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CEYLON ASSOCIATION  
FOR THE ADVANCEMENT OF SCIENCE



# Proceedings of the Twentyfifth Annual Session

*19th-22nd December 1969*

**PART I**  
**SECTIONAL PROGRAMMES AND ABSTRACTS**

COLOMBO 1969

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PART I

SECTIONAL PROGRAMMES AND ABSTRACTS

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## SECTION A: MEDICAL AND VETERINARY SCIENCES

(Physics Theatre)

### Friday, 19th December:

- 8.15 .. Bacteriological and Therapeutic Studies in Diarrhoeas—  
Priyani E. Soysa and K. Arulanantham.
- 8.35 .. Early Ambulation in Acute Myocardial Infarction—  
M. A. Macan Markar, J. Jeyaratnam and T. Jesudhason.
- 9.00 .. Spread of Infectious Hepatitis in the Family Group.  
A Report of Biochemical Investigations—N. Naga-  
ratnam, Dawn F. de Silva, S. Sentheshanmuganathan,  
H. R. Peiris and N. Nagarajah (Jointly with Section E).
- 10.30 .. THE NEPHROTIC SYNDROME—SIR MAX ROSENHEIM
- 11.30 .. Presidential Address: "On Reading a Twenty Five Year  
old Text Book of Human Physiology"—V. Basnayake.
- 2.00 .. Necrotising Enteritis in Ceylon—P. C. A. Ranatunga,  
R. G. Panabokke, C. B. Kumarakulasinghe, H. L. Eaton,  
and A. Tharmarajah.
- 2.20 .. A Bacteriological Study of Septic Surgical Lesions—  
C. S. Sinnatamby, K. Nadanachandran, T. E. D. Chap-  
man and H. A. Nanayakkara.
- 2.40 .. Asymptomatic Bacteriuria in Females in Relation to  
Anaemia. A Preliminary Report—T. Varagunam, L. M.  
de Silva, U. Wijayawardhana and S. N. Arsecularatne.
- 3.00 .. Lesions associated with Interstitial Pneumonitis—N. Koda-  
goda and Daphne Attygalle.

### Saturday, 20th December:

- 8.00 .. Pulmonary Function in Tropical Eosinophilia—M. S.  
Nesarajah and Vallimani Kanapathipillai.
- 8.20 .. Glucose Tolerance during Pregnancy—C. de F. W.  
Goonaratna, S. A. N. Perera and Selvi Sinnatamby.

- 8.40 .. Ankle-Jerk Time in Ceylonese—A. D. Mariadasan, E. D. Rodrigo and C. C. Fonseka.
- 9.00 .. The Permeability of Nerve "Diffusion Barriers" in Diabetes—K. N. Seneviratne and O. A. Peiris.
- 9.20 .. Enzyme Histochemical Studies on Hydatidiform Mole and Choriocarcinoma—R. G. Panabokke, A. D. G. Nelson, W. H. Fernando, B. Jayaweera, D. E. Gunatillake and W. B. Karunaratne.
- 1.30 .. Survey of Salt Intake—K. Mahadeva and E. Karunayake.
- 1.50 .. A Method of Determining Skeletal Maturity of Ceylonese Girls aged 7-15 Years—M. B. O. Pieris.
- 2.10 .. Incidence of *Salmonellae* in Dessicated Coconut Mills—the late T. Velaudapillai and H. A. Tillekeratne.
- 2.30 .. Investigations on the Control of Bacterial Organisms in the Manufacture of Dessicated Coconut—the late T. Velaudapillai and H. A. Tillekeratne.
- 3.00 .. A Rapid Method for the Separation of Phenylalanine in Serum by Thin Layer Chromatography and Establishment of the Clinical Norm for Ceylonese Subjects—S. Sentheshanmuganathan, Sita Rordrigo and S. Kamanathan (Jointly with Section E).

#### Sunday, 21st December:

- 8.30 .. The innervation of the oesophagus in the mouse—Daya Samarasinghe.
- 8.50 .. The Pathogenesis and Effects of a Selective Chloride Deficit in Man—Brian Senewiratne.
- 9.10 .. Aldosterone, Potassium Balance and the Plasma Potassium Level—Brian Senewiratne.
- 9.30 .. The Release of Potassium from Enteric-Coated and Slow-Release Potassium Chloride Tablets—Brian Senewiratne.
- 10.00 .. Difficulties in Excreting Orally Administered Potassium in Patients with Fluid Retention States—Brian Senewiratne.

- 2.00 .. Some Trematodes of Vertebrates hitherto unreported from Ceylon with a Description of a New Species of *Bilorchis* and a Revision of the Genus—D. W. W. Kannangara (Jointly with Section D).
- 2.20 .. *Parathelphusa ceylonsis* and *Parathelphusa rugosa* as Second Intermediate Hosts of *Paragonimus*, with Observations on Other Parasites in the Fresh Water Crabs in Ceylon—D. W. W. Kannangara (Jointly with Section D).
- 2.40 .. Changes Observed in the *Rhacophorus leucomystax maculatus* (Gray) during Metamorphosis—Therese Joseph and A. D. P. Jayatilaka (Jointly with Section D).
- 3.00 .. Myenteric Plexus of the Oesophagus—P. S. S. Panditharatne.

#### Monday, 22nd December:

- 8.30 .. The Pattern of Rabies Neutralising Antibody Formation in Exposed Persons who have undergone different Schedules of Antirabies Treatment in Ceylon—A. Sathasivam and S. Selvarajah.
- 8.50 .. Immunological Reactions in *Mycobacterial* Infections  
1. Skin Sensivity Patterns of Ceylonese to Six Mycobacterial Antigens.  
2. An Evaluation of the Kaolin Agglutination Test (KAT) in the Diagnosis of Tuberculosis—  
M. R. M. Pinto, S. N. Arsecularatne and C. G. Urugoda.
- 9.10 .. *Staphylococcus aureus* in Ceylon. Biological Properties including Phage Types and Antibiotic Sensitivity Patterns—C. Navaratnam, S. N. Arsecularatne, Yvette E. Hermon and K. Kuganesan.
- 9.30 .. The Determination of Aflatoxin Producing Capacity of Strains of *Aspergillus flavus*—S. N. Arsecularatne and C. H. S. R. Bandunatha.
- 10.00 .. Business Meeting.

## ABSTRACTS

### BACTERIOLOGICAL AND THERAPEUTIC STUDIES IN DIARRHOEAS

PRIYANI E. SOYSA AND K. ARULANATHAM  
(Dept. of Paediatrics, University of Ceylon, Colombo)

Three separate studies were made on cases of acute and subacute diarrhoeas admitted to the University Paediatric Unit at Lady Ridgeway Hospital, Colombo.

The first was a study of the role of Salmonella and Shigella in the causation of diarrhoea in hospital patients. 316 cases of diarrhoeas admitted to the unit were studied. Diarrhoeas due to amoebae were excluded from the study. Salmonella or Shigella were isolated from 15.5% of cases studied.

The second was a study to find the effect of chloramphenicol, neomycin and a combination of chloramphenicol and neomycin (Entocetran) on acute and subacute diarrhoeas. Cases where amoebae were found as the cause of the diarrhoea and cases which had received antibiotics prior to admission were excluded from the study. There was no significant difference in the results obtained using the three different drugs.

The third study was to find the role of antibiotics in the treatment of diarrhoeas not due to salmonella, shigella or amoebae. Symptomatic treatment with kaolin was given to 54 cases and the results compared with cases treated with neomycin (48 cases) and chloramphenicol (32 cases). No significant difference was found.

With the limited laboratory facilities available, many practitioners routinely use antibiotics on all cases of diarrhoeas. This has no advantage over symptomatic and supportive treatment in cases of diarrhoea of unproven aetiology.

### EARLY AMBULATION IN ACUTE MYOCARDIAL INFARCTION

M. A. MACAN MARKAR, J. JEYARATNAM AND T. JESUDHASON  
(Department of Medicine, University of Ceylon, Peradeniya)

This study was stimulated by our observation that patients admitted with an acute attack of myocardial infarction walked to and fro to the toilet situated about 10-20 yards away from the first day of admission.

All warnings to the contrary were disregarded as they were apparently unaware or perhaps unconvinced about the possibility of any ill-effects of early ambulation. Further a careful search into the literature revealed that the earliest mobilisation on record after acute myocardial infarction was the 15th day (Gorden et al 1967). Therefore we felt that we had a ready made 'volunteer' group to study the effects of very early ambulation.

This study of ours was made to determine whether early ambulation altered the mortality and morbidity rates or interfered with the time of return to normal work. Further, it intended to evaluate the significance of bed rest after an acute episode of myocardial infarction and finally to determine any physical or psychological causes that may prevent a person from resuming normal work within a period of 3 or 6 months.

Gorden et al (1967) could not find a significant difference in morbidity, mortality or rapidity of return to work in his patients who were rested for 15 or 25 days. Wicott and Caird (1966) emphasised the value of an optimistic and active approach during convalescence in rehabilitating these patients. Sharland (1964) found no ill effects on an early return to work.

For the purpose of our study we selected 50 male patients under 65 years with a first episode of acute myocardial infarction. All of them had classical E.C.G. changes and survived their hospital stay. On discharge they were followed periodically, one month, three months, six months, one year and two years after the initial attack. This time of resumption of normal work and any complications were noted.

All patients were of the low socio-economic group. Their daily physical activity in hospital or at home after the attack of myocardial infarction were graded. Their occupation and extra curricular activity before and after the myocardial infarction were also graded and their follow up varied from 3 months to 2 years. A detailed psychological assessment was made.

### Summary of results

So far 40 cases were thoroughly studied. 63% of our patients were back at work within 3 months and 68% within 6 months. (Sharland 1964) 55% within 3 months. (Wicott and Caird 1966) 58% within 3 months.

(Gorden 1967) 79% within 6 months. 22 of our patients who were using the toilet within 3 days of their acute episode 17 (77%) resumed normal work within 3 months and 19 (86%) within 6 months.

In the different category of workers 50% 'hard' and 77% 'intermediate' and 'light' resumed normal work within 3 months (Wincott 1966) 75% 'hard' and 66% 'intermediate' and 'light' workers were back at work within 3 months.

13 patients (32%) had not returned to work. One was medically advised not to go back and could not be convinced by us. Another, a ferry boat mower was looking for a lighter job for fear of a second episode. Ten were incapacitated with grade 2 or 3 angina or dyspnoea (Wood). One died after a second attack of myocardial infarction.

#### References

- B. M. Gorden, A. Alison and G. B. Shaw (1967). Management of Myocardial Infarction. The Effect of Early Mobilisation. *Scot. Med. J.* 12, 435.
- Elizabeth A. Wicott, F. I. Caird (1966). Return to work after Myocardial Infarction. *B.M.J.* 2, 1302-1304.
- Sharland (1964). Ability of Men to Return to Work after Cardiac Infarction. *B.M.J.* 2, 718-720.

### SPREAD OF INFECTIONS HEPATITIS IN THE FAMILY GROUP

#### A REPORT OF BIOCHEMICAL INVESTIGATIONS

N. NAGARATNAM, DAWN F. DE SILVA  
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S. SENTHESHANMUGANATHAN, H. R. PEIRIS AND N. NAGARAJAH  
(Department of Biochemistry, Medical Research Institute,  
Colombo 8)

In Ceylon, as in other countries, there is an increasing incidence of infectious hepatitis. Epidemics are uncommon but sporadic cases abound. It was therefore, thought worthwhile to investigate the families of patients admitted to hospital with infectious hepatitis with a view to mapping out the incidence of infection in the household and to evaluate the common liver function tests under such a situation.

Tests used in the study included serum bilirubin, changes in plasma proteins (Zinc Sulphate Turbidity) and serum enzyme levels (Alkaline phosphatase, serum glutamic oxaloacetic transaminase, and serum glutamic-pyruvic transaminase).

Thirty Ceylonese families (consisting of 140 contacts) of patients with infectious hepatitis were investigated. Of these, 80% of the contacts had raised Zinc Sulphate Turbidity, 50% had raised alkaline phosphatase levels and about 20% had raised transaminase levels. The clinically positive cases had bilirubin values above 1.2 mg. % while all the 140 contacts had bilirubin values within the limits of normality. Two contacts who had elevated bilirubin levels were considered as positive cases. On the contrary the contacts had serum bilirubin levels below normal though they showed other evidences of hepatic cellular dysfunction (subclinical or non-icteric hepatitis). It was noticed that those who showed a moderate increase in SGOT activity also showed an increased SGPT activity. On the other hand, a minimal increase in SGOT activity was more often unaccompanied by a rise in SGPT activity and the converse was also found to be true.

