA IRRADIATION

G. W. E. Fernando and P. Ganeshan
(*Agricultural Research Station, Maha Illuppallama*)

Seeds and cuttings of *Brachiaria brizantha* were irradiated with Cobalt 60 gamma rays. From the irradiated material a number of mutants were isolated and studies were made on their variability, from the parent type. Distinct morphological differences have been observed between the mutants and the parent.

The relative usefulness of some of these mutants in pastures is discussed.

SOME AGRO-INDUSTRIAL CROPS FOR THE UNIRRIGABLE HIGHLANDS OF THE DRY ZONE

G. W. E. Fernando
(*Agricultural Research Station, Maha Illuppallama*)
AND
L. J. Fernando
(*C.I.S.I.R., Colombo*)

Substantial possibilities exist in the Dry Zone for the cultivation of cash crops which can support basic processing and subsequently more sophisticated manufacturing industry with a primary export orientation.

The crops presently programmed for study are those which appear to offer a substantial market potential, external as well as internal, suited to the rainfed unirrigable highlands of the Dry Zone and compatible with the requirements of modern commercial agriculture.

Among such crops now under field study at the Agricultural Research Station, at Maha Illuppallama, are Soyabean, Castor, Camphor-Ocimum, Vetivert, Lemongrass, Saff flower, sunflower, Guar, Manioc and Konaf.

The agronomy of these crops and their agrotechnical potential in relation to the current research findings at Maha Illuppallama are discussed.

THE RICE SOILS OF AMPARAI DISTRICT—A PRELIMINARY REPORT

M. W. Thenabadu and B. L. Fernando
(*Division of Agricultural Chemistry, Central Agricultural Research Institute, Peradeniya*)

The rice soils of Amparai District were studied in order to ascertain edaphological factors that limit productivity. A characteristic feature of these soils is the high content of sand in the profiles. In areas such as Central Camp., Pattimadu and Kora-Kalappu, the textures of surface soils range from sands to loamy sands. The sand fraction of these soils which may be more than 90 per cent reflect their poor nutrient status and water-holding capacity. These soils are low in organic matter and nitrogen, and in the availability of phosphorus, potassium and other essential nutrient elements. In other areas like Akkaraipattu where the soils are less sandy the organic matter content and fertility are comparatively higher.

The characteristics of these soils are discussed on the basis of laboratory and field data and remedial measures suggested to improve their fertility.

USE OF BONEMEAL MANURE ON RICE

D. M. Rodrigo
(*Central Agricultural Research Institute, Peradeniya*)

Before 1939 paddy lands were generally not fertilized. If any fertilizers were used at all it was only bonemeal, as bonemeal, which could be stored for a number of years, was available in local shops. Though it is more economical to use inorganic fertilizers than bonemeal, some farmers having got accustomed to bonemeal still prefer to use it.

Fertilizer trials were carried out in peaty and marshy rice soils at 17 locations in cultivators' fields in Colombo, Kalutara, Galle and Ratnapura Districts to test the efficiency of bonemeal against inorganic fertilizer formulations. A trial was also conducted in the Rice Research Station at Bombuwela.

The following inferences could be drawn from these experiments.

1. Fertilizer formulations containing saphosphosphate with top-dressings of nitrogen and bonemeal with top-dressings of nitrogen, performed better than bonemeal without top-dressings of nitrogen.

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2. There was no significant difference between saphosphosphate with top-dressings of nitrogen and bonemeal with top-dressings of nitrogen.

3. Top-dressings of nitrogen appear to be essential.

PERFORMANCE OF GRANULAR-COMPOUND-FERTILIZERS ON RICE IN THE WET-ZONE OF CEYLON

M. W. Thenabadu, K. Wickremasinghe and T. B. Perera

(*Division of Agricultural Chemistry, Central Agricultural Research Institute, Peradeniya*)

Several factors hinder the efficient use of fertilizers applied to rice fields in the wet-zone of Ceylon. Among these, losses due to leaching probably rank first in order of importance, while excess of a nutrient like nitrogen may cause appreciable yield depressions due to inducement of disease, excessive vegetative growth, and lodging of mature plants.

Experiments with granular-compound-fertilizers on research stations, farms and cultivators' fields in the districts of Ratnapura, Kalutara and Matara have revealed their superiority over simple fertilizers which are currently used. One dressing of a granular-compound-fertilizer either at planting or one week after supplying 45 lbs. each of N, P_2O_5 and K_2O has been found superior to simple fertilizers that supply the same quantities of these nutrients. The results are discussed and the advantages of granular-compound-fertilizers are compared with the simple fertilizers which are currently popular.

THE EFFECT OF PUDDLING ON THE WATER STABILITY OF SOIL AGGREGATES AND THE CHANGES IN PORE SPACE DISTRIBUTION

M. W. Thenabadu

(*Division of Agricultural Chemistry, Central Agricultural Research Institute, Peradeniya*)

Depending on the moisture content at the time of land preparation, cultivation implements affect the stability of soil aggregates and the distribution of pore space in a soil. The effect of puddling on soil structure may however be compensated for if the soil is well supplied with clay, organic matter, sesquioxides, silica and other cementing agents.

Laboratory investigations on the effect of puddling a soil have indicated that a large proportion of soil aggregates are destroyed and virtually reduced to primary particles with the elimination of the non-capillary pore spaces, while the structure of the soil approaches that of a monodispersed system. In contrast, addition of organic matter encouraged the formation of water stable soil aggregates.

Coarse textured soils, inadequately supplied with organic matter and other cementing agents, would suffer considerably from the deleterious effects of puddling which is usual in rice culture. On these soils it would therefore be advisable to adapt alternate cultivation practices to improve their structure.

A NEW APPROACH TO RICE PRODUCTION—MINIMUM CULTIVATION TECHNIQUES

M. K. Mittra

(*Chemical Industries (Colombo) Ltd.*)

A co-operative research project in Ceylon among the Department of Agriculture, Chemical Industries Colombo Ltd., and the Plant Protection Ltd., England, explored the possibility of adopting or developing ploughless farming or chemical cultivation techniques in wetland rice. Extensive trials were conducted in Maha and Yala during 1966-67 at three Government Research Stations at Maha Illuppallama, Bombuwala and Ambalantota, and three cultivators' plots at Akkaraipattu, Vavuniya and Mirissa, covering both dry and wet zones.

Results to date have shown that the number and extent of cultivations now in practice in Ceylon could be minimized considerably with the help of 'Gramoxone' (Paraquat) used as a pre-emergent herbicide. 'Gramoxone', a contact herbicide, when used at a rate of 2 pints/acre to desiccate the existing weeds prior to one cultivation (considered necessary to prepare the seed bed), could eliminate 2 to 3 cultivations/puddling, thus saving time, man, animal and machinery hours and water.

Because of the smaller demand on water, man-animal-and machinery-hours in the new techniques, not only each of the above resources becomes more productive, but also provides a greater flexibility to the techniques themselves.

The saving in time for land preparation amounting to 15 to 30 days in each season has opened the possibility of growing three crops of rice a year in the wet zone (rainfed) as well as dry (irrigated).

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As a result of this co-operative work, it has been possible to make tentative recommendations for 'Gramoxone' minimum cultivation techniques and demonstrations of these techniques to cultivators has already commenced in both dry and wet zones. The basic recommendations are as follows:

1. Spray 'Gramoxone'@ 2 pts./acre,
2. After 3 days give a good cultivation, and
3. Flood for 7 days, then
4. Drain, level and seed or transplant.
5. Use fertilizers at the government recommended dose.

Results obtained upto date and the potential of the techniques are discussed in detail.

SECTION C: ENGINEERING

(Arts Theatre)

Tuesday, 19th December:

2.00 .. Use of rubberised bitumen in roads—M. J. Fernando.

2.45 .. Reinforced-concrete Lintels—M. Amaratunga.

Wednesday, 20th December:

8.30—11.30 Symposium: "Construction methods and quality control at Udawalawe headworks".

Repairs to concrete during construction and maintenance—D. D. Wijemanne.

Concrete mix designs to achieve impermeability—M. W. W. Dharmawardana.

Quality control of concrete for pre-stressed concrete construction—K. Amirthalingam.

1.30—3.30 Symposium: "Construction methods and quality control at Udawalawe headworks" (contd.).

Construction of a Reservoir power plant—S. Pathmanathan.

Construction and quality control of earth embankment—N. K. T. Munasinghe.

Thursday, 21st December:

9.00 .. Energy dissipation in a chute spillway—P. D. H. N. Gomes.

9.30 .. Construction of Ambewala tunnel by the shield method—D. L. O. Mendis.

10.15 .. Tea.

10.30 .. Use of Network Analyser or Digital Computer for Power System Studies—A Comparison—Prof. C. S. Ghosh.

11.30 .. Presidential Address—"Some aspects of water resources development in Ceylon"—H. de S. Manamperi (*Physics Theatre*).

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1.30—3.30 Visit to Walkers.
—"computer programming".

Friday, 22nd December:

9.00 .. Use of aerial survey methods in the study of river courses—A. D. N. Fernando.

10.15 .. Tea.

10.30 .. Prevention and Control of Pollution of Water—D. Subramani.

11.15 .. Business meeting.

ABSTRACTS

REINFORCED-CONCRETE LINTELS

M. AMARATUNGA
(Faculty of Engineering, University of Ceylon, Peradeniya)

Lintels carrying brickwork are usually overdesigned. The load distribution on a lintel is generally assumed to be in the form of an isosceles triangle with the base angles 60° or 45°. The design is then carried out according to standard practice. This paper describes some experimental investigations into the actual load distribution which is found to be entirely different from the assumed distribution. A method of design is discussed and an example of a practical application where a specified 12 inch deep lintel was reduced to a 2 inch deep one is given.

USE OF RUBBERISED BITUMEN IN ROADS

M. J. FERNANDO
(Chemist, Research Institute, P.W.D., Ratmalana)

Attempts were made to study the effective uses of different types of latex blended with bitumen for road surfacings. Definite improvements were observed in the physico-chemical properties of rubberised bitumen so vital to the roads engineer. Difficulties in the addition of latex to bitumen were overcome. Laboratory experiments were conducted to study the dispersion of rubber particles, temperature-dependent properties, rheological properties, ageing and stripping of rubberised bitumen.