The epidemiology of this illness will be discussed. Large families with an accompaniment of poverty, overcrowding, unhygienic living conditions and increased avenues for person to person contact have been found to be the main cause for the high incidence of the infection.

### NECROTISING ENTERITIS IN CEYLON

C. A. RATNATUNGA, R. G. PANABOKKE, C. B. KUMARAKULASINGHE,  
H. L. EATON AND A. THARMARAJAH  
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and General Hospital, Kandy)

Several patients presenting with abdominal pain, fever and dark bloody stools have been seen at the General Hospital, Kandy, during the past few years. At laparotomy they were seen to have patchy lesions of the small bowel, ranging from congestion and oedema to gangrene of the wall of the bowel. The pathological findings in the affected segments of bowel examined were similar to those of Necrotising Enteritis, a disease described in two major studies, in Germany (Fick and Wolken, 1949) and in New Guinea (Murrell, Roth, Egerton, Samels and Walker, 1966). This disease has not been documented in Ceylon.

This paper is a preliminary communication of a study of this disease in Ceylon. The pathology and clinical features are described and the aetiology discussed. Necrosis of the bowel was seen in all the cases examined histologically. It appeared that the necrotic process commenced in the mucosa and spread outwards to the peritoneal coat. Clinically they presented as patients with an acute abdomen.

The incidence of our cases in a two year study period appears to have been seasonal, as in the study in New Guinea. It differs from both the New Guinea and German studies however in that the consumption of meat was not a precipitating factor.

Further studies which are being evaluated are the relationship of ascariasis and clostridial infection to this disease.

#### References

- Fick, K. A. and Wolken, A. P. (1949). Necrotic Jejunitis. *Lancet.*, **1**, 519-521.
- Murrell, T. G. C., Roth, L., Egerton, J., Samels, J. E. and Walker, P. D. (1966). Pig-Bel—Enteritis Necroticans, A Study in Diagnosis and Management. *Lancet.*, **1**, 219- .

#### A BACTERIOLOGICAL STUDY OF SEPTIC SURGICAL LESIONS

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In a survey of surgical wound infection in England and Wales, the Public Health Laboratory Service found *Staphylococcus aureus* in 60% of septic wounds (Williams, McDonald and Blowers, 1960). At the Massachusetts General Hospital in Boston, the incidence of *Staphylococcus aureus* in cases with major sepsis was 65% (Barnes, Behringer, Wheelock and Wilkins, 1961). The bacterial flora of a random selection of more than a hundred cases of septic surgical lesions at the General Hospital, Colombo, was studied, and the coagulase-positive *Staphylococcus* was found to be the predominant organism.

Buhr and Scott (1959) found that 30% of staphylococcal infections seen at the Accident Service of the United Oxford Hospitals were penicillin resistant. Antibiotic sensitivity tests were carried out on the organisms isolated in this study, and a significant proportion of the *Staphylo-*

cocci encountered were observed to be penicillin resistant. Some of these organisms were found to be also resistant to streptomycin, tetracycline and erythromycin. The latter group, though small, pose special problems in management. The effects of previous antibiotic therapy and duration of stay in hospital on the incidence of antibiotic-resistant staphylococci are considered. Antibiotic regimes commonly used for septic surgical lesions are compared in the light of the results of this study.

The coagulase negative *Staphylococcus*, *Staphylococcus albus*, is generally thought to be non pathogenic, but Wilson and Stuart (1965) have shown that they play an important role in a small proportion of surgical infections. The significance of the finding of *Staphylococcus albus* in some of the cases in this series is discussed.

No organisms could be isolated from the pus obtained from some septic lesions. Possible causes for this phenomenon are put forward.

#### References

- Barnes, B. A., Behringer, G. E., Wheelock, F. C. and Wilkins, E. W. (1961). Postoperative sepsis. *Ann. Surg.*, **154**, 585-595.
- Buhr, A. J. and Scott, J. C. (1959). Penicillin-resistant staphylococci. *Lancet.*, **1**, 1019-1021.
- Williams, R. E. O., McDonald, J. C. and Blowers, R. (1960). Incidence of surgical wound infection in England and Wales. *Lancet.*, **2**, 659-663.
- Wilson, T. S. and Stuart, R. D. (1965). *Staphylococcus albus* in wound infection and in septicæmia. *Canad. med. Ass. J.*, **93**, 8-16.

#### ASYMPTOMATIC BACTERIURIA IN FEMALES IN RELATION TO ANAEMIA

##### A PRELIMINARY REPORT

T. VARAGUNAM, L. M. DE SILVA, U. WIJAYAWARDHANA  
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The relationship between bacteriuria and anaemia has been the subject of apparently only 1 report and that too in only 15 patients whose haemoglobin was less than 125 g/l. (Vejlsgaard, 1965). We have

investigated a total of 207 non-pregnant females, who did not have any symptoms suggestive of a urinary tract infection. Of these, 104 had haemoglobin contents of less than 100 g/l. Quantitative urine cultures (Kass, 1955) were done on all of them. The incidence of positive cultures was 18% in those females with haemoglobin contents of less than 100 g/l. and 6% in those with more than 100 g/l. The relationship of bacteriuria to age and parity is discussed.

#### References

- Kass, E. H. (1955). Chemotherapeutic and antibiotic drugs in the management of infections of the urinary tract. *Amer. J. Med.* **18**, 764-781.
- Vejlsgaard, R. (1965). Bacteriuria in patients with Diabetes Mellitus (a controlled study) in *Progress in Pyelonephritis* Edited by Kass, E. H., Philadelphia, F.A. Davis Company.

#### LESIONS ASSOCIATED WITH INTERSTITIAL PNEUMONITIS

N. KODAGODA AND DAPHNE ATTYGALLE

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Wolman and Goldberg (1958) defined interstitial pneumonia as an inflammatory process of the lungs, with exudate within the alveolar septa. Steinberg and Mignerey (1963) laid down criteria for the histological diagnosis of the condition. This condition was described in Ceylon in 1968 (Attygalle and Kodagoda, 1968).

The present series deals with 15 cases of undiagnosed illness terminating in sudden and unexpected death. The cause of death was shown to be interstitial pneumonitis in 14 of them.

These cases showed lesions in other organs also, exhibiting a cell picture similar to that found in the lung. The mononuclear infiltrate so characteristic of pneumonitis was seen in the myocardium (7 cases), liver (7 cases), epicardium (6 cases), intestinal mucosa (5 cases), intestinal submucosa (4 cases), meninges (4 cases), brain (2 cases), and kidney (1 case).

It is suggested that the inflammatory lesion operative in interstitial pneumonitis is not confined to the lung, although the predominant effect in the cases reviewed in this series is on the pulmonary tissue.

#### References

- Attygalle, D., and Kodagoda, N. (1968). Interstitial pneumonitis as a cause of sudden death among Ceylonese. *Proc. Ceylon Ass. Advmt Sci.*, **1**, 7-8.
- Steinberg, B., and Mignerey, H. F. (1963). Acute interstitial pneumonitis as cause of sudden unexpected death in infants. *Proceedings of the Third International Meeting in Forensic Immunology, Medicine, Pathology and Toxicology*, p. 167-179. London.
- Wolman, M., and Goldberg, M. G., (1958). The microscopical criteria of interstitial pneumonia, *Arch. Path.*, **65**, 272-278.

#### THE INNERVATION OF THE OESOPHAGUS IN THE MOUSE— AN ELECTRON MICROSCOPE STUDY

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(Department of Anatomy, University of Ceylon, Colombo)

The peri-oesophageal nerve bundles contained both myelinated and unmyelinated fibres. The nerves passed through the outer layer of the muscularis externa to the myenteric plexus which contained ganglion cells. No myelinated fibres were observed internal to this plexus.

The motor end-plates in the oesophagus showed no regional differentiation. At the end-plate the surface of the muscle was either slightly depressed or flattened. The terminal axons were grouped together so that the troughs, when present, contained many axons. Junctional folding was evident and there was an accumulation of mitochondria in the sole plasm. The nerves leading to the motor end-plates were unmyelinated for a considerable length. Furthermore, they were arranged in bundles and their relationship to the Schwann cell was characteristic of the unmyelinated nerve bundle (Gasser 1958). Axons at the site of sarcolemmal contact were swollen and contained both mitochondria and 'synaptic vesicles'. The terminal Schwann cell was either spread out over the axons and the sarcolemma or it retained the standard pattern of the unmyelinated nerve bundle. In the former arrangement desmosomes were observed between adjacent axons. Muscle spindles were not seen in the sections examined. A submucous and a subepithelial plexus were present. The significance of these observations will be discussed.

## Reference

Gasser, H. S., (1958). Comparison of the structure, as revealed with the electron microscope, and the physiology of the unmyelinated fibres in the skin nerves and the olfactory nerves. *Expl Cell Res. (Suppl.)*, 5, 3-17.

## PULMONARY FUNCTION IN TROPICAL EOSINOPHILIA

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Pulmonary functions tests have been carried out in twenty patients with Tropical Eosinophilia. The results have been compared with those obtained in healthy Ceylonese. The total lung capacity and its subdivisions have been measured using a closed circuit helium dilution spirometer (Godart Pulmonet) and the expiratory flow rates using a low resistance spirometer (Collins Vitalometer) and a Wright peak flow meter.

Two main patterns are discernible in the results:

1. Mild to moderate airway obstruction with diminished lung volumes.
2. Mild to moderate airway obstruction with normal lung volumes.

Evidence for airway obstruction was furnished by a low forced expired volume in one second when expressed as a percentage of the vital capacity and a low peak expiratory flow rate, whilst diminished vital capacity and diminished total lung capacity have been taken as evidence for diminished lung volume.

Our observations are not entirely consistent with those of Udawadia (1967) who observed diminished lung volumes in all of his patients.

(This research was supported by a Grant to one of us from the Wellcome Trust U.K.)

## Reference

Udawadia, F. E., (1967). Tropical Eosinophilia—A correlation of Clinical, Histopathologic and Lung Function Studies. *Dis. Chest.* 52, 531-538.

## GLUCOSE TOLERANCE DURING PREGNANCY

C. DE F. W. GOONARATNA, S. A. N. PERERA AND SELVI SINNATAMBY  
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Glucose tolerance was studied in two groups of women of comparable mean age. The first group consisted of 51 healthy women in the last trimester of pregnancy randomly selected from admissions to the De Soysa Maternity Hospital, Colombo. The second group consisted of randomly selected 40 non-pregnant healthy women tested during the same period.

Care was taken to exclude from the study subjects who fulfilled one or more of the criteria of "potential diabetes", as defined by the report of the W.H.O. Expert Committee on diabetes mellitus in 1965.

Blood glucose estimations were done on samples of capillary blood by the method first described by King and Garner, modified by Delory (1949).

The results obtained support the view that the 50g. oral glucose tolerance is not impaired during the last trimester of normal pregnancy. The mean blood glucose values at the end of one, one and a half and two hours respectively were 136, 116 and 99 mg./100 ml. blood in the first group. The corresponding values for the second group were 133, 115 and 99 mg./100 ml. blood.

The mean "fasting" and half-hour values for blood glucose in the first group were 81 and 135 mg./100 ml. blood. However, the corresponding values for the second group were 92 and 151 mg./100 ml. blood. The significance of these results with reference to the findings of other workers will be discussed.

## References

Delory, G. E., (1949). *Photoelectric Methods in Clinical Biochemistry*, pp. 70-72. London: Hilger and Watts.

World Health Organisation (1965). *Tech. Rep. Wld Hlth. Org.* No. 310.

## ANKLE-JERK TIME IN CEYLONESE

A. D. MARIADASAN

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E. D. RODRIGO AND C. C. FONSEKA

(Department of Physiology, University of Ceylon, Colombo)

That the tendon reflexes are prolonged in myxoedema and shortened in thyrotoxicosis is well established. Various techniques have been devised for timing the ankle-jerk. This communication is a preliminary report of the results of a survey undertaken to determine the mean ankle-jerk time for healthy Ceylonese adults, using a method based on that of Lawson (1958). The electromagnetic recording device (Kinemometer) used in the present survey was constructed locally. The method involves the use of a bar magnet strapped to the sole. When the ankle-jerk is elicited the magnet moves with the foot and this movement generates current in an adjacent coil recording directly on an electrocardiograph. From the tracing obtained, the time interval between the maximal rate of contraction and the maximal rate of relaxation, designated the VP interval by Nuttall and Doe (1964) is determined. The VP interval is an index of the tendon reflex time. The method is simple and cheap and can be used wherever an electro-cardiograph can be operated. It is a reliable diagnostic aid in the investigation of thyroid disorders (Nuttall and Doe, 1964).