Uses of rubber in mix-designs are also evaluated. A new stripping test is devised to study the use of rubberised bitumen. An effective mechanism is proposed to understand the behaviour of rubber particles in bitumen.

An experimental road is laid to investigate the full potentialities of rubberised bitumen on roads under local conditions.

REPAIRS TO CONCRETE DURING CONSTRUCTION AND MAINTENANCE

D. D. WIJEMANNE
(Uda Walawe Project)

During construction of Power Plants and other structures at Uda Walawe Headworks, repairs to concrete during construction has been necessary on account of one or more of the following causes;

Unsatisfactory composition of concrete.
Movement of formwork.
Unsatisfactory vibration and consolidation.
Shrinkage.
Thermal Stresses.
Poor design details.
Settlement of foundation.

Types of repairs can be broadly classified into two catagories, namely repairs that are effected early, and those that should be done after the lapse of some time.

At least the same attention should be paid to repairs, as to actual construction work of concrete structures.

This paper describes how these repairs have been effected according to SPECIFICATIONS drawn up for the purpose jointly by the River Valleys Development Board and the contractors.

Types of repairs include grouting, surface repairs, repairs necessitated by settlement of foundation etc.

A special requirement of the Reservoir Power Plants was the impermeable quality of concrete in the walls. Repairs to the above therefore must satisfy the same conditions of quality. This involves the repairs to cracks using an epoxy resin.

Some deterioration of concrete structures is also anticipated after the filling up of reservoir and proposed repairs to such cases during maintenance are also dealt with.

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CONCRETE MIX DESIGNS TO ACHIEVE IMPERMEABILITY

M. W. W. Dharmawardana
(Uda Walawe Project)

The concrete structures at Uda Walawe Headworks, consist of two reservoir power plants, a river diversion sluice, a gated spillway and the inverted syphon of the left bank channel. The use of impervious concrete is a necessary feature in the construction of these structures. This paper outlines the methods and procedures adopted for:

(i) The preparation of concrete mix designs,

and (ii) the laboratory testing of impermeability. BS 1881 for the testing of concrete and the U S Bureau concrete Manual (Sixth Edition), specified in the contract documents as standards for control of concrete construction, do not specify any methods for the testing of the permeability of concrete. ASTM Proceedings—Volume 36 1936 Part I and the Materials Laboratory manual of the US Bureau of Reclamation Outline methods for permeability tests on concrete.

Since apparatus for such testing was not available in Ceylon an apparatus to suit the requirements was made at the RVDB workshop and testing is being done satisfactorily.

Specimens of concrete have been tested satisfactorily at a constant head of 240 feet of water for 64 hours.

QUALITY CONTROL OF CONCRETE FOR PRE-STRESSED CONCRETE CONSTRUCTION

K. Amirthalingam
(Uda Walawe Project)

At Uda-Walawe Headworks post-tensioned pre-stressed box-section concrete beams are being manufactured for three bridges, two of them being access bridges to the Reservoir Power Plants, and the third a 5-span bridge over the Gated Spillway.

Construction, according to Czechoslovakian standards, is being done for the contractor Skodaexport, by another CZ agency, Prumislove Stavby, Gottwaldov (P.S.G.).

Construction is supervised by the River Valleys Development Board. As far as possible British standard specifications are followed.

Consultative services have been obtained from the Chief Engineer, Bridges Branch of the Public Works Department.

Quality control of concrete is carefully maintained. Testing of aggregates and cement, mixing of concrete, water-cement ratio, and placement of concrete are being done strictly to specifications. At the start, a pan-mixer was used for mixing concrete but this broke down and spare parts were not available for repairs. Truck-mixers have been used thereafter. By careful study and control, good results are being obtained with the truck-mixers.

In view of the high atmospheric temperature at this site, careful records of temperature, atmospheric pressure, and humidity are being maintained round the clock, and these records are being used to facilitate quality control. An attempt has been made to relate atmospheric temperature and relative humidity with the water-cement ratio of the concrete.

CONSTRUCTION OF A RESERVOIR POWER PLANT

S. Pathmanathan
(Uda Walawe Project)

Two reservoir power plants of total capacity 5.4 m.w. are under construction for the first time in Ceylon at Uda-Walawe Headworks.

The left bank power plant described in this paper consists of two identical 1.8 m.w. hydrogenerators installed in the tower area of the conventional irrigation sluice. A right bank power plant with one unit is also under construction.

On account of the location of the structure inside the reservoir the concrete has to be of impermeable quality. Mix designs to achieve this and the required crushing strength were done in the Headworks Laboratory and proper quality control has been maintained right throughout the construction. Normal power plant design requires massive blocks of reinforced concrete at least for the sub-structures and these tend to produce shrinkage and careful construction techniques were adopted to overcome the problems involved.

Reinforced concrete spirals (or scroll cases) and draft tubes have been constructed for the first time in Ceylon where so far steel liners have been used in hydropower plants.

Intricate shuttering has been necessitated and this work has been ably handled by Ceylonese carpenters employed by the sub-contractors Messrs. Ceylon Development Engineering Co. Ltd.

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The entire job had to be done to definite schedule as the reservoir construction and river closure operations were all closely co-related to the progress on the power plants. Programming by network and the application of critical path analysis has contributed a lot in co-ordinating and promoting the progress of work in the power plants and other structures.

Other unusual aspects of construction including shuttering and technological equipments such as the turbines have been described.

CONSTRUCTION AND QUALITY CONTROL OF EARTH EMBANKMENT

N. T. K. Munasinghe
(*Uda Walawe Project*)

The subject matter of this paper will fall into four broad divisions.

(i) Cut-off trench and foundation grouting.

(ii) Construction of the earth embankments on the L.B. and R.B. flanks.

(iii) Foundation treatment and construction of river-closure part of embankment.

(iv) Quality Control.

Part (i) describes different methods used for excavation, dealing with ground water springs, and procedures for drilling and grouting.

Part (ii) describes the stages and equipment used in construction of the embankment including filters and filter drains.

Part (iii) describes the different methods of foundation treatment used, the equipment and operational methods used in construction of the closure embankment.

Part (iv) describes the methods used for testing the quality of materials in the borrow pits and tests carried out in the fill to ensure that the specifications laid down by the design were conformed to.

ENERGY DISSIPATION IN A CHUTE SPILLWAY

P. D. H. N. Gomes
(*Irrigation Department, Colombo*)

The design of energy dissipators still continues to be a major field of hydraulic model investigations, and a large amount of experimental work has been done in connection with energy dissipation at spillways and other structures. It is, however, often necessary to carry out model studies for individual structures due to the varying hydraulic and other factors that govern every design problem.

This paper deals with the experimental work carried out on energy dissipation in the chute spillway for the Ambewela Reservoir Project, now under construction. Test results indicated that the conventional stilling basin with the standard types of stilling devices did not give the performance necessary to ensure smooth flow conditions downstream of the structure, due in some measure to the existing site conditions. Energy dissipation in the chute itself was resorted to, and a type of zig-zag baffle was evolved for this spillway design which gave excellent results. The efficiency of this type of dissipator made possible the adoption of a more economical design for this chute spillway. The various considerations that led to the final design are discussed.

CONSTRUCTION OF AMBEWALA TUNNEL BY THE SHIELD METHOD

D. L. O. Mendis
(*Uda Walawe Project*)

Shield-tunnelling through soft ground was invented by Mare Isambard Brunel in the 19th century.

In Ceylon, a tunnel shield was used for the first time in 1962 for the construction of a tunnel at Ambewala Reservoir Scheme. This shield is 8½ ft. long, 8½ ft. inside diameter, 9 ft. outside diameter and weighs 10,000 lbs. It has been fabricated from half inch mild steel plate and incorporates a turnbuckle-cum-handwheel operated "crane-arm" for lifting and placing in position the reinforced concrete pre-cast lining for the tunnel, in quarter segments.

Work was started in 1962 on a convential horse-shoe shaped tunnel. This had to be abandoned on account of frequent earthslips which may have endangered the Ambewala Railway Station under

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which the tunnel is located. Tunnelling with the shield was started in 1965 and completed early this year. The shield has been retrieved, and offered to the C.A.A.S. as a permanent exihibit in its proposed Science Museum.

USE OF AERIAL SURVEY METHODS IN THE STUDY OF RIVER COURSES

A. D. N. Fernando

(*Air Survey Branch, Survey Department, Colombo*)

A study of the form and behaviour of a river is a prerequisite for harnessing its resources.

The form of a river could be ascertained by direct measurement. Its behaviour, however, is dependent on a complexity of factors only some of which are measurable. By the study of working models and the study of the history of a river it would be possible to predict its future behaviour, with a certain degree of accuracy.

Hydraulic models of rivers are being studied in the Irrigation Department. The study of the past behaviour of rivers has apparently not been attempted in Ceylon upto date. This paper attempts to show the importance of such a study with special reference to the Mahaveli from the point of view of engineering, archaeology and prehistory.

PREVENTION AND CONTROL OF POLLUTION OF WATER

D. Subramani

(*Water Resources Board*)

1. **Definition of Pollution**—Waters may be considered as polluted if their composition or characteristics have been changed as a direct or indirect effect of industrial activity and the living conditions of the people. The problem of water pollution is common to both developed and developing countries and there is urgent need for effective legislation. Pollution control adds to the water resources of a country as effectively as the provision of more water. Water is used for drinking, in industries, irrigation, power, cooling, navigation and fisheries.

2. **Types of Pollution**—Pollution may be solid (like wood straw, carcass etc.) or liquid (like sewage and industrial wastes). The commonest form of pollution is crude or partially treated sewage. Next in importance as a cause of river pollution is the discharge of trade wastes. Recently, many insecticides and herbicides

have found extensive use in agriculture and some of these compounds are extremely toxic to fish.

3. **Treatment**—As far as sewage is concerned the modern methods of treatment such as Percolating Filters and Activated Sludge Process are very effective. However, with regard to trade wastes it is not yet possible to purify every tradewaste to the same high standard as for sewage. Sedimentation, flocculation, filtration evaporation, electrolysis, volatilization, aeration and chemical and biological methods are used in the treatment of trade wastes.

4. **Standards**—Some countries have adopted stream standards while others have adopted standards for effluents. Usually standards are prescribed for biochemical oxygen demand, ph values, suspended solids, temperature, amount of chemical present, oils and grease etc.

5. **Legislation**—In the opinion of the World Health Organization, there should be special authorities responsible for each entire river and also that pollution and water resources management should be the functions of the same authority. It is recommended strongly that a River Board be set up very early for the Kelani Ganga which is getting badly polluted.

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SECTION D: NATURAL SCIENCES

(Biology Theatre)

Tuesday, 19th December:

1.30 .. The mechanism of genetic recombination—M. H. V. Cooray.

2.00 .. Mullaitivu-Mannar cyclone of 9th November 1966—L. A. D. I. Ekanayake (jointly with Section E—abstract in Section E).

2.30 .. Studies on Intra-genic recombination using *Sordaria brevicollis*—M. H. V. Cooray.

3.00 .. Preliminary investigations on the leaf scorch decline of coconut palms—O. S. Peries and J. K. T. Kirthisinghe (jointly with Section B—abstract in Section B).

Wednesday, 20th December:

8.30 .. Agricultural development in the Gal-Oya peasant colony—H. N. C. Fonseka (jointly with Section F).

9.00 .. The significance of urban and regional planning in a developing economy—S. W. P. Bulankulame (jointly with Section F).

9.30 .. Blue-green algae and soil fertility—Prof. G. E. Fogg, F.R.S. (jointly with Section B).

10.15 .. Tea.

10.30 .. Notes on the Tectonics of the Hantane-Uduvela Region, south of Katugastota—K. Kularatnam.

11.00 .. Biochemical aspects of foliar senescence in *Perilla frutescens*—C. G. Kannangara.

1.30 .. Molluscs inhabiting rocky shores in Ceylon—D. H. Atapattu.

2.00 .. Cell movements in the morphogenesis of a molluscan embryo—A. H. Sathananthan.

2.30 .. Some new miocene vertebrates from Ceylon—P. E. P. Deraniyagala.

3.00 .. The effect of salinity changes on the heart rate and oxygen consumption in *Penaeus indicus* (Milne Edwards)—M. Weerasinghe and K. D. Arudpragasam.

Thursday, 21st December:

8.30 .. Studies on the duration of the egg laying cycle and dispersal habits of the mosquito *Culex pipiens fatigens* (Wiedemann) by means of mark-release-recapture experiments using poster paint and 32p.—W. A. Samarawickrema (jointly with Section A).

Friday, 22nd December:

9.00 .. An Occurrence of Allanite at Owella Estate, Matale East—L. J. D. Fernando.

9.30 .. The Haputale—Haldummulla Earth slips, 1966—L. J. D. Fernando, V. S. Balendran and L. K. Seneviratne.

10.15 .. Tea.

11.00 .. "UNESCO-CAAS Science Teacher Award 1967"—Presentation Address.

Observations on *Pontodrillus bermudensis* from the Thondamannar Lagoon—M. Atputhanathan (jointly with Section F).

11.30 .. Presidential Address—"Biology and the University in a developing country"—Mahes Ladduwahetty (*Physics Theatre*).

12.15 .. Business meeting.

ABSTRACTS

THE MECHANISM OF GENETIC RECOMBINATION

M. H. V. Cooray

(Department of Botany, University of Ceylon, Peradeniya)

While the classical explanation for genetic recombination, namely the breakage of entire chromatids and their subsequent re-union, fits the data on inter-genic recombination, such a coarse model, which does not take into account the chemical structure and

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the possible physical construction of the chromatid, is found to be inadequate in explaining phenomena commonly associated with intra-genic recombination. Such phenomena include negative interference, non-reciprocal recombination or 'gene-conversion' and hence non-Mendelian segregation, post meiotic segregation and polarity.

Mechanisms involving the idea of 'copy-choice' in various forms can explain some but not all of the above phenomena.

A mechanism proposed by Whitehouse involving the formation of 'hybrid DNA' segments, and the correction of mispaired nucleotide bases seem to fit the intra-genic data better. This mechanism is basically one of breakage and re-union, but here each chromatid is assumed to be a single length of double helical DNA, breakage is assumed to be at the level of single nucleotide chains, and reunion assumed to occur by complementary base pairing.

The above mechanism is discussed along with a closely similar one proposed by Holliday. In addition some theoretical arguments are presented for a possible mechanism of meiotic pairing.

STUDIES ON INTRA-GENIC RECOMBINATION USING *Soradaria brevicollis*

M. H. V. Cooray

(*Department of Botany, University of Ceylon, Peradeniya*)

Sordaria brevicollis is a heterothallic ascomycete in which each ascus, when mature, contains eight dark brown ascospores which are linearly ordered. Preliminary studies revealed that mutations affecting the colour of the ascospore were easily obtainable in this organism. Hence it was chosen, for work on intra-genic recombination, in preference to *Neurospora* and other fungi hitherto used in genetical studies.

A series of yellow-spore mutants very closely linked to each other, was obtained by using UV, was mapped and used to test two basic postulates of both the Whitehouse and the Holliday models of recombination, namely the formation of hybrid-DNA segments and the occurrence of a process of correction of mispaired DNA bases.

The types and frequencies of 'abnormal' octad segregations, obtained for the above mutants seem to justify the first postulate; while the effect of temperature on the frequencies of individual

classes of such segregations suggest on enzymatic correction of mispairing. Polarity is evident not only in hybrid-DNA formation but also in correction. In addition, these studies seem to yield some purely genetic evidence for a little extra synthesis of DNA at the time of recombination.

One class of octad, namely aberrant $4^+:4^-$ which could give more conclusive evidence cannot be easily scored in this organism due to frequent overlapping of mitotic spindles. This could however be overcome by using another series of spore mutants, closely linked to each other, all buff in colour and mapping on the same chromosome arm as the yellow series and nine units proximal to the latter. In a buff × yellow cross the double mutant turns out to be white spored. Hence all genotypes and all possibly abnormal segregations can be scored directly under the microscope. This is the first record of such a system and is being used presently to collect more data on recombination.

AGRICULTURAL DEVELOPMENT IN THE GAL OYA PEASANT COLONY

H. N. C. Fonseka

(*Department of Geography, University of Ceylon, Colombo*)

This paper emerged from a agro-economic survey of the Gal-Oya left bank colony carried out in 1966. The principal method of investigation was questioning the peasant allottees. Information collected on the following aspects: economic background of the allottees in their villages of origin, present social conditions, crops cultivated, cultural practices adopted, agricultural production, marketing and income is presented and analysed. The principal conclusion that emerges from this study is the low level of income derived from agriculture.

THE SIGNIFICANCE OF URBAN AND REGIONAL PLANNING IN A DEVELOPING ECONOMY

S. W. P. Bulankulame

(*Department of Town and Country Planning*)

Urban and Regional Planning implies ordered physical development of the landscape. There are the towns that need to be planned, new ones to be built and old ones to be renewed. Then there are the problems of urban renewal itself, the whole question of slum clearance and re-housing. Added to this, of course, are the problems of a developing economy, for example, the new populations that

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need to be directed to employment mostly in cities. This employment is mostly of an industrial nature. Consequently, building of industrial estates with the whole question of living and workplace amenities has to be planned. Then there is the wider question of regional planning, incorporating entire regions of both the town and country. The whole question of resources of the region has to be carefully considered in order to make the optimum use of the land. Thus, in a developing economy like Ceylon, the agricultural sector has to be geared to both urban and regional planning. We have examples in the River Valleys Development Projects of both Gal-Oya and Walawe where planning should become a prime factor. These are some of the factors that are dealt with in this paper.

NOTES ON THE TECTONICS OF THE HANTANA-UDUVELA REGION

(South of Katugastota)

K. Kularatnam

(*Department of Geography, University of Ceylon, Colombo*)

A preliminary investigation of the tectonics of the Hantana-Uduvela region has brought to light the existence of a remarkable confusion of strikes and dips within this small area. This indicates complex tectonic disturbances and several anomalies associated with severe torsion effects.

Flow structures and magnetic intrusions of various types noticeable in the area also lend support to the view that the present topograph is essentially a reflection of the complicated tectonic history of the region rather than of its subsequent erosional history.

This paper is illustrated with a map showing the lithology and structural features of the area.

BIOCHEMICAL ASPECTS OF FOLIAR SENESCENCE IN *Perilla Frutescens*

C. G. Kannangara

(*Department of Botany, University of Ceylon, Colombo*)

Perilla leaves begin to lose a high molecular weight protein fairly early in life. Just before full expansion of the leaf, there is a sharp drop in the so called fraction I protein. Associated with this sharp drop there is a build up of insoluble proteins that correspond to chloroplast lamellae. Since fraction I protein resembles lamellar proteins it is suggested that during leaf expansion there is a transformation of fraction I protein into insoluble lamellar proteins. Following this period of sharp decline there is a period of gradual loss of fraction I protein. When fraction I protein declines to a certain

minimum quantity the lamellar proteins begin to show signs of decline. This indicates that there is a sort of equilibrium between fraction I and the lamellar proteins of the leaf. Alongside the decline of the lamellar proteins there is a drop in chlorophylles and other chloroplast pigments. This is understandable since these pigments are structurally associated with proteins in chloroplast lamellae. The rate of loss of chlorophyll is faster than that of carotenoids and therefore at later stages leaves assume a yellow colour.

MOLLUSCS INHABITING ROCKY SHORES IN CEYLON

D. H. Atapattu

(*Department of Zoology, University of Ceylon, Colombo*)

This paper deals with part of the results of a study of the content and distribution of molluscs on littoral rocks in Ceylon. The dominant species encountered are listed together with observations on the ecology of these species. Their ranges of distribution are also defined.

The species of molluscs found on the east coast of the island are different from those characteristic of the west coast. This is especially true of the littorinids, neritids and patellids. The molluscs of the northern shores show greater affinity to those of the east than to those of the west.

CELL MOVEMENTS IN THE MORPHOGENESIS OF A MOLLUSCAN EMBRYO

A. H. Sathananthan

(*Department of Zoology, University of Ceylon, Colombo*)

Cell movements have been closely followed in the early development of the slug *Arion ater refus*. The behaviour of blastomeres during cleavage, the budding and migration of the primary mesodermal cell into the blastocoele and the invagination of endoderm, have been studied in living embryos and in sections.

The micromeres in blastulae show rhythmic pulsatory movements in connection with the expulsion of water from the blastocoele. Mutual adhesion between cells and pseudopodial activity seems to play a prominent part in the movement of cells during gastrulation. These observations are discussed in the light of recent work on cell movement and cell contact in the morphogenesis of the sea urchin embryo.