In the present survey 126 healthy adults, most of them medical students of both sexes, were examined. The ages ranged from 18 to 60 years. The mean VP interval from these subjects was 162 milliseconds, with a range of 120 to 220 milliseconds.

The few proved cases of thyrotoxicosis tested so far gave values for VP below 100 milliseconds; proved cases of myxoedema gave values over 260 milliseconds.

### References

- Lawson, J. D. (1958). The free Achilles reflex in hypothyroidism and hyperthyroidism, *New Engl. J. Med.*, **259**, 761-764.
- Nuttall, F. Q., and Doe, R. P. (1964). The Achilles Reflex in Thyroid Disorders, *Ann. intern. Med.*, **61**, 269-288.

## THE PERMEABILITY OF NERVE "DIFFUSION BARRIERS" IN DIABETES

K. N. SENEVIRATNE AND O. A. PEIRIS

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

Previous studies (Seneviratne and Peiris, 1968) have shown that the peripheral nerves of subjects with diabetes mellitus are more resistant to ischaemia than are the nerves of healthy control subjects. Seneviratne and Peiris (1969) have since shown that the isolated peripheral nerves of alloxan-diabetic rats show a similar resistance to the effects of hypoxia.

Two alternative mechanisms could be responsible for this phenomenon. It has been suggested (Gregersen, 1968) that diabetic nerves can maintain their activity under anoxic conditions by utilizing non-oxidative metabolic pathways. The experiments described in this paper were designed to test the alternate hypothesis suggested by Seneviratne and Peiris (1969), that the sequence of excitability changes during anoxia was determined by the dynamics of K<sup>+</sup> equilibrium in the peri-axonal spaces, and that the abnormal resistance of the diabetic nerve was due to an abnormal permeability of the peri-axonal connective tissue diffusion barriers which surround the nerve.

The excitability of isolated sciatic nerves of control and alloxan-diabetic rats have been studied during exposure to anoxic and hypoxic conditions and the experiments repeated after insulin had been used to increase the intra-cellular K<sup>+</sup> concentrations. The results obtained strongly support the hypothesis that the resistance of diabetic nerves to ischaemia is due to alterations in the properties of the peri-neural diffusion barriers.

### References

- Gregersen, G. (1968). A study of peripheral nerves in diabetic subjects during ischaemia. *J. Neurol. Neurosurg. Psychiat.*, **31**, 175-181.
- Seneviratne, K. N. and Peiris, O. A. (1968). The effects of ischaemia on the excitability of sensory nerves in diabetes mellitus. *J. Neurol. Neurosurg. Psychiat.*, **31**, 348-353.
- Seneviratne, K. N. and Peiris, O. A. (1969). The effects of hypoxia on the excitability of the isolated peripheral nerves of alloxan-diabetic rats. *J. Neurol. Neurosurg. Psychiat.* —In print.

## ENZYME HISTOCHEMICAL STUDIES ON HYDATIDIFORM MOLE AND CHORIOCARCINOMA

R. G. PANABOKKE, A. D. G. NELSON, W. H. FERNANDO, B. JAYAWEERA,  
D. E. GUNATILLAKE AND W. B. KARUNARATNE

(Departments of Pathology and Obstetrics, University of Ceylon  
Peradeniya, and Obstetrics Units of General Hospital, Kandy)

Acid phosphatase, non specific esterase, leucine aminopeptidase and monoamine oxidase respectively were looked for in biopsies from hydatidiform moles and choriocarcinoma. Normal full term placentae were similarly examined for comparison.

Acid phosphatase and non specific esterase were demonstrated by an azo dye technique. L-leucyl 4 methoxy—beta naphthol amide hydrochloride was used for demonstrating leucine aminopeptidase (Barka and Anderson, 1965). Monoamine oxidase activity was shown up by the method described by Pearse (1960).

Both cytotrophoblast and syncytiotrophoblast of normal placentae show considerable activities for acid phosphatase, non-specific esterase and monoamine oxidase. Leucine aminopeptidase activity is absent in normal trophoblast. Acid phosphatase, non specific esterase and monoamine oxidase activity is positive in the syncytiotrophoblast but is absent or minimal in proliferating cytotrophoblastic cells in hydatidiform moles. Leucine aminopeptidase is strongly positive both in the cytotrophoblast and syncytiotrophoblast in hydatidiform moles.

In choriocarcinoma acid phosphatase and monoamine oxidase were diminished both in the cytotrophoblastic and syncytiotrophoblastic cells; whereas non specific esterase followed the same pattern observed in the proliferating trophoblast in hydatidiform moles. Leucine aminopeptidase activity was found in both elements of the trophoblast in choriocarcinoma but was considerably weaker than that seen in hydatidiform moles.

Enzymic alterations in the trophoblastic epithelium in hydatidiform moles and choriocarcinoma, suggest that cytotrophoblastic elements in them appear to be the seat of greater metabolic dearrangements than syncytiotrophoblastic elements.

Further investigations are being carried out in order to determine whether the enzyme changes observed, will be of diagnostic significance.

## References

- Barka, Tibor and P. J. Anderson (1965). *Histochemistry* Harper Row Publishers Inc. New York.
- Pearse, A. G. Everson (1960). *Histochemistry Theoretical* (2nd Edition) London: J. and A. Churchill.

## SURVEY OF SALT INTAKE

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Salt is a convenient household commodity which is generally used as a vehicle in the prophylactic treatment of endemic goitre.

Iodisation of salt depends on the normal requirement of iodine, intensity of the environmental iodine deficiency, the presence of goitrogenic factors and the daily per capita consumption of salt (Chen, 1964; Mahadeva, Seneviratne, Jayatilleke, Shanmuganathan, Premachandra and Nagarajah 1968).

Although the intake of most nutrients has been worked out during the normal course of dietary surveys in the past, the daily per capita consumption of salt has not been estimated.

In this survey a simple method has been described for evaluating this.

This finding will be the baseline on which the iodisation programme will be planned. The iodisation programme of various countries is discussed.

## References

- Chen, K. P. (1964). Pilot project on Endemic Goitre Prevention with Iodized Salt in Hsinchi, Taiwan, China. *Second Far East Symposium on Nutrition, Taipei, Taiwan, China*, 210.
- Mahadeva, K., Seneviratne, D. A., Jayatilleke, D. B., Shanmuganathan, S. S., Premachandra, P. and Nagarajah, M. (1968). Further studies on the problem of goitre in Ceylon. *Brit. J. Nutr.*, 22, 527-534.

## A METHOD OF DETERMINING SKELETAL MATURITY OF CEYLONESE GIRLS AGED 7-15 YEARS

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Standards correlating skeletal development with chronological age (i.e. skeletal standards) are not available for Ceylonese children. Since skeletal development is an index of physical maturity, such standards are of value in determining the maturational status of children. Although a set of standards could be compiled for Ceylonese children, such a procedure would be costly and time-consuming, requiring about 20 years to complete.

A roentgenographic study of the skeletal changes in the bones of the hand and wrist is particularly suitable for assessing skeletal maturity because of the large number of distinctly recognisable changes which occur in this region from birth to the age of about 18 years. Thus, an assessment of the skeletal maturity of an individual can be made by studying the time of appearance of the centres of ossification, the changes in their shapes and articular facets and the time of fusion of the epiphyses of the long bones with their shafts.

A pilot study was made with 10 girls, randomly selected, from each age group (i.e. 7-15 years, at yearly intervals). Their chronological ages were determined from their certificates of birth. Based on the roentgenographic findings in these children, the skeletal maturity was determined using the Greulich and Pyle Atlas. It was shown that the coefficient of correlation between the skeletal maturity of the Ceylonese girls and the American girls was very high ( $r=0.97$ ,  $p \leq 0.001$ ). An extended study was therefore undertaken with 30 girls in each age group.

An analysis of the results showed that this Atlas, though compiled for American girls is applicable for determining either the chronological age or the skeletal age of Ceylonese girls where only one age is known.

### Reference

Greulich, W. W. and Pyle, S. I. (1950). *Radiographic Atlas of Skeletal Development of the Hand and Wrist*. California: Stanford University Press.

## INCIDENCE OF SALMONELLAE IN DESICCATED COCONUT MILLS

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Investigations were carried out in several Desiccated Coconut mills for evidence of salmonellae in the premises.

- (a) In three mills salmonellae were isolated from the stacking yards while in one of these mills the same serotype that was isolated in the stacking yard was also isolated from the hatcheting section and Desiccated Coconut (DC) manufactured at this mill.
- (b) Salmonellae were isolated from the floor of the washing section of four of the mills and in three of them the same serotypes were isolated from the water in the washing tanks, while in two of them the identical serotypes were isolated from the D.C. manufactured in these mills.
- (c) Two different serotypes of salmonellae were isolated from sterilised coconut at three different mills and in another mill two different serotypes were isolated from disintegrated coconut while in all these cases the final product viz. D.C. was free of salmonellae.
- (d) In one of the mills the same serotype of salmonellae was isolated from the foot bath, floor of washing section, washing tank, feet of a worker, gloves used for handling D.C. trays, water inside a drain in the drying section and also in D.C.
- (e) In another mill two different serotypes were isolated from a flower bed, a hatcheting axe, floor of washing section, washing tank, washed coconuts, sweepings of desiccated coconut from the floor of the 'sterile' section and also from lumps of partially dried coconut. One of these serotype was also isolated from D.C. manufactured at this mill.

## INVESTIGATIONS ON THE CONTROL OF BACTERIAL ORGANISMS IN THE MANUFACTURE OF DESICCATED COCONUT

THE LATE T. VELAUDAPILLAI, H. A. TILLEKERATNE AND  
M. M. I. DABARA

*(The Ceylon Coconut Board, Colombo 1)*

- (a) Samples of coconuts washed preparatory to the manufacture of desiccated coconut showed a high count of bacterial organisms.
- (b) After immersion in boiling water for 90 seconds, samples of pre-washed coconuts, showed a reduction in the number of viable organisms.
- (c) Viable counts carried out on coconuts disintegrated immediately after the heat treatment showed an increase in the number of viable organisms and the final product also showed a high bacterial content.
- (d) When disintegration was done two hours after the heat treatment, there was a marked reduction in the number of bacterial organisms, both in the disintegrated wet product as well as in the final product.

## THE PATHOGENESIS AND EFFECTS OF A SELECTIVE CHLORIDE DEFICIT IN MAN

BRIAN SENEVIRATNE

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When a powerful diuretic is given to man, there is an increase in the urinary excretion of sodium, potassium, and chloride. The chloride excretion is often in excess of the sodium excretion which consequent production of a "selective" chloride deficit.

With the development of drugs which block potassium (but not chloride) excretion, it has been possible to prevent potassium depletion so that the effects of a "pure" chloride depletion can be studied.

Experiments were first done to investigate the incidence and magnitude of a "selective" chloride deficit in clinical practice.

21 patients with cirrhosis and ascites were given known amounts of chloride (in the form of KCl) and the excretion of chloride estimated. In 16 of the 21 patients there was a large chloride retention which ranged from 193-900 mEq (mean 389mEq). Experiments were then done to determine the cause and effects of these large chloride deficits. It was found that diuretics play a major role in the production of these chloride deficits and that we have no effective diuretic, or combination of diuretics, in clinical use today that can reliably prevent this from happening.

The effects of this chloride deficit on the plasma chloride concentration and the plasma potassium concentration were then studied. It was found that a selective chloride deficit in addition to lowering the plasma chloride concentration also lowered the plasma potassium concentration and that correcting the chloride deficit without the supply of any potassium, resulted in the return of the plasma potassium concentration to normal.

The clinical significance of these findings in relation hypokalaemia seen in clinical practice is discussed.

## ALDOSTERONE : POTASSIUM BALANCE AND THE PLASMA POTASSIUM LEVEL

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The major site of action of aldosterone is thought to be at the site of the sodium-potassium exchange mechanism in the distal tubule of the nephron, resulting in an increased excretion of potassium (Vander, Malvin, Wilde, Lapidus, Sullivan and McMurry, 1958; Vander, Wilde and Malvin, 1961). Thus, when a fall in the plasma potassium level occurs in clinical states characterised by hyperaldosteronism, it has been assumed that this hypokalaemia is a manifestation of true potassium depletion.

Experiments were done on the author to determine whether the fall in plasma potassium in states characterised by high levels of circulating aldosterone could be explained in terms of potassium depletion. The author took a constant potassium intake and injected himself with 0.5 mg. b. d. of Aldosterone under balance conditions. It was found that the kidney "escaped" from the renal effects of aldosterone (sodium retention, potassium loss) after a short time, and that the subsequent fall in the plasma potassium level could not be explained in terms of a negative balance. It is therefore suggested that one of the major actions of

aldosterone is on the plasma potassium level, lowering it, probably by an internal redistribution of potassium rather than by true potassium depletion.

This suggested that the hypokalaemia associated with states characterised by high levels of circulating aldosterone might simply be a reflection of the "plasma potassium lowering" effect of aldosterone rather than a manifestation of a true potassium depletion. In order to test this hypothesis, hypokalaemic patients were given the aldosterone antagonist spironolactone, and the plasma potassium and the potassium balance determined. It was found that there was a prompt correction of the hypokalaemia, and that this was not associated with any significant potassium retention.

The clinical implications and the role of aldosterone antagonists in clinical practice are discussed.

#### References

- Vander, A. J., Malvin, R. D., Wilde, W. S., Lapides, J., Sullivan, L. P., and McMurray, V. M. (1958). Effects of adrenalectomy and aldosterone on proximal and distal tubule sodium transport. *Proc. Soc. exp. Biol.*, **99**, 323-326.
- Vander, A. J., Wilde, W. S., and Malvin, R. S. (1961). A theoretical mode of action of aldosterone. *J. theor. Biol.*, **1**, 273, 279.

### THE RELEASE OF POTASSIUM FROM ENTERIC-COATED AND SLOW-RELEASE POTASSIUM CHLORIDE TABLETS

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There has been a sudden recent increase in the incidence of small-bowel ulceration, and this has been attributed to enteric-coated potassium chloride tablets. It has been suggested that there is rapid release of potassium from the enteric-coated tablet resulting in a high local concentration of potassium which results in ulceration of the mucosa, either by a direct toxic effect on the mucous membrane (Baker, Schrabar and Hitchcock 1964) or by a venous spasm (Boley, Schultz, Kreiger, Schwartz, Elguezebal and Allen, 1965).

A new preparation of KCl—"slow-K" (Ciba) where the potassium was embedded in wax matrix was produced, and it was claimed that the tablet was safer than the enteric-coated tablet.

In vitro experiments were done (1) to compare the rate of release of potassium from enteric-coated and "slow-release" KCl tablets, and (2) to determine the local concentration of potassium which built up around the two types of tablets under conditions which simulated those existing in the stomach and in the small intestine.

It was found that the enteric-coated tablet released potassium very rapidly when directly suspended in alkaline pancreatin, but that this was considerably slowed if the tablet had been previously exposed to acid pepsin. The slow-release tablet did release potassium slowly. However, unlike the enteric-coated tablet, the slow-release tablet released some potassium in the stomach.

There was a very high local concentration of potassium (550 mEq/L) around the enteric-coated tablet. However, a concentration (200 mEq/L) was also found around the slow-release tablet. Bervenmark, Erikson, Ljunberg and Paalzow (1966) have already shown that increasing the concentration of potassium from 4 mEq. to 12-18 mEq. is sufficient to cause a spastic contraction of the gut.

The clinical and pharmaceutical implications, with special reference to the place of these tablets in therapy are discussed.

#### References

- Baker, D. R., Schrabar, W. H. and Hitchcock, C. R. (1964). Small-bowel ulceration apparently associated with thiazide and potassium therapy. *J. Amer. med. Ass.*, **190**, 586-590.
- Boley, S. J., Schultz, L., Kreiger, H., Schwartz, S., Elguezebal, A., and Allen, A. G. (1965). Experimental evaluation of thiazides and potassium as a cause of small bowel ulceration. *J. Amer. med. Ass.*, **192**, 763-768.
- Bervenmark, H., Erikson, G., Ljunberg, S., and Paalzow, L. (1966). Sustained release tablets of potassium. *Acta pharm. Suec.*, **3**, 45-58.

### DIFFICULTIES IN EXCRETING ORALLY ADMINISTERED POTASSIUM IN PATIENTS WITH FLUID RETENTION STATES

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According to the currently accepted theory of urinary potassium excretion (Berliner, Kennedy and Hilton, 1950; Berliner, 1960), all the

potassium filtered at the glomerulus is reabsorbed at the proximal tubule of the nephron. Potassium which finally appears in the urine is derived from a distal site (probably in the distal half of the distal tubule) where intraluminal sodium is exchanged for tubular cell potassium. In severe fluid retention states, there is a marked retention of sodium (Goodyer, Relman, Lawrason and Epstein, 1950). It is posulated that if this reabsorption of sodium is at a proximal tubular site, sufficient sodium would reach the site of the distal tubule for the Na-K exchange to occur, resulting in potassium retention. Under these circumstances there might be a rapid rise of the plasma potassium in response to an oral load.

The hypothesis was tested by giving 21 patients with cirrhosis and ascites 75-100 mEq/day of potassium. In 4 of the patients there was a marked rise in the plasma potassium concentration to hyperkalaemic levels. It was shown that this was due to a failure of the kidneys to excrete the oral load despite a normal glomerular filtration rate. Normal subjects given the same load excreted the potassium rapidly, and the plasma potassium showed no change.

The clinical and physiological implications are discussed.

#### References

- Berliner, R. W., Kennedy, T. J., (Jr.), and Hilton, J. G. (1950). Renal mechanisms for the excretion of potassium. *Amer. J. Physiol.*, **162**, 348-352.
- Berliner, R. W. (1960). Renal mechanisms for potassium excretion. *Harvey Lectures* **55**, 141-152.
- Goodyer, A. V. N., Relman, A. S., Lawrason, F. D., and Epstein, F. H. (1950). Salt retention in cirrhosis of the liver. *J. Clin. Invest.*, **29**, 973-981.

#### SOME TREMATODES OF VERTEBRATES HITHERTO UNREPORTED FROM CEYLON WITH A DESCRIPTION OF A NEW SPECIES OF *BILORCHIS* AND A REVISION OF THE GENUS

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A number of trematodes predominantly gastrointestinal parasites, hitherto not recorded in Ceylon, were discovered on examination of some vertebrate animals.

Six unreported trematodes including two species of *Haplorchis*, one species each, of the genera *Galactosomum*, *Stictodora*, *Plagiorchis* and *Prosthodendrium* were found in the small intestine of dogs from the Dog Pound in Colombo. This is probably the first record of a *Prosthodendrium* sp. from a dog.

A third species of *Haplorchis* was found in the fishing cat. A strigeid, *Pharyngostomum cordatum* and *Testifrons cristata* were recovered from a civet cat and a rusty spotted cat from the North Central Province, the former being attached to the small intestinal mucosa in clusters. A jackal from the same area harboured large numbers of *Echinochasmus liliputanus*.

Examination of a mongoose trapped in the animal house revealed the presence of *Euparadistomum buckleyi* in the gall bladder.

Two species of *Pleurogenoides*, an amphistome, and an interesting species of *Ganeo* with one intestinal caecum short, were recovered from the common frog *Rana hexadactyla*.

A species of *Euamphimerus* from ashdove, an *Echinochasmus* sp. and *Prosthogonimus* from a pond heron and a *Paradistomoides* sp. from a gecko are also described.

A new trematode belonging to the genus *Bilorchis* and differing significantly from *B. indicum*, the only species reported so far, was recovered from the gall bladder of a fresh water tortoise. The discovery of the present species has thrown light on the generic diagnosis which was originally based only on one species.

#### PARATELPHUSA CEYLONENSIS AND PARATELPHUSA RUGOSA AS SECOND INTERMEDIATE HOSTS OF PARAGONIMUS, WITH OBSERVATIONS ON OTHER PARASITES IN THE FRESH WATER CRABS IN CEYLON

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Large numbers of fresh water crabs collected from different habitats in various parts of Ceylon were examined for the metacercariae of *Paragonimus*. Two foci of fairly heavy infection were detected at Upper Hantane and Mawanela. *Paratelphusa rugosa* collected from a mountain stream at Upper Hantane harboured, predominantly in the hepatopancreas, a metacercaria of *Paragonimus* with a fragile double cyst

wall and containing large numbers of pink granules in the parenchyma *P. ceylonensis* collected in a paddy field in Mawanella had an oval metacercaria in the blood vessels with thin outer and thick inner cyst walls and a distinct knob in the outer wall for attachment. These metacercariae which belong to two different species have been fed to experimental animals to obtain adults.

In addition to *Paragonimus* a number of other parasites were observed in these crabs. The only parasites that have been described so far from fresh water crabs of Ceylon are a leech *Paraclepsis vulnifera* by Fernando (1960), a larval nematode, and the metacercaria of *Pleurogenoides sitapurii* (Dissanaike and Fernando, 1958). These we found to be common in many parts of the island, the larval nematode being the commonest. In addition, an adult nematode and several different types of metacercariae including *Paragonimus* found in these crabs are described.

#### References

- Dissanaike, A. S. and Fernando, C. H. (1960). *Parathelphusa ceylonensis* C. H. Fern., Second intermediate host of *Pleurogenoides sitapurii* (Srivastava). *J. Parasit.*, **46**, 889-890.
- Fernando, C. H. (1960). The Ceylonese fresh water crabs (Potamonidae). *Ceylon J. Sci. biol. sci.*, **3**, 191-222.

### CHANGES OBSERVED IN THE *RHACOPHORUS LEUCOMYSTAX MACULATUS* (GRAY) DURING METAMORPHOSIS

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During investigation of the effects of aflatoxins on developing tadpoles (work in progress), no literature was available on the morphogenesis of the median eminence of the hypothalamus, hypophysis cerebri and thyroid gland during normal metamorphosis of the *Rhacophorus leucomystax maculatus* in order to compare with these organs in the experimental animal. This study was undertaken to establish these norms.

Tadpoles from a single spawn nest were studied at various stages of development as noted by their body lengths (BL) and total length (TL) i.e. body length and tail length. Measurements were made in mm.

BL/TL—12/30. These tadpoles showed the presence of a small single thyroid follicle, in transverse section and identified with difficulty, between the fused hypohyal and ceratohyal cartilages and a rudimentary

hypophysis cerebri in a line vertical with the developing optic lobes of the brain. There was no indication of the presence of the median eminence.

BL/TL—17/35. The thyroid gland was identified with ease at this stage and it showed numerous follicles partially filled with colloid. The median eminence and the forerunners of the hypophyseal-portal systems were faintly visible around the hypophysis cerebri which was well marked at this stage.

BL/TL—17/57. (First appearance of hind limbs). The follicle sizes of the thyroid gland were much larger than in the 17/35 stage and the colloid nearly filled the lumina of the follicles. The median eminence was more developed and the hypophyseal-portal system well established around the hypophysis cerebri.

BL/TL—18/50. (Hind limbs about 23 mm and a day after appearance of forelimbs). The thyroid gland was more than double in size when compared with the 17/57 stage. The thyroid follicles were packed with colloid. The median eminence was observed as a thick bundle with marked sunken capillaries within it. The anterior hypophysis cerebri was well developed and showed chromophobes and chromophores.

Two days after the appearance of forelimbs the histological picture of these three organs were similar. The remaining tadpoles (48) underwent metamorphosis in 3 days quite contrary to the observations of some workers, especially Etkin (1964, 1968), that the metamorphic climax lasted 6-7 days.

#### References

- Etkin, W. (1964). In *Physiology of the amphibia*. ed. Moore, J. A. New York: Academic Press. pp. 427-468.
- ibid* (1966). How a tadpole becomes a frog. *Sci. Amer.*, **214**, No. 5. 76-88.

### "MYENTERIC PLEXUS OF THE OESOPHAGUS"

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The myenteric plexus of the stomach and intestine have been studied, and it has been assumed that the myenteric plexus of the oesophagus has a similar pattern, arrangement and types of cells (Kuntz, 1934).

The purpose of this study was to observe the form and extent of the myenteric plexus of the oesophagus and the nature of arrangement of ganglion cells. The myenteric plexus of the oesophagus is studied in monkey and man. Frozen sections were stained with silver, using a modified Bielschowsky method.