Certain cytochemical tests have also been carried out on gastrulating embryos to elucidate whether there is a chemical basis for these cellular interactions.

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SOME NEW MIOCENE VERTEBRATES FROM CEYLON

P. E. P. Deraniyagala
(26, *Guildford Crescent, Colombo 7*)

The oldest fossil vertebrates from Ceylon are Miocene ones. Some recorded in 1937 from the *Malu deposit* of north western Ceylon comprised fragmentary bones probably from reptiles and mammals and teeth of fishes. A land tortoise, a marine turtle and a cetotheriid whale which had occurred in association at this site indicate deposition under estuarine conditions which is supported by the composition of their compacted matrix. The fishes will be dealt with elsewhere, the other vertebrates are now named tentatively and described as follows. All dimensions are in millimetres.

Class Reptilia, Family Testudinidae

Genus *Miotestudo* gen.nov. Anterior carapace margin strongly reverted, marginals broad, carapace strongly domed. Genotype *Miotestudo ibba* sp.nov. Holotype, a fragment of the right humeral arch with marginals and part of a costal plate. Angle formed by reverted marginals with costal, about 110°. Specimen 86 long, 50 high, anteriorly, 70 high posteriorly. Estimated straight carapace length 500.

Family Cheloniidae

Genus *Miocaretta* gen.nov. marginal bones free from costals and more massive than in living genera, penultimate marginal with two pits for rib tips. Genotype *Miocaretta lankae* sp.nov. Holotype a right penultimate marginal 60 long, 52 wide, 30 thick. Estimated straight carapace length 1,300.

Class Mammalia. Family Cetotheriidae

As these whales had not been recorded from southern Asia the present specimen is tentatively assigned to a new genus and species.

Genus *Miocеta* gen.nov.

mysticetid whales of small size inhabiting tropical waters. Genotype *Miocеta bigelowi* sp.nov. Holotype a posterior cervical vertebra. Its bilateral centrum width 86, centrum height 65, antero-posterior length 35, estimated total bilateral width 216. Estimated length of whale 8 metres.

(I am grateful to Dr. Remington Kellogg of the Smithsonian Institute for his opinion on a sketch that I sent him, that "it agrees most closely with a posterior cervical vertebra of some late tertiary whale bone whale, the Cetotheriidae".)

THE EFFECT OF SALINITY CHANGES ON THE HEART RATE AND OXYGEN CONSUMPTION IN *Penaeus indicus* (MILNE EDWARDS)

M. Weerasinghe and K. D. Arudpragasam
(*Department of Zoology, University of Ceylon, Colombo*)

The effect of salinity changes on the rate of heart beat and oxygen consumption was studied in specimens of *Penaeus indicus* collected from the Negombo lagoon.

Experiments were conducted using water of salinity ranging from 10% sea water to 100% sea water by units of 10% (the water used was made up by dilution of sea water of salinity 34.34%). It was found that there was an increase in the rate of heart beat from 10% sea water upwards reaching a maximum level around 50% sea water. In concentrations higher than 50% a sharp drop in the rate of heart beat was registered, a minimum level being reached in 100% sea water.

With regard to oxygen consumption *P. indicus* showed little variation up to around concentrations of 50% sea water. Above 50% there was a tendency for an increase in the rate of consumption.

The results obtained are discussed in relation to those of other workers.

STUDIES ON THE DURATION OF THE EGG LAYING CYCLE AND DISPERSAL HABITS OF THE MOSQUITO *Culex pipiens fatigans* (WIEDEMANN) BY MEANS OF MARK—RELEASE—RECAPTURE EXPERIMENTS USING POSTER PAINT AND 32_P

W. A. Samarawickrema
(*Department of Entomology, Medical Research Institute*)

The duration of the egg laying cycle (gonotrophic cycle), dispersal habits and flight range of a vector are important factors of its biology when control or eradication measures are considered.

Dissections of wild caught *C. p. fatigans* infected with *Wuchereria bancrofti* from Peliyagoda-Kelaniya area have shown that the females, after the infecting meal, needed only two egg laying cycles to become infective.

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The duration of the egg laying cycle was determined by the mark—release—recapture experiments with laboratory bred *C. p. fatigans* at Kelaniya using, first, artists' poster paint and subsequently ^{32}P. Both methods gave very similar results. The radioactive tagging method seemed to be harmless to the mosquito and also enabled the release of a large number of mosquitoes. Some data on the flight range of both sexes of the mosquito, under congested housing conditions at Kelaniya, have been gathered.

The experiment also yielded valuable information on the daily mortality of adult mosquitoes and on the total mosquito population of the area.

AN OCCURRENCE OF ALLANITE AT OWELLA ESTATE, MATALE EAST

L. J. D. Fernando

(*Geological Survey, Ceylon*)

During the course of mineral exploration work in the Matale East District, a small, localised area of unusually high radioactivity was detected in Owella Estate, Kaikawela. Investigations carried out indicated that the radioactivity is due to the mineral allanite which occurs in abundance as large, tabular crystals several inches in length. The allanite occurs in a quartz felspar pegmatite at its contact with crystalline limestones, while the mineral is absent or only sparsely developed within the main pegmatite body. Orientation of the allanite crystals is not evident. Pegmatites are of widespread occurrence in the district and exhibit great variation in size and shape, and in their relationships to the country rocks. They are mainly cross-cutting bodies of lenticular shape, exhibiting 'pinch and swell' structure, and consisting essentially of quartz, felspar and biotite. The allanite shows a thin earthy crust due to weathering and the changes during the process of alteration are briefly examined. Several chemical analyses are furnished and the genesis of the mineral discussed.

THE HAPUTALE—HALDUMMULLA EARTH SLIPS, 1966

L. J. D. Fernando, V. S. Balendran and L. K. Seneviratne.

(*Geological Survey, Ceylon*)

Several disastrous earth slips occurred in the Haputale—Haldummulla area in November 1966 following a period of unusually heavy rains. All the earth slips are confined to the scarp face of the Haputale escarpment which was extensively affected. An investigation was carried out of the affected area by the authors to determine the causes of the land slides and to suggest ameliorative measures. Three major slips were identified and several smaller ones they all occurred more or less simultaneously. The investigation has led to the conclusion that unusually heavy rain and the over-saturation arising therefrom contributed to the instability of the area where very steep slopes are a dominant feature. Mechanical action of the rain water has aggravated the instability and widened the affected area. Certain geological aspects of the earth slips are examined and various remedial measures discussed.

OBSERVATIONS ON SOME OF THE ECOLOGICAL FACTORS AND THE DISTRIBUTION OF *Pontodrillus bermudensis*, BEDDARD 1891—STUDY OF A SPECIFIC PROBLEM FROM THE HYDRO-BIOLOGICAL SURVEY OF THE THONDAMANNAR LAGOON

M. Atputhanathan

(*J/Chidambara College, Valvettiturai*)

During the survey of the Thondamannar lagoon, a large number of specimens of the oligochaete worm *Pontodrillus bermudensis*, Beddard 1891, were collected. A study of the external and internal organisation of many of the specimens was conducted. Certain speculations are made about the taxonomic position of the worm.

Observations were made on the distribution and some aspects of the ecology of the worm. It was found that the worm occurred only at the mouth of the Thondamannar lagoon in a belt between two to four feet away from the water's edge.

The nature of the physical and biotic environment was observed and experiments were conducted to study the responses of the animal to salinity; pH, water content of the soil, and roots of grasses. The results of these studies are presented and discussed.

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SECTION E: PHYSICAL SCIENCES

(King George's Hall A)

Tuesday, 19th December:

1.30 .. Emerging Pattern of Manufacturing Industry in Ceylon—H. D. Dias (jointly with Section F—abstract in Section F).

2.00 .. Mullaittivu-Mannar cyclone of 9th November 1966—L. A. D. I. Ekanayake (jointly with Section D).

2.30 .. Oil extension of natural rubber and its use in Ceylon for the retreading of passenger car tyres—M. Nadarajah.

3.00 .. An apparatus for measuring diffusion layer thickness in stirred solutions—Vinodhini Guruswamy and M. A. V. Devanathan.

3.30 .. Presidential Address—"Enzymes—the core of life"—M. C. Karunairatnam (*Physics Theatre*).

Wednesday, 20th December:

The chemistry and pharmacology of *Thespesia populnea*:

8.30 .. Part I. Optically active Gossypol from *Thespesia populnea*—L. B. de Silva, J. J. King and R. M. Dharmatilleke (jointly with Section A).

8.50 .. Part II. Pharmacological studies on Gossypol—K. Jayasena (jointly with Section A—abstract in Section A).

9.15 .. Coenzyme A and Mn^{++} levels in tea "flush"—R. L. Wickremasinghe, B. P. M. Perera and U. L. L. de Silva.

9.45 .. Studies of some of the chemical changes occurring during the storage of black tea—R. L. Wickremasinghe and K. P. W. C. Perera.

10.15 .. Tea.

10.30 .. Studies on the transaminase and polyphenol oxidase of tea "flush"—R. L. Wickremasinghe and U. L. L. de Silva.

1.30 .. Occurrence of dulcitol as an exudate—L. B. de Silva and Seetha I. Rodrigo.

2.00 .. Studies on Ceylon cocoas:

I. The sugars in finished cocoa powders—C. V. Pasupathy, U. M. Senanayake and R. O. B. Wijesekera (jointly with Section B).

2.30 .. II. Assay of purine bases in cocoa products—C. V. Pasupathy, U. M. Senanayake and R. O. B. Wijesekera (jointly with Section B).

Thursday, 21st December:

8.30 .. A new chromatographic spray for the detection of catechins—A. S. L. Tirimanna and K. P. W. C. Perera.

9.00 .. The separation of acid phosphatases of the tea leaf by horizontal starch gel electrophoresis—A. S. L. Tirimanne.

9.30 .. Acid phosphatase iso-enzymes in rat liver lysosomes—K. Balasubramaniam, G. J. Reginald and S. Wijesundera.

10.15 .. Tea.

10.30 .. Night-time equatorial Pi 2 micropulsations—P. C. B. Fernando and M. L. T. Kannangara.

11.00 .. The characteristics of Pc^4 and Pc^5 micropulsations as observed in Colombo (8°N, 79°E)—M. Aiyamuthu.

1.30 .. Some observations of the lower Ionosphere using frequency-modulated radio waves of medium frequency—S. Gnanalingam and D. Ratnaweera.

2.15 .. Studies on effect of mechanical strain on metal dissolution kinetics—M. J. Fernando and M. A. V. Devanathan.

2.45 .. Business meeting.

Friday, 22nd December:

8.30 .. Visit to Tyre Factory, Kelaniya.

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ABSTRACTS

MULLAITIVU-MANNAR CYCLONE OF 9TH NOVEMBER 1966

L. A. D. I. EKANAYAKE
(*Department of Meteorology*)

The track of this cyclone as it travelled cross country over Ceylon was very close to that of the cyclone of 22/23 December 1964. The big cyclone had wind strengths of 100 m.p.h., while the cyclone now described had winds of 55 Knots (63 m.p.h.) which just brings it within the category of cyclones.

2. It was first located on our 5.30 a.m. (Ceylon Standard Time) Weather Chart of 7th November as a mild depression out in the Bay of Bengal, position Lat. 7½°N, Long. 87°E. At 10 p.m. that night a cable from Weather Bureau Washington stated that Weather Satellite Essa 3 had photographed a vortex at 1-19 p.m. CST 7th November, centered near 9 N 86 E. Further positions as located on the Ceylon Weather Charts are given below.

3. The depression intensified into a cyclone, and moved towards Ceylon, crossing the coast between Mullaitivu and Trincomalee about 10.30 a.m. on 9th November. It moved in the direction of Mannar, and heavy rain, and winds gusting to over 60 m.p.h. were experienced along its track. The cyclone was over Mannar at 4.30 p.m. on the 9th November. Crossing the Gulf of Mannar, it moved over India, and was detectable as a mild depression till 14th November.

4. *Positions of Centre.*

		Time (C.S.T.)	*Lat° N*	*Long° E*	
1966 Nov.	7	5.30 a.m.	07	89	
		1.19 p.m.	09	86	(ESSA 3)
		5.30 p.m.	07½	87	
,,	8	5.30 a.m.	08	86	
		5.30 p.m.	08½	84½	
		11.30 p.m.	09	83	
,,	9	5.30 a.m.	09	81½	
		11.30 a.m.	09	80½	
		5.30 p.m.	09½	79½	
,,	10	5.30 p.m.	10½	77½	
,,	11	5.30 a.m.	12½	75	
,,	12	5.30 a.m.	14	73	
,,	13	5.30 a.m.	16	72	
,,	14	5.30 a.m.	20	74	

5. The lowest pressures recorded were 1003 mb at Trincomalee at 0930 CST, and 996 mb at Mannar at 1530 CST, corresponding normal values for November being 1012 and 1009 mb respectively.

OIL EXTENSION OF NATURAL RUBBER AND ITS USE IN CEYLON FOR THE RETREADING OF PASSENGER CAR TYRES

M. NADARAJAH
(*Rubber Technology Section*)
(*Ceylon Institute of Scientific and Industrial Research, Colombo*)

Almost all imported passenger car tyre treads are made of oil extended synthetic rubber. The natural rubber presently used for retreading in Ceylon is not oil extended. The Natural Rubber Producers' Association, England have shown that natural rubber can be oil extended in the internal mixer. We have repeated this procedure in our laboratory experiments and compared it with rubber, extended with oil in the latex phase. Our experiments have shown that good quality natural rubber must be used, if the rubber is to be oil extended in the internal mixer.

Further, oil extension in the latex phase gives compounds with better physical properties than when oil extension is done in the internal mixer, but they are more scorchy. To remedy this, a retarder and a safe delayed action accelerator must be used.

Any rubber process oil could be used for oil extension in the internal mixer; but for oil extension in the latex phase, properties of the oil such as viscosity are important. This limits the choice of the rubber process oils that could be used with latex; Dutrex 130 used in our experiments was found satisfactory.

The advantages of oil extension of natural rubber are:

(1) additional mixing time is saved in that premastication of the rubber is unnecessary;

(2) oil extended compounds have better extrusion characteristics;

(3) resilience decreases with increasing oil content. This makes the tyre more skid resistant;

(4) abrasion is improved relative to an unextended natural rubber compound. This would give better wear;

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(5) The savings in cost of tyre retreading compounds as a result of 25% oil extension of natural rubber would be about 10%, when the price of R.S.S. 1 is 75 cents per pound.

Experiments are being conducted to make experimental compounds of oil extended rubber in a medium size internal mixer at two commercial firms and to use these compounds to retread passenger car tyres. It is also hoped that the experience gained in the use of oil extended natural rubber in the retreading of tyres would be useful to the Tyre Corporation.

AN APPARATUS FOR MEASURING DIFFUSION LAYER THICKNESS IN STIRRED SOLUTIONS

VINODHINI GURUSWAMY
AND
M. A. V. DEVANATHAN
(*Physical Chemistry Division*)
(*Ceylon Institute of Scientific and Industrial Research (CISIR), Colombo 7*)

A simple apparatus for the measurement of diffusion layer thickness in stirred solution using fast electrochemical reactions to measure the rate of transfer is described. Some preliminary results obtained are discussed.

THE CHEMISTRY AND PHARMACOLOGY OF *Thespesia populnea*

PART I. OPTICALLY ACTIVE GOSSYPOL FROM *Thespesia populnea*

L. B. DE SILVA
(*Medical Research Institute, Colombo 8*)
R. M. DHARMATILLEKE
(*Oriental Medical Science Fund, Research Student*)
AND
T. J. KING
(*Department of Chemistry, University of Nottingham*)

Thespesia populnea (L) Soland ex. Corr. (fam. Malvaceae) (Sinh. Suriya) is a common plant in Africa, Asia and the Pacific Island. The extracts of the bark have been used in Ceylon by ayurvedic physicians for the treatment of certain allergic conditions like bronchial asthma and eczema.

T. R. Seshadri and coworkers (1938, 1943, 1947) had previously reported the presence of Kaempferol and Herbacetin in the flowers of Thespesia populnea.

The present paper describes the isolation and the structural elucidation of the pharmacologically active principle from the bark and the flowers. The active principle is a mixture of ± gossypol, which had previously been isolated from Cotton Seed by Campbell et al (1937) and the hitherto unknown + gossypol. The mixture has been separated into + gossypol and ± gossypol. Some of the chemical properties of + gossypol are described.

This is the only example of optical activity due to restricted rotation of β-β' dinaphthyls in nature.

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Rao P. S. and Seshadri T. R. (1947). Constitution of populnin. *Chem. Abstr.* **41**, 3798.

Campbell K. N., Morris R. C. and Adams R. (1937). The structure of Gossypol I. *J. Amer. Chem. Soc.*, **59**. 1723.

COENZYME A AND Mn^{++} LEVELS IN TEA "FLUSH"

R. L. WICKREMASINGHE, B. P. M. PERERA AND
U. L. L. DE SILVA
(*Tea Research Institute, Talawakelle*)

The investigations of Goodwin (1952), on *Phycomyces blakesleeanus* indicated that the amino-acid leucine was a precursor of carotenes, and later investigations suggested that mevalonate was an intermediate. This biosynthetic route is also one of the pathways for the production of terpenoid compounds during the manufacture of black tea. (Wickremasinghe & Sivapalan, 1966). Coenzyme A and Mn^{++} are necessary for the operation of this pathway, and hence the levels of these co-factors were determined in different clones of tea. Studies were also made of the seasonal variations in the levels of these co-factors in view of their possible effect on the flavour of black tea.

Coenzyme A was determined by the sulphanilamide acetylation technique (Kaplan & Lipman, 1948), which had to be modified on account of the inhibitory effect of the polyphenols of tea on the pigeon liver enzyme. Mn^{++} was determined by the formal-

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doxime method, (Bradfield, 1957), modified by Chenery. Using these methods it was found that the coenzyme A and Mn^{++} levels showed both clonal and seasonal variations. The levels were high during the flavoury season and low during the non-flavoury season, suggesting that these two co-factors played an important part in the development of flavour. It was also found that the levels of these two co-factors were higher in those clones which produce flavoury teas than in those which produce teas of little or no flavour. A comparison of the coenzyme A and Mn^{++} levels of the same clone growing at different elevations suggested that the amounts of these co-factors was greater in the clones growing at Talawakelle than at Ratnapura.

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Chenery, E. M., personal communication.

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Wickremasinghe, R. L. and Sivapalan, K., (1966). The role of leucine in tea flavour, *Abstr. Ceylon Ass. Advmt. Sci.*, 47.

STUDIES OF SOME OF THE CHEMICAL CHANGES OCCURRING DURING THE STORAGE OF BLACK TEA

R. L. Wickremasinghe and K. P. W. C. Perera

(*Tea Research Institute, Talawakelle*)

Freshly manufactured teas possess a raw or "greenish" taste which disappears on storage of the teas for a certain period of time. The teas "mature" during storage, and investigations were carried out to determine the chemical changes that occur during the "maturation" process. One sample of tea was stored in an air tight container, whilst another was stored in a loosely covered box. Analyses were made at weekly intervals for theaflavins, thearubigins, total polyphenols, vanillin-reacting polyphenols, leucoanthocyanins and amino-acids, and the samples of tea were also assessed by the Tea-Taster.

The results indicate that freshly manufactured teas contain a high level of epigallocatechin gallate and possibly other unoxidised polyphenols, and that this level decreases on storage. At the same time the level of theaflavins was found to first increase, and then decrease. The thearubigins also show changes in concentration on storage and it would appear that after a storage period of about

two or three weeks, the theaflavin/thearubigin ratio reaches an optimal level. The effect of prolonged storage is now under investigation.