In both monkey and human specimens the myenteric plexus is situated mainly between the circular and longitudinal muscle layers, and consists of primary, secondary and tertiary plexuses. From the tertiary plexus fine nerve bundles pass into the muscle layers. These plexuses are more obvious in the lower part of the oesophagus, and are best developed in the region of the gastro-oesophageal junction. The bundles forming these nerve plexuses are relatively larger in the human.

The ganglia are situated at the nodes of the plexus, and the number of ganglion cells varies from a few in some, to 60-80 in others. These are Type I and Type II cells of Dogiel (1896) and are large. Small type I and type II cells are not seen. The arrangement and significance of cells in these ganglia is discussed.

#### References

- Dogiel, A. S. (1896). Zwei Arten sympathischer Nervenzellen; *Anat. Anz.*, **11**, 679-687.  
Kuntz, A. (1934). *The Autonomic Nervous System* 2nd ed., p. 220, London: Bailliere, Tindall and Cox.

#### THE PATTERN OF RABIES NEUTRALISING ANTIBODY FORMATION IN EXPOSED PERSONS WHO HAVE UNDERGONE DIFFERENT SCHEDULES OF ANTIRABIES TREATMENT IN CEYLON

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Although in previous investigations (e.g. Atanasiu, P., Cannon, D. A., Dean, D. J., Fox, J. P., Habel, K., Kaplan, M. M., Kissling, R. E., Koprowski, H., Lepin, P. and Perez Gallardo, F., 1961) the rabies neutralising antibody response to different schedules of serum and vaccine inoculation has been assessed, these studies have been made on non-exposed persons. In the present investigation antibody levels were studied in persons who had been exposed to rabies and who had been therefore given different schedules of antirabies treatment.

Specimens of sera from about 80 patients were collected at different times before and during the course of treatment and thereafter. Three groups of patients studied were those who received—

- (a) Hyperimmune rabies serum followed by twenty one injections of antirabies vaccine plus two booster injections thereafter
- (b) Twenty one injections of antirabies vaccine
- (c) Fourteen injections of antirabies vaccine.

The antirabies vaccine used was a 5% sheep brain suspension containing 0.5% phenol. The hyperimmune rabies serum was an imported serum of equine origin.

The findings indicate:—

1. that the antibody level sufficient to neutralise about 100 LD<sub>50</sub> of challenge virus is found only about 10 days after completion of the full course of treatment.
2. that in severe exposures to rabies infections, antirabies vaccine alone is insufficient for protection and hence a combination of hyperimmune rabies serum and antirabies vaccine is necessary in these cases.

#### Reference

- Atanasiu, P., Cannon, D. A., Dean, D. J., Fox, J. P., Habel, K., Kaplan, M. M., Kissling, R. E., Koprowski, H., Lepin, P. and Perez Gallardo, F. (1961). Rabies neutralising antibody response to different schedules of serum and vaccine inoculation in non-exposed persons, *Bull. Wld Hlth Org.*, **25**, 103-114.

#### IMMUNOLOGICAL REACTIONS IN MYCOBACTERIAL INFECTIONS

1. Skin Sensitivity Patterns of Ceylonese to Six Mycobacterial Antigens
2. An Evaluation of the Kaolin Agglutination Test (Kat) in the Diagnosis of Tuberculosis

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1. Since their characterisation in 1958 'Anonymous Mycobacteria' have been reported in several bacteriological and skin sensitivity studies

abroad (United States, Africa, Malaya and India) as having been responsible for pulmonary and extrapulmonary disease and infection in asymptomatic people demonstrable by skin reactions of the delayed hypersensitivity type.

No information is available on the incidence of "Anonymous" infection in Ceylon. The importance of the recognition of infections by these bacteria lies in the difference in the prognosis and management of such cases as compared with tuberculosis.

We have examined the skin sensitivity patterns of about 800 asymptomatic Ceylonese (and of 100 patients with tuberculosis and 50 with other lung pathology) to the following antigens:—

PPD-Y (Runyon Group I); PPD-G (Group II); PPD-B and PPD-A (Group III); PPD-F (Group IV) and PPD-S (*Mycobacterium tuberculosis*, using 5 TU injected intradermally).

A high incidence of sensitization was found in asymptomatic people to the 'Anonymous' antigens with some reaction diameters approaching 20 mm. The profiles of sensitivity which differed with each antigen are discussed. These results indicate that infections produced by these bacteria may be of greater frequency than is thought at present.

2. The non-availability of a rapid, sensitive and specific serological test is a serious limitation in the diagnosis of tuberculosis. Gel diffusion, haemagglutination and carrier particle agglutination have been suggested as the basis of tests for this purpose. Recent literature (Takashashi, 1962) described the use of sensitized kaolin particles in an agglutination test but the specificity of the test has not been firmly established. We have investigated this reaction with 150 sera from normal persons and from patients with tuberculosis or other lung pathology. We find this test to have definite value in confirming active tuberculosis. Our findings in relation to sensitivity and specificity are discussed.

#### Reference

- Takahashi, Y. (1962). Specific serum agglutination of kaolin particles sensitized with tubercle phosphatides and its clinical evaluation as a serodiagnostic test for tuberculosis. *Amer. Rev. resp. Dis.*, **85**, 708-719.

## STAPHYLOCOCCUS AUREUS IN CEYLON. BIOLOGICAL PROPERTIES INCLUDING PHAGE TYPES AND ANTIBIOTIC SENSITIVITY PATTERNS

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The factors responsible for the pathogenic effects of *Staph. aureus* are as yet, not clearly defined. Current research on this problem is being directed towards (a) the correlation of clinical lesions with the properties of the strains isolated from them and (b) the experimental study of staphylococcal lesions.

No quantitative or standardised data appears to exist on the biological properties of *Staph. aureus* in Ceylon apart from phage types of strains from hospital epidemics.

We have examined about 300 strains of this organism from hospital and rural sources, which were coagulase positive, by the following tests:—pigmentation, production of opacity on egg yolk media, lipolysis, DNase production, mercuric chloride sensitivity, phage type, penicillinase production and sensitivity to the following antibacterial substances—penicillin, cloxacillin, methicillin, ampicillin, streptomycin, tetracyclin, erythromycin, sulphonamide, neomycin, bacitracin; a standardised disc sensitivity method was used. Minimum inhibitory concentrations in tube tests were determined for neomycin and penicillin, with representative resistant and sensitive strains. The 'Oxford' staphylococcus was used as reference strain.

Compared with studies published abroad, our strains show differences in regard to distribution of resistance to mercuric chloride, correlation of 'egg yolk positivity' with other properties and the frequency distribution of zone diameters with some antibiotics. The usefulness of the DNase production test and the application of the tests mentioned above to the tracing of the identity of strains in epidemiological studies are discussed; phase typing alone often fails to reveal non-identity of strains which is only shown up by a combination of several tests mentioned above.

## THE DETERMINATION OF AFLATOXIN PRODUCING CAPACITY OF STRAINS OF *ASPERGILLUS FLAVUS*

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Studies on the aflatoxin producing capacity of strains of *Aspergillus flavus* are often made by the assay of toxin levels in suitable substrates which have been infected for an arbitrarily selected interval of time. Conversely media have been examined for their capacity to support toxin production by similar methods using standard strains of *A. flavus*.

Using strains of *A. flavus* isolated from coconut products we have found that the aflatoxin content of cultures varies in a phasic manner with duration of incubation and that strains differ in the pattern of variation with respect of aflatoxin B<sub>1</sub> and aflatoxin G<sub>1</sub>; some strains produce biphasic variations in both B<sub>1</sub> and G<sub>1</sub> while others are monophasic for B<sub>1</sub> only. The relative amounts of each component in the two phases likewise differ with strain.

These results indicate that the examination of the toxigenic capacity of strains by the assay of toxin levels in cultures at an arbitrarily selected interval of time does not give a true picture of either the toxigenic capacity in terms of either aflatoxin B<sub>1</sub> or G<sub>1</sub> or of the capacity of a medium to support toxin production, unless data of the time course of variation of toxin content under a given set of conditions is first, determined.

The cause of the variation, whether it be a growth rhythm, renewed growth due to reutilisation of metabolites or to transient detoxification, is not determined.

## SECTION B : AGRICULTURE AND FORESTRY

(Chemistry Theatre)

### Friday, 19th December:

- 8.00 .. Precipitation Probabilities of Raingauging Stations in Ceylon, With Long Term Records—W. S. Alles and Miss T. Sanmugam.
- 8.30 .. An Identification and Demarcation of the Distinctive Agro-Climatic Regions of Ceylon—C. R. Panabokke.
- 9.00 .. Studies on the Mineralization of Organic Matter in Some High Organic Matter Content Montane Soils of the Wet Zone of Ceylon—M. W. Thenabadu, F. S. C. P. Kalpage and H. James.
- 9.25 .. The Nature of Organic Matter in Some High Organic Matter Submerged Soils—H. James, F. S. C. P. Kalpage and M. W. Thenabadu.
- 9.50 .. Studies on the Organic Phosphorus Fraction of Rubber Soils in Ceylon: I. Forms of Phosphorus—V. Pavanasaivism and F. S. C. P. Kalpage.
- 10.30 .. Studies on the Organic Phosphorus Fraction of Rubber Soils in Ceylon: II. Mineralization of Organic Phosphorus—V. Pavanasaivism and F. S. C. P. Kalpage.
- 2.00 .. Symposium: "Problems and Prospects of Tropical Farming" Session IV: Socio-Economic Factors.

### Saturday, 20th December:

- 8.30 .. Fertility Survey of Sugar Cane Growing Soils in Gal Oya—R. G. Manuelpillai.
- 8.50 .. A New Approach to Classification of Some Paddy Soils in Ceylon—S. Tokutome, S. O. J. de Silva and U. T. Aturupane.
- 9.20 .. Further Studies on the Use of Granular-Compound Fertilizers for Rice—M. W. Thenabadu.

- 9.45 .. Basic Intake Rate of Irrigation Water—J. A. Lewis.  
 2.00 .. Zero Tillage in Rice Cultivation—I. P. S. Dias and  
 A. D. Somapala.  
 2.30 .. LECTURE BY A. B. JOSHI.

#### Sunday, 21st December:

- 9.00 .. Determination of Critical Periods of Weed Competition  
 in Rice and Chillies under Rainfed Conditions in the  
 Dry Zone of Ceylon—V. Velmurugu.  
 9.20 .. Induced mutation studies in Some Indica Rice Varieties  
 of Ceylon—P. Ganashan.  
 9.45 .. Effect of Clove Size and Plant Density on the Growth and  
 Yield of Garlic (*Allium sativum* L.)—M. Jeyabalan.  
 10.30 .. LECTURE BY G. DONALD SHERMAN.  
 11.30 .. Presidential Address: "The Vital Role of the Agricultural  
 Scientist in Ceylon's Developing Agricultural Projects"—  
 I. P. S. Dias (Physics Theatre).  
 1.30 .. Axillary Branching in Potato—U. Pethiyagoda (Jointly  
 with Section D).  
 2.00 .. Pangola (*Digitaria decumbens*, Stent.), a Promising  
 Pasture Grass for the Low Country Wet and Dry Zones  
 of Ceylon—G. W. E. Fernando, T. Sivalingam and  
 J. A. Jayaratne.  
 2.20 .. Some Features of the Growth and Yields of RRIC 100—  
 D. M. Fernando and W. A. C. Wijesinghe.  
 2.40 .. Mite Outbreaks on Tea in the Uva District and Economics  
 of their Control—W. Danthanarayana.  
 3.00 .. A Study of the Carotenoid Pigments of Ceylon Chillies  
 (*Capsicum* Species)—A. S. L. Tirimanna. (Jointly with  
 Section E).  
 3.15 .. Quantitative Estimation of Total Capsaicin (Hot Prin-  
 ciple) in Ceylon Chillies (*Capsicum* Species)—A. S. L.  
 Tirimanna. (Jointly with Section E).

#### Monday, 22nd December:

- 8.30 .. Some Effects of an Insecticide 'Dursban' and a Weedicide  
 'Linuron' on the Microflora of a Submerged Soil—  
 K. Sivasithamparam (Jointly with Section D).  
 9.00 .. Business Meeting.