STUDIES ON THE TRANSAMINASE AND POLYPHENOL OXIDASE OF TEA "FLUSH"

R. L. Wickremasinghe and U. L. L. de Silva

(*Tea Research Institute, Talawakelle*)

Transamination of leucine to give α-ketoisocaproic acid is the first step in the conversion of this amino-acid to terpenoid compounds in the manufacture of black tea. Evidence has already been obtained that there is a marked increase in the level of α-ketoisocaproic acid during the "withering" stage of manufacture, which is followed by a decrease during the subsequent stage of "fermentation", (Wickremasinghe, 1964). In the present study it was found that tea "flush" contains a leucine—α-ketoglutarate transaminase system which could provide the mechanism for the production of α-ketoisocaproic acid. The enzyme system could also utilise α-alanine of valine in place of leucine and was, in fact, most effective when α-alanine was the amino group donor. Pyruvate or oxaloacetate could not substitute for α-ketoglutarate. Transamination between α-alanine and α-ketoglutarate occurred over the pH range 5.8 to 8.0, whereas in the case of leucine and valine there was optimal transamination at pH 7.4. The above studies were made with an extract obtained by grinding tea "flush" with polyclar and sand, (Sanderson 1964), in $\frac{M}{5}$ phosphate buffer at pH 7.4, followed by dialysis. Pyridoxal phosphate was added to the dialysed enzyme extract, and evidence of transamination was obtained by semi-quantitative paper chromatographic analyses.

Studies of the polyphenol oxidase of tea leaves were made with an enzyme extract prepared by the above-mentioned procedure, except that the dialysis step was omitted. The enzyme extract was incubated with epigallocatechin gallate, and the activity of the polyphenoloxidase assessed by the amount of theaflavin gallate formed. Examination of the bud, as well as 1st, 2nd, 3rd and older leaves showed that there were marked variations of polyphenol oxidase activity with age of the leaves. This finding is of some significance in tea manufacture, as polyphenol oxidase activity is one of the factors responsible for the development of quality.

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OCCURRENCE OF DULCITOL AS AN EXUDATE

L. B. DE SILVA AND SEETHA I. RODRIGO

(*Medical Research Institute, Colombo* 8)

During the hot period in July 1963, some bushes in Uggalkaltota which have not been identified upto the time of writing were observed to possess a white incrustation. Chemical investigation of the exudate has shown it to consist almost entirely of dulcitol.

STUDIES ON CEYLON COCOAS
I. THE SUGARS IN FINISHED COCOA POWDERS

C. V. PASUPATHY, U. M. SENANAYAKE AND R. O. B. WIJESEKERA

Section of Natural Products

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As part of a programme covering the detailed study of the chemistry of Ceylon-grown cocoas, we have examined various finished cocoa powders for the sugars present in them. We have used the techniques of paper chromatography employed by Cerbulis (1965) and Thin Layer Chromatographic methods. The presence of glucose, fructose, sucrose, mellibiose, raffinose and stachyose was detected by chromatography using a variety of solvent systems and spray reagents. The chromatographic behaviour was compared with that of authentic samples. Two unidentified ketoses were found to be present in some of the powders.

Attention has also been paid in this study to the development of techniques for the analysis of mixtures of sugars based on Thin Layer Chromatography.

Reference

Cerbulis, J. (1965), Carbohydrates in Cacao Beans. II Sugars in Caracas Cacao Beans *Arch. Biochem. Biophys.* **58**, 406.

STUDIES ON CEYLON COCOAS
II. ASSAY OF PURINE BASES IN COCOA PRODUCTS

C. V. PASUPATHY, U. M. SENANAYAKE AND R. O. B. WIJESEKERA

Section of Natural Products

(*Ceylon Institute of Scientific and Industrial Research, (CISIR), Colombo* 7)

The purine bases Caffeine and Theobromine play a significant role in the flavour and other characteristics of chocolates and cocoa beverages. No satisfactory method for the simultaneous assay of the two compounds was hitherto available. A method based on quantitative thin layer chromatography has now been worked out in this laboratory (Senanayake and Wijesekera, 1967). This method has been used to make quantitative studies of the purine bases in chocolates and finished cocoa powders.

Reference

Senanayake, U. M. and Wijesekera, R. O. B., (1967). A rapid micro-method for the separation, identification and estimation of the purine bases, caffeine, theobromine and theophylline, *J. Chromatog.*, 28, (in press).

A NEW CHROMATOGRAPHIC SPRAY FOR THE DETECTION OF CATECHINS

A. S. L. TIRIMANNA AND K. P. W. C. PERERA

(*Tea Research Institute of Ceylon, Talawakelle*)

A method is described for the detection of catechins on paper chromatograms. This method is based on the ability of the catechins to react with 2, 4, 6–trinitrophenol under alkaline conditions to give a red coloured complex.

This colour reaction appeared to be specific for the catechins, and could be easily distinguished from the orange colour given by certain guanidines under similar conditions. Other polyphenols such as quercitin, naringenin, coumarin, cyanidin and catechol, did not answer this test.

The sensitivity of the method and its uses will be discussed.

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THE SEPARATION OF ACID PHOSPHATASES OF THE TEA LEAF BY HORIZONTAL STARCH GEL ELECTROPHORESIS

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(*Tea Research Institute of Ceylon, Talawakelle*)

The enzyme extract of the tea leaf was prepared according to a modification of the method of Roussos (1962).

Connaught hydrolysed starch was used for the preparation of the gel. Horizontal electrophoresis was carried out using Buchler equipment, for 16 hours against a potential gradient of 2 volt/cm. The buffers used were Tris-Succinic acid (pH 6 for gel) an Acetate (pH 4 for bridge).

The enzymes were localised on the starch gel by the azo-dye technique of Goldberg and Barka (1962). This technique is based on the use phosphate esters of 'Napthol AS' derivatives (Sigma) as substrates and the use of hexazonium p-rosaniline as a coupler.

Six bands having acid phosphatase activity were separated on the gel, and two of these bands carried a positive charge.

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Goldberg, A. F. and Barka, T. (1962). Acid phosphatase activity in human blood cells. *Nature* **195**, 297.

ACID PHOSPHATASE ISOENZYMES IN RAT LIVER LYSOSOMES

K. Balasubramaniam, G. J. Reginald and S. Wijesundera
(*Department of Biochemistry, University of Ceylon, Peradeniya*)

Isoenzymes were first demonstrated in different tissues and more recently in the mitochondrial and cytoplasmic fractions of the same cell. We are reporting in this paper the presence of two acid phosphatase isoenzymes in the same subcellular particle, namely the rat liver lysosomes.

These two acid phosphatases have characteristics similar to those of erythrocytic and prostatic acid phosphatases. Erythrocytic acid phosphatase acts optimally at pH 5.5. It is completely inhibited by 0.2 M formaldehyde but is not at all affected by tartrate at 0.02 M concentration. Prostatic acid phosphatase which, on the other hand, has an optimim pH of about 4.9 is completely inhibited by tartrate but is not affected by formaldehyde at these concentrations of inhibitors (see Wilkinson, 1965). Eighty-eight percent of the acid phosphatase present in the rat liver lysosomes was formaldehyde stable whilst 21% was resistant to tartrate. The ratio in which these were present in cytoplasmic fraction was reversed; 84% of activity was tartrate-stable whilst 33% was formaldehyde stable. Enzymic activity was measured as described by King and Jegathesan (1959).

The pH optimum of the formaldehyde-stable acid phosphatase of rat liver lysosome was 4.7 and that of the tartrate-stable fraction was 5.75. The tartrate-stable acid phosphatase was stimulated preferentially by cysteine. Over 100% stimulation was obtained with 10^{-2} M L-cysteine. Cysteine added direct to the test system enhanced the activity of the enzyme, but maximal stimulation was obtained only on pre-incubating the enzyme with 10^{-2} L cysteine at 37°C for 1 hour at pH 6·5. The Km values for the tartrate-stable and formaldehyde-stable acid phosphatases were 2.7×10^{-3} M and 12.5×10^{-3} M respectively; disodium phenyl phosphate was used as substrate in 0.1 M citrate buffer at pH 4.0.

Paper electrophoresis of lysosomal extracts in phosphate buffer, pH 6.5, showed two bands of activity moving towards the anode. Seventy-seven percent of the total activity recovered was present in the slower moving component whilst the balance was observed in the faster component.

These results suggest the presence of two similar acid phosphatases or isoenzymes in the lysosomes of rat liver. The effect of various activators and inhibitors on these isoenzymes and their approximate molecular weights are under investigation.

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NIGHT-TIME EQUATORIAL PI 2 MICROPULSATIONS

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Micropulsations in the period band 15 secs to 150 secs were recorded over an uninterrupted period of one year from 17th October 1964. This period coincided partly with the International Quiet Sun Year (IQSY) of 1964.

Events selected from the records for study in the present paper were oscillations which had an abrupt beginning, an amplitude>0.2 gamma and a duration of <30 minutes. Only events occurring at night (1800 to 0600 L.S.T.) were considered.

The dominant period of Pi 2 oscillations recorded were mainly between 50 and 120 secs, the highest probability of occurrence was for oscillations in the period range 60 to 80 secs. (at the XLII General Assembly of the I.U.G.G. 1963 Pi 2's were defined as pulsations of limited duration usually less than one hour and covering the period range 60 to 100 secs).

The diurnal occurrence pattern when averaged over different seasons and over varying conditions of the interplanetary medium showed two marked peaks at (2400 to 2415 L.S.T.) and at (2100 to 2130 L.S.T.). The changes in the occurrence pattern with season and Kp index have also been studied.

This particular study was undertaken as there is current interest in theories which postulate that the equatorially located neutral sheet in the magnetospheric tail is a rich source of particles and hydromagnetic waves. It is believed that these could provide the particles and the accelerating mechanism for particle deposition at high latitudes leading to aurorae. Since equatorial Pi 2's could be the direct manifestation of the hydromagnetic waves originating in the neutral sheet, the experimental study of these Pi 2's could yield valuable information.

THE CHARACTERISTICS OF Pc4 AND Pc5 MICROPULSATIONS AS OBSERVED IN COLOMBO (8° N, 79° E)

M. Aiyamuthu
(*Physical Laboratories, University of Ceylon, Colombo*)

Pc4 and Pc5 geomagnetic micropulsations were recorded during the two periods, 14-7-66 to 28-7-66 and 18-8-66 to 21-9-66, mainly with a view to detecting any diurnal variations in their characteristics. The visual analysis of the chart records indicates that:—

(1) Pc4 oscillations are most active at about 11.00 hrs. L.S.T., whereas Pc5 oscillations show maximum activity at local noon.

(2) the dominant periods of oscillation of the Pc4 and Pc5 activities when plotted as a function of local time, seem to fall very roughly into three period bands centred round 40 seconds, 80 seconds and 225 seconds respectively. In the Pc4 range the spectral peak is strongly dependent on local time.