### ABSTRACTS

#### PRECIPITATION PROBABILITIES OF RAINGAUGING STATIONS IN CEYLON, WITH LONG TERM RECORDS

W. S. ALLES AND MISS T. SANMUGAM

(Central Agricultural Research Institute, Peradeniya)

The rainfall statistic which is published and generally available for use is the arithmetic mean. While this measure of central tendency is useful, the available data could be made considerably more useful for agricultural work by introducing some information on precipitation probability. Two methods are available for calculating precipitation probability: (1) calculation from the tabulated or plotted frequencies of the observed data; (2) fitting a theoretical frequency distribution to the data, and calculation from the theoretical function. The theoretical frequency distribution commonly used is the Normal distribution. In the case of rainfall, the data does not always fit a normal distribution and may show varying degrees of skewness. In such cases, the data may require transformation to give a transformed variate which is normally distributed, or a theoretical distribution which contains a skewness factor in its function must be used.

Farmer (1952, 1954) used the graphical method and determined selected percentile values of monthly rainfall for several Dry Zone stations. Glover and Robinson (1953), Holland (1962) and Robinson and Glover (1954) used the normal distribution for calculating precipitation probability, while Manning (1950, 1956), Panabokke (1960) and Walker and Rijks (1967) used a logarithmic transformation suggested by Kleczkowski (1949) in an attempt to normalize skewed data. Barger, Shaw and Dale (1959, 1960) used the incomplete gamma distribution (which contains a skewness factor) to calculate the precipitation probabilities for the North Central States of the U.S.A.

In the present work, the nature of the frequency distributions exhibited by some long term records of Ceylon rainfall are examined, the applicability and the relative merits of each of the above methods discussed and precipitation probabilities calculated for a few selected stations by each of the methods, with a view to selecting a method which would be satisfactory for determining precipitation probabilities for a large number of stations throughout the island.

## References

- Barger, G. L., Shaw, R. H., and Dale, F. R. (1959). Gamma distribution parameters from 2- and 3- week precipitation totals in the North Central Region of the U.S.A., *Iowa State Univ. Agric. Station publication*.
- Barger, G. L., Shaw, R. H., and Dale, R. F. (1960). Precipitation probabilities in the North Central States, *Univ. of Missouri Agric. Expt. Sta. Bul.* 753.
- Farmer, B. H. (1952). Peasant Colonization in Ceylon. *Pacific Affairs* 25, 398-
- Farmer, B. H. (1954). Problems of land use in the Dry Zone of Ceylon. *Geog. Journ.* 120, 21-23.
- Glover, J., and Robinson, P. (1953). A simple method of assessing the reliability of rainfall. *J. Agric. Sci.* 43, 275-280.
- Holland, D. A. (1962). The Prediction of monthly rainfall as exemplified by data from South-east England. *J. Agric. Sci.* 58, 327-331.
- Kleczkowski, A. (1949). The transformation of local lesion counts for statistical analysis. *Ann. of App. Biology* 36, 139-152.
- Manning, H. L. (1950). Confidence limits of expected monthly rainfall. *J. Agric. Sci.* 40, 169-176.
- Manning, H. L. (1956). *Proc. Royal Soc. B* 144, 460-480.
- Panabokke, C. R. (1960). Paper presented at the sessions of the C.A.A.S.
- Robinson, P. and Glover, J. (1954). The reliability of rainfall within the growing season. *E. Afr. Agric. J.* 19, 137-139.
- Walker, J. J., and Rijks, D. A. (1967). A computer programme for the calculation of confidence limits of expected rainfall. *Expl. Agric.* 3, 337-341.

## AN IDENTIFICATION AND DEMARCATION OF THE DISTINCTIVE AGRO-CLIMATIC REGIONS OF CEYLON

C. R. PANABOKKE

(Land Use Division, Irrigation Department)

In the transition from empirical to planned agricultural land use at regional levels, a reliable definition of the country's distinctive agro-climatic regions becomes a prime requirement.

Matching the presently available soil maps of this country against the main environmental elements, together with correlations of crop performance, it has been possible to identify ten agro-climatic regions in the wet zone, four in the intermediate zone, and six in the dry zone respectively.

It is observed that the differentiation of the wet zone into its distinctive agro-climatic regions is governed more by the elements of rainfall and elevation than by the nature of the soil. In the dry zone, on the other hand, it is the nature of the soil that primarily determines the identity of the individual agro-climatic region. In the intermediate zone, it is observed that both environmental elements as well as soil play an equally important role.

A functional nomenclature as outlined below is suggested for the individual agro-climatic regions that have been identified within the three major zonal divisions of Ceylon.

Wet Zone	Intermediate Zone	Dry Zone
1. Wet Humic Upland	1. Semi—Dry Upland	1. Reddish Brown Earth Region
2. Wet Upland	2. Semi—Dry Midland	2. Latosol Region
3. Semi-Wet Upland	3. Semi—Wet Lowland	3. Noncalcic Brown Soil Region
4. Very Wet Midland	4. Semi—Dry Lowland	4. Black and Grey Soil, and Alkali-Saline Soil Region
5. Wet Midland		5. Regosol Region
6. Semi—Wet Midland		6. Very Dry Coastal Lowland
7. Very Wet Lowland		
8. Wet Lowland		
9. Wet Laterite Lowland		
10. Wet Ill-Drained Lowland		

The approximate boundaries of the foregoing regions have been delineated on a map of scale 1: 250,000 and will be published on a map of scale 1: 500,000.

# STUDIES ON THE MINERALIZATION OF ORGANIC MATTER IN SOME HIGH ORGANIC MATTER CONTENT MONTANE SOILS OF THE WET-ZONE

M. W. THENABADU

(Division of Agricultural Chemistry, Central Agricultural Research  
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F. S. C. P. KALPAGE

(Division of Agricultural Chemistry, Faculty of Agriculture, University of  
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AND

H. JAMES

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Studies were continued on the high organic matter content montane  
(*patana*) soils of the wet-zone which were described earlier (Kalpage and  
Thenabadu, 1968).

Measurements of rates of mineralization of carbon in several of these  
soils were made under different conditions of temperature, liming and  
nutrient status. The rate of carbon dioxide evolution increased with  
increases in temperature and soil pH but was not affected by additions of  
available nitrogen and phosphorus to the soil.

Attempts were also made to follow the conversion of organic nitrogen  
and phosphorus to inorganic forms. These results are discussed in terms  
of fertility of these soils.

## Reference

Kalpage, F. S. C. P., and Thenabadu, M. W. (1968). Some characteris-  
tics of the high organic matter content montane soils in the wet-  
zone. *Proc. Ceylon Ass. Advmt Sci.*, 24(1): 22.

# THE NATURE OF ORGANIC MATTER IN SOME HIGH ORGANIC MATTER SUBMERGED SOILS

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F. S. C. P. KALPAGE

(Division of Agricultural Chemistry, Faculty of Agriculture,  
University of Ceylon, Peradeniya)

AND

M. W. THENABADU

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

Soil profiles in three high organic matter submerged soils in the  
wet zone of Ceylon namely Mutturajawela, Kotte and Bombuwela were  
studied with special reference to the nature and distribution of organic  
matter.

Soils studied are rich in organic matter, those of Mutturajawela and  
Kotte containing large amounts of it. Surface soils are rich in total  
nitrogen. C/N ratios are wide and increase with depth. High C/N ratios  
at lower depths in the soils at Mutturajawela and Kotte suggest that  
organic matter in these have developed from high carbon organic resi-  
dues. Both these soils contain large amounts of incompletely decomposed  
organic residues. In Mutturajawela half decomposed tree trunks and  
large woody roots are abundant in the lower horizon.

In contrast to total organic matter, alkali extractable humus substan-  
ces decrease with depth due to slower humification at lower depths.  
C/N ratios of humus substances also increase with depth.

Humic acid and fulvic acid decrease with depth while humic acid  
carbon: fulvic acid carbon ratio is high due to greater solubility and  
removal in water of fulvic acid.

# STUDIES ON THE ORGANIC PHOSPHORUS FRACTION OF RUBBER SOILS IN CEYLON: 1. FORMS OF PHOSPHORUS

V. PAVANASIVAM AND F. S. C. P. KALPAGE

(University of Ceylon, Peradeniya)

Rubber is grown in Ceylon in hot wet areas where rapid minerali-  
zation of organic matter occurs. Under conditions of intensive leaching

much of the phosphorus exists in the organic form and its mineralization can contribute to the plant available phosphorus.

Total, organic, inorganic and Truog available phosphorus are reported for surface soils from the main rubber growing districts of Ceylon. Total phosphorus varies from 89.3—977.8 ppm with an average of 285.5 ppm. Organic phosphorus ranges from 25.8—416.5 ppm with an average of 112 ppm. The organic fraction expressed as a percentage of total phosphorus varies from 9.4 to 72 with an average of 44; in about 40 per cent of the soils studied it formed more than 50 per cent of the total phosphorus. Inorganic phosphorus values were deduced from total and organic phosphorus. Truog available phosphorus varies from 8—31.5 ppm, forming about 6 per cent of total phosphorus and 12 per cent of inorganic phosphorus.

These findings are discussed in the light of similar results obtained by other workers.

## STUDIES ON THE ORGANIC PHOSPHORUS FRACTION OF RUBBER SOILS IN CEYLON: II. MINERALIZATION OF ORGANIC PHOSPHORUS

V. PAVANASIVAM AND F. S. C. P. KALPAGE

(University of Ceylon, Peradeniya)

This paper reports incubation studies on at least one sample of surface soil from each of seven series of soils from the main rubber growing districts of Ceylon.

More organic phosphorus was mineralized with increase in incubation time except in the limed samples of the Matale and Parambe series. In all samples, there was more mineralization at 40°C than at 30°C. During the first 10 days at 40°C more mineralization took place than during 50 days at 30°C. Both increased temperature and liming promote mineralization but three of the soils studied showed a drop in extractable phosphorus at 40°C on liming. At 40°C most of the mineralizable organic phosphorus seems to have been converted into extractable forms during the first ten days. Reversion of extractable phosphorus into relatively insoluble forms is most likely in soils of the Deniya, Matale and Agalawatta series and crop responses to phosphorus fertilizer application can be expected on these soils.

## FERTILITY SURVEY OF SUGAR CANE GROWING SOILS IN GAL OYA

R. G. MANUELPIILLAI

(Research Officer, Soils—Sri Lanka Sugar Corporation)

The land for the growing of sugar cane in the Gal Oya valley was selected on the basis of reports submitted by Walwalkar (1952); Van Dillewijn (1953); Vermaat (1954); and Kandiah (1956). The main minerals associated with the soils of the Gal Oya valley are quartz; biotite; mica; orthoclase; sodium and calcium plagioclase.

The soil fertility survey of the valley, commenced in May 1968, and to this date an area of 5,000 acres have been covered. As a guide to this study the 'Reconnaissance Soil Survey Map—Gal Oya' prepared by Pannabokke, was superimposed on the block map of Gal Oya sugar area. Soil samples were drawn from the surface foot layer, and detailed soil chemical and mechanical analysis were carried out.

Critical values for macro-nutrients (nitrogen, phosphorus, potassium, calcium, magnesium) at three levels; viz. low, medium, and high are prepared. The macro-nutrient requirements in raising a 40 ton crop of cane per acre is discussed. These critical values are superimposed on a  $\frac{1}{2}$  mile to an inch scale soil fertility map of Gal Oya sugar area, and fertilizer recommendations based on the above critical values are worked out.

This soil fertility map is a preliminary report for crop-log studies in sugar cane. Foliar indexes established for sugar cane under conditions prevailing in Kantalai are in agreement with indexes arrived at in Mauritius, Jamaica, and British Guiana.

Studies on a few randomly selected lots, revealed that the Gal Oya soils are of a poor buffering capacity for lime.

### References

- Dillewijn, C. van (1953). Report on Sugar Cane Production. F.A.O. report No. 187.
- Pannaboke, C. R. (1965). Reconnaissance Soil Survey Map—Gal Oya.
- Vermaat, J. G. (1954). Preliminary report of the Reconnaissance Soil Survey of the area projected for the cultivation of Sugar Cane in the Gal Oya Valley.
- Kandiah, S. (1956). Report submitted to Gal Oya Development Board on Soil Survey on the extension of Sugar Cane Area.
- Walwalkar, D. G. (1952). Report submitted to the Gal Oya Development Board.

## A NEW APPROACH TO CLASSIFICATION OF SOME PADDY SOILS IN CEYLON

S. TOKUTOME, S. O. J. DE SILVA AND U. T. ATURUPANE

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

In a natural system of soil classification genetic factors constitute the main criteria for classification. Since this is of limited utility value, a new system for classification of paddy soils has been evolved, which takes into consideration hydromorphic properties, fertility characteristics and genetic factors.