An attempt has also been made to correlate Pc4 and Pc5 occurrence with geomagnetic activity (Kp-index figures) and solar activity (solar-flares and prominences). This analysis indicates that:—

(*a*) Pc4 occurrence shows no significant correlation with magnetic activity (Kp-index figures) whereas Pc5 occurrence shows a significant positive correlation.

(*b*) Both Pc4 and Pc5 occurrence correlate better with solar-activity (solar-flares and prominences) when a suitable lag is introduced to account for the time of traverse of the particles from the sun to the earth.

The magnetic and solar data were obtained from the world data centre.

SOME OBSERVATIONS OF THE LOWER IONOSPHERE USING FREQUENCY-MODULATED RADIO WAVES OF MEDIUM-FREQUENCY

S. Gnanalingam
(*Ceylon Institute of Scientific and Industrial Research*)
and
D. Ratnaweera
(*Vidyodaya University of Ceylon*)

To determine the structure of the D- and E- regions of the ionosphere from ground—based experiments, it is necessary to use radio waves of frequency less than about 2 MHz. In the daytime, however, there is considerable ionospheric absorption at these frequencies and the echo is generally very weak. The widely used pulse method of sounding the ionosphere fails to provide the necessary sensitivity to detect these weak echoes unless the transmitter radiates high peak powers of the order of several hundred kilowatts, or sophisticated techniques are adopted in the receiver to obtain coherent pulse integration.

In ionospheric sounding, as in radar, use can be made of either pulse methods or frequency-modulation methods, and the ultimate sensitivity of both methods can be made the same, provided the same mean power is radiated by the transmitter, and the most effective means of noise filtering is employed at the receiver. Two

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outstanding advantages of the frequency-modulation method are (*a*) that a high mean power output can be obtained from a conventional communication transmitter operating on relatively low voltage power supplies and (*b*) that coherent detection is innate in the method, and so does not require special instrumentation. The main disadvantages of the method are (*a*) that the receiver has to be separated from the transmitter by a distance of several miles to prevent overloading by the direct wave and (*b*) that weak echoes cannot be detected in the presence of much stronger echoes.

The paper presents the preliminary results of measurements made at Colombo (6o°54′ N, 79°52′ E, Magnetic dip 5° S) on 1.33MHz and 570 kHz using a simplified form of the frequency-modulation method developed by Gnanalingam (1954). With a transmitted power of approximately 150 watts and an output bandwidth of 10Hz it has been possible to measure absorption values up to 85 decibels on 1.33MHz. The sensitivity of the system is rather less on 570 kHz because of the high level of atmospheric noise and broadcast interference on this frequency.

The noon height of reflection on 1.33 MHz is found to be 96 ± 2 kms. (102 ± 2 kms. on 2 MHz) and does not change appreciably from day to day or with season. Large variations in the noon absorption on this frequency are accompanied by similar variations on the higher frequencies, indicating that the major portion of the absorption occurs at levels below 96 kms. Night-time observations have revealed that electron densities in excess of 20,000 electrons/c.c., possibly in a thin layer, persist in the E-region for long intervals of time. This appears to be a regular feature of the equatorial ionosphere.

The noon height of reflection on 570 kHz is approximately 77 kms., so that the electron density at this level (neglecting the small difference between the true height and virtual height) is 4000 electrons/c.c. This is a higher value than has been reported for temperate latitudes. At night, reflection generally occurs in the height range 88-100 kms. F- region echoes have never been observed on this frequency since observations were commenced early in May 1967. It would appear that the maximum electron density in the equatorial E- region (either normal—E- or sporadic —E) never falls below 4000 electrons/c.c.

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STUDIES ON EFFECT OF MECHANICAL STRAIN ON METAL DISSOLUTION KINETICS

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An apparatus for the measurement of metal dissolution rates under various strains is described. Preliminary results obtained with this instrument with steel and pure copper are discussed.

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SECTION F: SOCIAL SCIENCES

(*Room* 28)

Tuesday, 19th December:

1.30 .. Emerging Pattern of Manufacturing Industry in Ceylon—H. D. Dias (jointly with Section E).

Wednesday, 20th December:

8.30 .. Agricultural development in the Gal-Oya Peasant colony—H. N. C. Fonseka (jointly with Section D—abstract in Section D).

9.00 .. The significance of urban and regional planning in a developing economy—S. W. P. Bulankulame (jointly with Section D—abstract in Section D).

9.30 .. A Preliminary Report on an Ordering Principle for and a Contingent Analysis of Psycho-Motor Aspects of Behaviour—J. Alles.

10-15 .. Tea.

Thursday, 21st December:

9.00 .. An Attempt at Restructuring Some Conceptual Frameworks Used in Curriculum Development and Evaluation—J. Alles, A. Perera, M. Ranaweera, J. Ratnaike and D. Weerasinghe.

9.30 .. A Preliminary Report on the Project for the Improvement of Evaluation Practices in Science G.C.E. (O.L.)—J. Alles and Staff, Science Evaluation Research Project, Ministry of Education.

10.15 .. Tea.

10.30 .. A Preliminary Analysis of Costs of Education Relating to First and Second Level Education in "Government Aided" Schools for the Period 1931-1960—J. Alles, S. V. de Silva and F. W. W. Kulatunga.

11.15 .. Business meeting.

1.30 .. The Rate of Mortality in the First Year of Life in Ceylon for the Period 1953-62—M. K. D. Patel (jointly with Section A).

3.30 .. Presidential Address—"Some Conceptual Analyses Relevant in Educational Administration"—J. Alles (*Physics Theatre*).

Friday, 22nd December:

9.00 .. An attempt to indicate two limitations of the application of statistical concepts to administrative procedure—H. E. Peries.

9.20 .. The Scope for Regional Economic Co-operation in South East Asia—C. A. B. N. Jayarajah.

9.45 .. A report on Exploratory Work directed towards the Improvement of Evaluation Practices in the G.C.E. (O) (Science Subjects) Examination—J. Ratnaike.

10.15 .. Tea.

10.30 .. Some Aspects of International Commodity Price Stabilization Schemes with special reference to Ceylon—D. S. Rajapatirana.

11.00 .. "UNESCO-CAAS Science Teacher Award 1967"—Presentation Address. Observations on *Pontodrillus bermudensis* from the Thondamannar Lagoon—M. Atputhanathan (jointly with Section D—abstract in Section D).

ABSTRACTS

EMERGING PATTERN OF MANUFACTURING INDUSTRY IN CEYLON

H. D. Dias

(*Department of Geography, University of Ceylon, Colombo*)

Although Ceylon has been primarily an agricultural country and still continues to derive most of its national products from the agricultural sector, the past decade has witnessed an increased interest and an accelerated growth in the field of manufacturing industry. The growth in this sector of production during this period has been due mainly to the growth of modern industry as opposed to the traditional industries. An analysis of the types of industry which have developed shows the dominant influence of market considerations, particularly the influence of the domestic market, but the influence of the resource base is identifiable in certain

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sectors. An important consideration from the viewpoint of long-term development is the balance between these two considerations. The viability of the structure of the emerging pattern as well as the benefits to be derived from the growth of industry would depend on this balance. Another aspect of the emerging pattern of industry is the areal distribution. In the spatial pattern that is emerging it is possible to identify a tendency towards the concentration of industry in a few areas, particularly in and around Colombo. Whether this trend should be permitted to continue unchecked and unguided is an important question. The longer this question remains unanswered the graver would be its consequences. But to seek an answer to that question it is necessary to find out the conditions that favour the emergence of that pattern and consider to what extent it is possible or desirable to manipulate these conditions to achieve a more balanced and beneficial pattern of growth. Although this task has not yet been taken in hand it is one that should receive the attention of our planners and researchers immediately.

A PRELIMINARY REPORT ON AN ORDERING PRINCIPLE FOR AND A CONTINGENT ANALYSIS OF PSYCHO-MOTOR ASPECTS OF BEHAVIOUR*

J. Alles
(*Department of Education, Colombo 2*)

An attempt has been made to analyse psycho-motor aspects of behaviour in the context of curriculum development and evaluation. A major ordering principle relating to the psycho-motor aspects of behaviour—"principle of adaptive routinization"—is recognised and on the basis of this principle an outline analysis of levels of psycho-motor execution are described.

This principle when analysed, yields the following sets of ordered levels of execution in the psycho-motor domain:

1.0 Initiatory Level of Execution
2.0 Pre-Routine Level of Execution
  2.10 Pre-Routine Non- adaptive Sub-level
  2.20 Pre-Routine Adaptive Sub-level
3.0 Routinized Level of Execution
  3.10 Routinized Non-adaptive Sub-level
  3.20 Routinized Adaptive Sub-level

* This study is developed in the context of curriculum development and evaluation.

The main purpose of the paper is the reporting of the principle and the associated ordered set of levels of psycho-motor execution. It is asserted that this principle and the set of levels may be specially useful as a basis for the evolution of an analytical tool for the evaluation of learning of psycho-motor behaviour sequences.

AN ATTEMPT AT RESTRUCTURING SOME CONCEPTUAL FRAMEWORKS USED IN CURRICULUM DEVELOPMENT AND EVALUATION

J. Alles, A. Perera, M. Ranaweera, J. Ratnaike and D. Weerasinghe
(*Department of Education, Colombo 2*)

In the field of curriculum development and evaluation two major studies of significance are "The Taxonomy of Educational Objectives—A Classification of Educational Goals—Handbook I, Cognitive Domain", by Benjamin S. Bloom et at, (1965), and "The Taxonomy of Educational Objectives—A Classification of Educational Goals—Handbook II, Affective Domain," by Krathwohl, et al, (1964). These two studies and the yet unpublished Handbook III, for the psycho-motor domain, are considered by the authors in a new perspective. It is suggested that the concept of "classification" or "categorisation" is not the most appropriate one. It is postulated that it is perhaps more useful and fundamentally more valid to view the so-called "categories" in these taxonomic studies, as "levels" of cognitive operation, "levels" of affective involvement, and "levels" of psycho-motor execution. In fact, it is suggested that the processes considered in these taxonomic studies are essentially potential scales relating to the learning of behaviour sequences.

A behaviour sequence may be learnt or elicited at a given level of intensity, potential, or level. This level may be denoted by the symbol L. It is asserted that Level L is the resultant of three component intensities or Levels, Lc, La, and Lm. These three components may be described as follows:

Lc —Level of Cognitive Operation
La —Level of Affective Involvement
Lm—Level of Psycho-motor Execution

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The scales corresponding to these may be designated thus:

Lc—Level of Cognitive Operation on the "Lc-scale"

Lc	..	6.0
Lc	..	5.0
Lc	..	4.0
Lc	..	3.0
Lc	..	2.0
Lc	..	1.0

La—Level of Affective Involvement on the "La-scale"

La	..	5.0
La	..	4.0
La	..	3.0
La	..	2.0
La	..	1.0

Lm—Level of Psycho-motor Execution on the "Lm-scale"

Lm	..	3.0
Lm	..	2.0
Lm	..	1.0

It will be evident that two "Potential" or "level" scales, Lc, La, in the main, appear to correspond to the principal taxonomic categories in Handbook I and in Handbook II. Also the potential scale for psycho-motor execution. Lm, corresponds to a scale evolved for the purpose in a companion research paper.

The term "level" occurs in isolated contexts in Handbook I. It occurs in Handbook II more frequently and rather more significantly. But neither Handbook isolates this idea of level *as a basic critical concept*. It is here postulated that the change of viewpoint from "category" to "level" is a significant one. It is likely to be more meaningful and may provide greater insight into the processes which are under consideration in Handbook I, in Handbook II and in the companion research paper.

A PRELIMINARY REPORT ON THE PROJECT FOR THE IMPROVEMENT OF EVALUATION PRACTICES IN SCIENCE G.C.E. (O.L.)

J. Alles and Staff of the Science Evaluation Research Project
(*Ministry of Education, Colombo*)

Curriculum design and development has been a major trend in educational reforms in many parts of the world during the last two decades. The Ministry of Education, Ceylon, has also sought to persue a significant programme of action in this field. Revised

syllabuses of instruction and schemes of work in Physics, Chemistry and Biology for the G.C.E. (O.L.) population have been designed with the objective of meeting more adequately the needs arising from the rapid changes in the social and economic characteristics in Ceylon. Associated with the curriculum redesign, some changes in the examination pattern were sought, with a view to achieving an enhanced validity and reliability in testing at this level. Instead of the former single three hour relatively unstructured essay type question papers in Physics, Chemistry and Biology, two separate papers were introduced—paper I, a 40-item multiple choice, objectively markable type question paper of 45 minutes duration, and paper II, a relatively, significantly structured, essay type question paper of 2 hours duration. In addition a relatively more systematic evaluation programme was initiated which included the use of relatively highly resolved Tables of Specification. The programme seeks to explore, among other things, the patterns and levels of pupil achievement with revised schemes of work on the basis of performance in the revised papers. A further objective of the project is the introduction of improved evaluation practices in the school system.

This preliminary report outlines a study of an item analysis of the science papers based on the performance of a National Stratified Random Sample selected in terms of educational region, medium of instruction, sex, grade of school and the degree of urbanisation of the G.C.E. (O.L.) science population. The study further includes correlations of performance of paper I with paper II in the various science papers, and each science paper with 1st Language, 2nd Language, Mathematics, Jayasuriya Intelligence Test, and Vedanayagam Intelligence Test. The correlations of performance of 1st Language with 2nd Language, Mathematics, Jayasuriya Intelligence Test, Vedanayagam Intelligence Test are also indicated. Other correlations of performance under study are Mathematics with Jayasuriya Intelligence Test, Vedanayagam Intelligence Test and a combination of Jayasuriya Intelligence Test and Vedanayagam Intelligence Test. The paper also includes a report on an analysis of science scores with respect to the different strata on which the sample was selected. An analysis of science scores in terms of the socio-economic background such as parental income, educational and occupational status is another aspect which is being preliminarily reported here.

The study of the various aspects of validity of the science papers in the examination is attempted by analysing the correlational study mentioned above. An examination of the scores analysed in terms of the different strata is attempted with a view to ascertaining how these strata factors affect pupil performance. In respect of paper I of the science papers a reliability index is worked out. This preliminary report is being presented essentially

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for professional comment and as a basis for discussion especially in view of the fact that it is intended that this mode of study and analysis of the examination should be continued for several years with a view to understanding the performance characteristics of the examination in detail.

A PRELIMINARY ANALYSIS OF COSTS OF EDUCATION RELATING TO FIRST AND SECOND LEVEL EDUCATION IN "GOVERNMENT AIDED" SCHOOLS FOR THE PERIOD 1931-1960

J. Alles, S. V. de Silva, F. W. W. Kulatunga

(*Division of Secondary Education, Ministry of Education, Colombo*)

A Preliminary analysis of the costs of education at the first and second levels of education in "Government aided" schools has been carried out for the period 1931-1960, using selected samples of schools. The data have been gathered from departmental school files. The unit costs have been worked out. The unit costs have been analysed in terms of "teacher-salary components", "non-teacher salary components", pension/provident fund contribution and "facilities and services" for "vernacular" schools, "Grade III" schools, "Grade II" schools and "Grade I" schools. In the case of Grade II and Grade I schools the costs have been derived directly from the survey for the two levels together. With suitable assumptions, an attempt has been made to analyse these costs for the first level and for the second level. The above data have been organised to show significant trends over the period 1931 to 1960.

THE RATE OF MORTALITY IN THE FIRST YEAR OF LIFE IN CEYLON FOR THE PERIOD 1953-62

M. K. D. Patel

(*Insurance Corporation of Ceylon*)

The purpose of this paper is to derive the rate of mortality at age zero in Ceylon for the decade 1953-62, separately for males and for females, and to study the changes that have taken place during this period. The rate is also analysed for major causes of deaths at age zero to one year, and the current rate in Ceylon is viewed in relation to the rate obtaining in England and Wales. The effect of reduction in the rate of mortality at age zero on the expectation of life at birth is also considered briefly. The paper falls into three parts.

After a brief discussion of the methods employed, the rates for the period are given in Part I, and the variations between male and female rates, as well as the variations over time, are commented upon. The rationale of the method is discussed in the Appendix.

In Part II, approximate rates of mortality by seven major causes are presented for the years 1953 and 1962 and the variations are commented upon. Comparison with the corresponding rates for England and Wales is also given, as an indication of the scope for further improvement.

In Part III, changes in the expectation of life at birth as a result of the improvement in infant mortality are considered.

AN ATTEMPT TO INDICATE TWO LIMITATIONS OF THE APPLICATION OF STATISTICAL CONCEPTS TO ADMINISTRATIVE PROCEDURE

H. E. Peries

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Administrative procedures are analysed and it is shown that they are a prescription of courses of action corresponding to different values of a statistic: that is, they are a previously prescribed strategy in the sense of Game Theory.

The similarity to Wald's decision functions is pointed out. The cost functions associated with these decision functions have to be modified to include social costs and to allow for the fact that the game is conducted by corruptible men on behalf of the state and against other men and not "nature".

The sample statistic has to be readily ascertainable and this limits the closeness of fit with the relevant population parameter.

These ideas are applied to entry to the universities and the need for frequent check between what actually happens and what is intended to be done, explained.

THE SCOPE FOR REGIONAL ECONOMIC CO-OPERATION IN SOUTH EAST ASIA

C. A. B. N. Jayarajah

(*Central Bank of Ceylon, Colombo*)

In recent years many of the less developed countries of the world, principally the countries in South East Asia have suffered serious reverses in their plans for economic development. The failure of primary products to earn sufficient income to finance

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development plans has been attributed to the poor demand in traditional export markets. The existence of high tariffs and other quantitative restrictions on exports of semi-manufactured and manufactured products has also to some extent limited the diversification of the range of exports of these countries.

This paper analyses the factors behind the poor export performance of less developed countries in South East Asia and investigates the possible role of closer economic co-operation as a solution to the problems of the slow growth in export income, the continuous decline in import capacity and the diseconomies involved in production for small markets. It discusses in particular, the scope for trade liberalization in South East Asia and the principal field in which closer economic co-operation could provide a catalyst for a more rapid rate of economic growth.

A REPORT ON EXPLORATORY WORK DIRECTED TOWARDS THE IMPROVEMENT OF EVALUATION PRACTICES IN THE G.C.E. (O) (SCIENCE SUBJECTS) EXAMINATION

J. Ratnaike
(*Department of Education, Colombo* 2)

The SSC/GCE(O) Botany (1955-59), Zoology (1955-58), Biology (1950-1953), General Science (1952-58), Physics (1949-58) and Chemistry (1957-60) examinations were analysed for validity of content and of level of achievement in the cognitive domain. The analysis showed that the coverage of both content and objectives was seriously dificient.

The December 1961 Examination in Chemistry was designed to correct these defects, and Tables of Specifications which portrayed both content and objectives were drawn up. The individual questions were broken into sub-questions (items) to enhance greater content and objective coverage. The questions, though of the free response (essay) type, were carefully, structured, and a detailed marking scheme evolved, so that the reliability of the marking may be improved.

The data from an approximately 20% stratified random sample were used to investigate techniques of developing item analysis for essay-type questions. Difficulty indices, discrimination coefficients, frequencies of choice and of zero marks, were found for each item.

Through these devices, an attempt was made to specify the items in the examination, and the achievement characteristics of the pupil population. These operations were repeated for each Chemistry G.C.E.(O) examination from 1963-1964.

From the experience derived in analysing the 1961-1964 G.C.E.(O) Chemistry Examinations, a revised Table of Specifications was evolved for the 1965 New Syllabus Examination.

SOME ASPECTS OF INTERNATIONAL COMMODITY PRICE STABILIZATION SCHEMES WITH SPECIAL REFERENCE TO CEYLON

D. S. Rajapatirana
(*Central Bank of Ceylon, Colombo*)

The post war period marked another phase which was characterised by fluctuations in commodity prices that enter international trade. A notable feature of the fluctuation was that the prices of exports of developing countries showed greater instability than those of the developed countries. In recent years export prices of developing countries fluctuated on a downward trend, thus causing the terms of trade of these countries to turn adverse.

The adverse terms of trade militate against the success of development programmes specially in countries like Ceylon which specialise in the export of few commodities. This paper will attempt to (1) isolate a few schemes that could be adopted by Ceylon in concert with countries producing the same commodities and the major importers of these commodities, (2) evaluate the suitability of these schemes with special reference to Ceylon.

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