As a result of submergence, there appears in the paddy soil profile a dark greenish gray colouration (gleization) in the reduced zone and a reddish brown colouration (mottles) in the oxidised zone. Based on gleization mottle formation in the B horizon, two great soil groups are distinguished. They are (1) surface water paddy soil and (2) ground water paddy soil. In addition an intermediate paddy soil is also recognized.

In spite of continuous human activities in paddy cultivation, Paddy soils continue to exhibit certain characteristics of original soil. Based on these, great soil groups are subdivided into families which are further divided into series depending on degree and intensity of gleization and mottle formation. Fertility characteristics such as texture of surface horizon constitute criteria for classifying series into types. Types are independently subdivided into phases, based on different soil properties that may be considered important.

With this information a base soil map demarcating soils that have undergone different pedologic processes and possessing different fertility characteristics can be drawn. Lower categories particularly types and phases are studied in detail to find out agronomic measures for managing a particular type and phase. Thus an approximate soil utilization map, which has to be continuously improved by field trials and edaphological investigations, can be prepared.

This scheme has been used in classifying paddy soils in Gampola in the Mid-country Wet Zone and in Kalawewa in the Dry Zone. At Gampola surface water paddy soils of medium texture and medium fertility are predominant. At Kalawewa a wide variety of soils which required different management practices are found.

## FURTHER STUDIES ON THE USE OF GRANULAR-COMPOUND FERTILIZERS FOR RICE

MERVYN W. THENABADU

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

Investigations with granular-compound-fertilizers have shown that generally these fertilizers are superior to straight fertilizers currently recommended by the Department of Agriculture for rice in the wet-zone (Thenabadu, Wickremasinghe and Perera, 1967). In the dry-zone however, there was no advantage from the use of these more expensive fertilizers because straight fertilizers applied according to recommendations of the Department of Agriculture were in most cases found to be as good or better than granular-compound-fertilizers.

The results of fertilizer trials in the wet-zone and dry-zone are discussed in the light of soil characteristics and laboratory studies.

### Reference

Thenabadu, N. W., Wickremasinghe, K. and Perera, T. B. (1967). Performance of granular-compound-fertilizers on rice in the wet-zone of Ceylon. *Proc. Ceylon Ass. Advmt Sci.*, 23(1): 32.

## BASIC INTAKE RATE OF IRRIGATION WATER

J. A. LEWIS

(Agricultural Research Station, Maha-Illuppallama)

The basic intake rate is the final, nearly constant rate at which water will enter the soil after a few hours of irrigation. It is an important factor in irrigation system design and water management practice.

In this paper appropriate techniques of determining the basic intake rates for some of the common systems of irrigation will be presented.

### Border Irrigation:

Basic intake rate is usually determined by estimating the stream size of irrigation water and out flow of drainage water.

### Furrow and corrugation irrigation:

The intake rates will be measured by inflow, outflow methods.

### **Sprinkler Irrigation:**

The intake under actual sprinklers with the appropriate nozzle size will be the most suitable.

The instrumentation, installation and data obtained in the dry zone soils (Maha-Illuppallama) will be presented in this paper. This paper will be also of use to engineers in the field of irrigation and water management.

### **ZERO TILLAGE IN RICE CULTIVATION**

I. P. S. DIAS AND A. D. SOMAPALA

*(Rice Research Station, Department of Agriculture, Ambalantota)*

This paper presents the results of investigations carried out over the last six seasons at the Rice Research Station, Ambalantota into the technique of zero tillage in rice cultivation.

The technique itself incorporated the use of the total weed-killer Grammoxone in the control of weeds as well as the killing of the previous season's stubble.

The data on rice yields obtained in these investigations over six consecutive seasons of zero tillage clearly indicate the possibilities of this technique in rice cultivation. The yield data and these possibilities are discussed in this paper.

### **DETERMINATION OF CRITICAL PERIODS OF WEED COMPETITION IN RICE AND CHILLIES UNDER RAINFED CONDITIONS IN THE DRY ZONE**

V. VELMURUGU

*(Agricultural Research Station, Maha-Illuppallama)*

One of the important criteria in weed control studies is the determination of critical periods of weed crop competition.

Experiments were carried out with different times of weeding in Rice and Chillies under rainfed conditions during Maha 1968/69, at the Agricultural Research Station, Maha-Illuppallama.

The results indicate that weed control in Paddy for a period of 35 days is necessary from germination of the crop, while, in chillies, the duration appears to be about 56 days. Further, the experiment show that presence of weeds causes negligible damage to the rice and chillies up to the 7th and 14th day respectively, from germination of the crop.

### **INDUCED MUTATION STUDIES IN SOME INDICA RICE VARIETIES OF CEYLON**

P. GANASHAN

*(Agricultural Research Station, Maha-Illuppallama)*

Four indica rice varieties H-4, H-8, H-7, and Pachchaiperumal 2462/11 (PP 2462/11) were subjected to physical and chemical mutagens at the following doses:—

- (1) Gamma rays—10 Kr to 60 Kr. (5 treatments).
- (2) Neutrons—300 r to 1,600 r. (5 treatments).
- (3) Ethyl Methane Sulfonate (EMS)—0.2% to 0.8%. (5 treatments).

The LD 50 level for gamma rays was 50 to 60 Kr, for neutrons 1,600 r and for EMS 0.4%.

Studies on the macro-mutations induced were made up to M-2 generation.

Varieties responded differently to the treatments in both generations. In the M-1 of the EMS treatment both germination and final plant stand were greatly reduced, while in the gamma treatment only the plant population was affected especially at the higher doses. The neutron treatment had only a slight effect in this generation. Among the varieties PP 2462/11 was more severely affected in final plant stand than the others.

In the M-2, there was segregation for various types of chlorophyll mutants. There was a wide spectrum of macro-mutations for grain size, shape etc. Variations in plant characters such as plant height, flowering date and sterility were observed, and grass clump types were also found occasionally.

The relative potentialities and characteristics of the promising mutants will be discussed.

### **EFFECT OF CLOVE SIZE AND PLANT DENSITY ON THE GROWTH AND YIELD OF GARLIC (ALLIUM SATIVUM L.)**

M. JEYABALAN

*(Agricultural Research Station, Maha-Illuppallama)*

The effect of clove size on yield of garlic was examined in a pot experiment using cloves of five different sizes ranging from 0.4-1.2

gms/clove, and the effect of density on yield was examined in a field experiment using six densities varying from 4.5-18 plants per square feet.

The analysis of yield data indicated that clove size bears a significant positive correlation to weight of the bulb and plant height. Significant increases in yields were observed with increasing plant density.

The significance of these relationships is discussed.

### AXILLARY BRANCHING IN POTATO

U. PETHIYAGODA

(Division of Plant Physiology, Tea Research Institute of Ceylon,  
Talawakelle)

Successive axillary buds along the potato main stem grow to very different extents. There is normally one zone of active lateral development near the base of the plant and another close to the top. The several intervening buds show only very slight expansion.

Influences exerted by the terminal bud are probably important in causing this zonation. By appropriately timed manipulative treatments and the use of growth retarding chemicals, this apical influence was modified and the resulting patterns of branch development were studied.

Stoppage of growth of the main stem, whether by decapitation or by the use of a growth retardant results in increased axillary development. It is suggested that the zonation of axillary development along the main stem of potato is due not to an inherent difference in the growth potential of successive axillary buds but by mechanisms involving changes during the life of the plant, of the dominance exerted by the apex. The growth of the topmost laterals may result from the change of the main apex from vegetative growth to flower production at the end of the season and a consequent reduction in its inhibitory influence or demand for nutrients. The reasons for the flush of axillary development nearer the base of the main stem, which occurs some weeks before flush formation are less evident.

No attempt was made in this experiment to observe the behaviour of organs within the soil. The results suggest that information on concurrent changes in the underground parts—particularly in respect of tuber initiation and bulking may be relevant to an understanding of the problem.

The effects of certain treatments in increasing leaf area and stolon production may have practical implications.

### PANGOLA (*DIGITARIA DECUMBENS*, STENT.), A PROMISING PASTURE GRASS FOR THE LOW COUNTRY WET AND DRY ZONES OF CEYLON

G. W. E. FERNANDO, T. SIVALINGAM AND J. A. JAYARATNE  
(Agricultural Research Station, Maha-Illuppallama)

The successful introduction and establishment of Pangola grass (*Digitaria decumbens*, Stent.) marks another turning point in the history of grassland farming in Ceylon. In preliminary yield trials at Maha-Illuppallama, Pangola significantly outyielded the reputed pasture grasses, *Brachiaria brizantha* and *Brachiaria miliformis*. Our studies have also shown that Pangola can be successfully established under coconuts and is found to be more suitable for cultivation under coconuts than either *Brachiaria brizantha* or *Brachiaria miliformis*. It tolerates shade and forms a dense pasture 3 to 4 month after planting. The desirability of establishing Pangola under coconuts in the coconut triangle is discussed.

### SOME FEATURES OF THE GROWTH AND YIELDS OF RRIC 100

D. M. FERNANDO AND W. A. C. WIJESINGHE

The increases in yield obtained in natural rubber are reviewed. The significant increases in growth and yield obtained from RRIC 100, in comparison with PB 86, are analysed. Other secondary characters such as partial wintering and satisfactory branching are described and the possible impact of this Clone on the industry is discussed.

### MITE OUTBREAKS ON TEA IN THE UVA DISTRICT AND ECONOMICS OF THEIR CONTROL

W. DANTHANARAYANA

(Tea Research Institute of Ceylon, Talawakelle)

Red Spider Mite (*Oligonychus coffeae* Nietn.) and Scarlet Mite (*Brevipalpus californicus* Banks) outbreaks in the Uva District are associated with weather. Mite populations that increase during the dry months preceding the North East Monsoon rains diminish with the onset of wet weather. In a series of field experiments, it was found that dicofol (Kelthane) and oxythioquinox (Morestan) are the most suitable acaricides for controlling the two species of mites. Control of a moderate

attack of Red Spider and Scarlet Mites, gave a yield increase of 182 lb. made tea per acre per pruning cycle of approximately four years. The yield increases during the first and the fourth years of the pruning cycle were not statistically significant; but an increase of 110.97 lb. made tea per acre in the second year and of 70.76 lb. made tea per acre in the third year were highly significant ( $P=0.001$ ). The results also indicated that the Red Spider and Scarlet mite numbers were heavy during the first two years of the cycle; the numbers during the third and fourth years were insignificant. Yield increases obtained during the second and third years, therefore, resulted from control measures taken during the first and second years. It would seem that mite control can be restricted to the first and second years; one prophylactic application and one curative application (if necessary) of an acaricide during each of these years is indicated. For an outlay of approximately Rs. 40.00 (cost of two applications for two years), a yield increase of 182 lb. made tea per acre can be expected. Considering the fact that in the experimental plots, a heavy mite attack did not develop, and that mite populations are at their maximum during the Uva flavoury season, it would seem that Red Spider and Scarlet mite control is economically worthwhile.

#### SOME EFFECTS OF AN INSECTICIDE ('DURSBAN') AND A WEEDICIDE ('LINURON') ON THE MICROFLORA OF A SUBMERGED SOIL

K. SIVASITHAMPARAM

(Agricultural Research Station, Sita Eliya, Nuwara Eliya)

The widespread use of selective chemicals for the control or elimination of agricultural pests has created a variety of new agronomic, biological and public health problems. Inasmuch soil micro-organisms play a key role in soil fertility, the residual effects of such chemicals are of considerable importance.

An investigation was carried out to ascertain the effects of the insecticide, Dursban, (0, 0, diethyl-0-3, 5, 6-trichloro-2-pyridyl phosphorothioate) and the weedicide, linuron, [3-(3, 4-dichlorophenyl)-1-methoxy-1-methylurea] on the microflora of a submerged soil.

Details of their effect on the numbers of fungi, bacteria and actinomycetes, and also on the ammonifiers; nitrifiers oxidizing ammonia to nitrite; nitrifiers oxidizing nitrite to nitrate; denitrifiers; aerobic nitrogen fixers; anaerobic nitrogen fixers; phosphate dissolvers; cellulose decomposers; sulfate reducers and iron precipitators, will be presented.

## SECTION C: ENGINEERING

(Arts Theatre)

### Friday, 19th December:

- 11.00 .. Effect of Latex on the Physical Properties of Cement and Concrete—A. Thevarasah and M. Selvaratnam (Jointly with Section E).
- 1.45 .. Applications of Evanescent Mode Waveguide Techniques—T. Arthanayake.
- 2.30 .. Use of Computers in Civil Engineering Industry—D. A. Gunasekara. ✓

### Saturday, 20th December:

- 8.30 .. Efficiency of Investment on Research and Manpower Development—A. M. N. Amarakone.
- 9.30 .. Precast Construction—Tissa de Silva. ✓
- 10.30 .. Symposium on "Low Cost Building Materials". ✓
- 1.30 .. Rate of strain and work hardening of copper—M. J. Fernando and M. A. V. Devanathan.
- 3.30 .. Presidential Address: "An Integrated Approach to Development and Planning in Ceylon"—A. D. N. Fernando (Physics Theatre).
- 4.30 .. Business Meeting.

### Sunday, 21st December:

- 9.00 .. Evaluation of a Master Plan for the development of the resources of Mahaveli Ganga—A. Maheswaran.
- 9.45 .. Industrial Engineering. Origin, Definition, Growth—Manfred Knayer.
- 10.30 .. Use of Air Survey Methods for Hydrographic Surveys under Dynamically Static Conditions—A. D. N. Fernando, G. B. A. Fernando and D. O. V. de S. Abeyewickrema.

- 11.00 .. Sequel to Underground Water Resources in Jaffna Peninsula—K. Arumugam.
- ✓ 1.30 .. Visit to State Engineering Corporation Laboratory, Sri Jinaratana Road.

**Monday, 22nd December:**

- 9.00 .. Intermediate Technology and Development Planning in Ceylon—D. L. O. Mendis (Jointly with Section F).
- 10.00 .. Stabilisation of Soils from Amparai with Lime— K. S. K. De Abrew, D. P. Dayananda and T. D. P. Karunatileke.

## ABSTRACTS

### APPLICATIONS OF EVANESCENT MODE WAVEGUIDE TECHNIQUES

T. ARTHANAYAKE

The miniaturisation of equipment has been a well established engineering goal. In the particular context of communications systems the resulting benefits have been considerable economies in the requirements for transportation and housings. In electronic circuitry the changes have been from valves to transistors to integrated circuits and to the current trends towards LSI (Large scale integration). In microwave circuitry, though standard waveguide circuits are still extensively used, two techniques have emerged which are directly applicable to the miniaturisation and integration of microwave sub-systems. They are:—

- (a) Thick film hybrid circuits
- (b) Evanescent mode waveguide

In their application the two techniques are found to be complementary rather than conflicting.

The synthesis of a passive filter network in evanescent mode waveguide using equivalent lumped circuits is described. The design procedure is then extended to the construction of active components. One such example, described in detail, is an evanescent mode upper side-band upconverted type transmitter.

### USE OF COMPUTERS IN THE CIVIL ENGINEERING INDUSTRY

D. A. GUNASEKARA

The paper deals with the basic problems encountered in the introduction of Computers Techniques in the Civil Engineering Industry with particular reference to Structural Engineering.

## EFFICIENCY OF INVESTMENT ON RESEARCH AND MANPOWER DEVELOPMENT

A. M. N. AMARAKONE

(State Engineering Corporation of Ceylon, Colombo)

The fundamental problem affecting the developing countries of the world which constitutes 2/3 of the world is the low level of technological knowhow and expertise available in these countries. Hence the lack of scientific insight into the socio-economic forces that control the vitality of these countries, invariably creates a permanent state of their dependence on the more developed countries. Under these circumstances, investment in every sector of the economy must be undertaken with utmost care and consideration for the need to promote not only a steady rate of growth in the economy to maintain political stability but also a fast take off in the technological fields, with a view to eventually establish parity with the developed nations. The present need for investment in industrial research must thus be evaluated in terms of a rapid introduction of technology into the country and the development of manpower and steady transformation of society. An attempt is made to isolate the factors involved in such an analysis which may be necessary in the eventual development of a science policy for the country.

## PRECAST CONSTRUCTION

TISSA DE SILVA

(State Engineering Corporation, Colombo)

From early beginnings precast form of construction was available to man. We might say that even bricks been used, is a precast form of construction. This mode has now changed towards bigger units which are handled by machines. Today we consider precast construction as that where large units are used. These units are precast in factories and erected at sites using heavy cranes, etc. The advantages based is that the quality will be as close as possible to that wanted by the designers. The cost can be kept low because of mass scale production and also by the use of latest developments in the construction industries, such as prestressing, steaming and use of other developments together with mechanized processes of placing of concrete, vibration and movement of shutters, etc. At the same time, there are certain disadvantages like the availability of equipment for transport etc. These of course will develop only if there is a planned programme. This is because the initial cost of a factory

is high and hence one should be sure that such an investment will get returns through the years to come and because the factory could be used and economical run for more than a decade. Also a main disadvantage is the acceptance of this form of constructed by the architects and designers who are now used to conventional forms. But this will be changed with the education of architects in this field.

### RATE OF STRAIN AND WORK HARDENING OF COPPER

M. J. FERNANDO AND M. A. V. DEVANATHAN

*(Physical Chemistry Division, Ceylon Institute of Scientific and Industrial Research, Colombo 7)*

The stress-strain curves obtained under static conditions are shown to contain several undefined experimental factors which render these curves unsuitable for theoretical analysis of work hardening. It is shown that curves obtained under uniform rates of strain are more amenable to theoretical treatment.

A simple experimental technique is described for obtaining dynamic stress-strain curves for copper wire in the range 4.7 to 91% strain per min. Plots of true strain vs. true stress are shown to have a paraboloid form, while plots of true stress vs.  $(\text{true strain})^{\frac{1}{2}}$  are straight lines with points of strain greater than 0.3 showing appreciable departures. This departure is greater the lower the rate of strain with the graphs of high rates showing little difference. This deviation from the straight line behaviour has been explained on the basis of the annealing rate constant described elsewhere.

An expression taking into account the annealing rate constant and the rate of strain derived. It is shown that for a reasonable value of  $h$ , all the curves fall on a single straight line. This conformity to the  $E^{\frac{1}{2}}$  law is regarded as proof of the Taylor-Mott theory of work hardening.

Current expressions for the creep behaviour of metals are discussed critically and it is shown that using the annealing rate constant, an equation for short time creep could be deduced which contains, no arbitrary constants. It is further shown that for these conditions, the empirical expressions for creep reduce to the theoretically deduced equation. The need for studying the annealing rate constant as a function of temperature is emphasised since this would enable the elucidation of molecular mechanism of creep.

### EVALUATION OF A MASTER PLAN FOR THE DEVELOPMENT OF THE RESOURCES OF THE MAHAWELI GANGA

A. MAHESWARAN

The Mahaweli Ganga, the longest river in the Island has a vast potential of untapped resources. Though there is evidence of irrigation development in the basins during the time of the ancient Sinhalese Kings, nothing substantial has been achieved during the past century. Systematic investigation of the availability of the resources in the Mahaweli Basin was commenced during 1957/58. During the long period of investigations, several alternative plans of development were considered.

This paper deals with the basic considerations in the studies made and provides a summary of the "Master Plan" that was evolved for the development of the resources. The first step in the implementation of the Master Plan is the Diversion of the river at Polgolla. Preliminary work on the construction has already commenced. The work on the main features of the Project will commence in February 1970.

### INDUSTRIAL ENGINEERING— ORIGIN—DEFINITION—GROWTH

MANFRED KNAYER

*(Management Development and Productivity Centre, M.D.P.C., Ceylon)*

To operate an enterprise efficiently, it is not enough to have men, materials and machines. They should be selected carefully; buildings, layout, handling equipment, operations and methods should be designed properly; sales, purchases, production, storage, delivery should be planned in time, organised, co-ordinated, controlled, and reported to management; corrective action must be proposed if necessary. All these activities can be grouped together under the title of Industrial Engineering.

Work Study, Production Planning and Control have remained the main functions—they are also a part of Production Engineering—but numerous other techniques, such as Value Engineering, Ergonomics, Statistical Analysis and Prediction, Inventory Control, Data Processing, Management Information, Systems Engineering and Operational Research have been developed and added during the past decades. After a successful start in the mechanical workshop and the electrical industries over half a century ago, Industrial Engineering has found wide applications, in the textile, food, chemical, building industries, also in agriculture, and even in fields such as transport, maintenance

services, administration and office work. Its value for the countries in development has been recognised; more and more universities have it included in their curricula, and the Industrial Engineering Associations are reporting a steady growth of their membership.

### USE OF AIR SURVEY METHODS FOR HYDROGRAPHIC SURVEYS UNDER DYNAMICALLY STATIC CONDITIONS

A. D. N. FERNANDO, G. B. A. FERNANDO AND  
D. O. V. DE S. ABEYEWICKREMA

Air Survey methods have been used before to determine bathymetric heights under non-turbulent conditions. Today, we are presenting a method of determining bathymetric heights under dynamically static conditions, using wave patterns.

In this instance we use an indirect method; by studying wave pattern and co-relating them with bathymetric heights. Theoretical considerations to confirm the use of this method would also be dealt with.

The Hydrographic Survey of the Bentota shoreline, covering a distance of approximately four miles, determined by this method will be illustrated.

This method would appreciably reduce not only the cost of the hydrographic survey, but would also help us to determine the bathymetric heights in a more precise manner.

### INTERMEDIATE TECHNOLOGY AND DEVELOPMENT PLANNING IN CEYLON

Development Planning is defined as a deliberate and sustained effort to increase the rate of economic growth in an under-developed country, with incidental social and institutional changes implied.

It is axiomatic that foreign aid is an essential ingredient of development planning. This foreign aid has very often been obtained in the form of plant, equipment and technical know-how from the developed countries. In this process, the aid-receiving or under-developed country is tacitly assumed to be capable of undergoing whatever economic, social and cultural changes are necessary to receive the full benefit of the transplanted technology of the aid-giving or developed country.

In the concept of Intermediate Technology, the sophisticated technology of the aid-giving or developed country is modified to suit the economic, social and cultural context of the under-developed country. There are three different methods of achieving this:

viz: by developing in the under-developed country existing traditional techniques and methods, to be more productive; by modifying existing advanced technology in the developed country, to suit the economic social and cultural levels of the under-developed country—generally by omitting labour-serving gadgets in plant and equipment, these being superfluous in labour abundant under-developed countries; and by deliberately using the technocratic sophistry of the developed country to invent new machines to meet particular requirements in the under-developed country.

The "lessons of experience" of development planning as disseminated by Waterston and others, are increasingly attracting the attention of Economists, Scientists and Engineers in this country. However, although foreign aid is also being used up at an increasing (some say alarming) rate, it is significant that neither the aid-giving countries nor our own scientists have so far enquired into the possibilities of an Intermediate Technology for utilization of foreign aid in any field of development planning.

In this paper some examples of the possible application of Intermediate Technology to suit actual problems of development planning in Ceylon today, are examined.

### STABILIZATION OF SOILS FROM AMPARAI WITH LIME

K. K. S. DE ABREW

("Kalyani", Pitobuwa, Hararaduwa)

D. P. DAYANANDA

(Potuwatha, Dodanduwa)

and

T. D. P. KARUNATILLEKE

(28, Nawinna Road, Maharagama)

Six samples of soils from Amparai were tested to determine the optimum amount of lime to be added to each of them. Particle size analysis, specific gravity, liquid limit, plastic limit, and compaction tests were carried out. All specimens for compression strength tests

were compacted to proctor density at optimum moisture content. Mixing of soils with lime and water was carried out using a mechanical mixer to approximate the conditions obtainable in the field. Optimum time of mixing for maximum strength was determined and used in the preparation of all samples for compression strength tests. Prepared specimens were cured at room temperature and optimum moisture content for 7, 14 and 21 days.

From the results it is seen that different soils vary widely in their behaviour. It is therefore necessary to test each soil before being stabilised with lime. Amount of water to be added should be carefully controlled and care should be taken not to exceed the optimum moisture content. From the results it is seen that there is a possibility of a relationship between the optimum percentage of lime to be added and the percentage of particles passing through the No. 200 sieve. If, in fact, such a relationship exists it would undoubtedly be of a great advantage to the practising engineer.

## SECTION D: NATURAL SCIENCES

(Biology Theatre)

### Friday, 19th December:

- 8.30 .. The Elimination of Residual Ilmenite in the Pulmoddai Non-magnetic Tailings—L. J. D. Fernando (Arts Theatre).
- 10.45 .. Cordierite Gneisses—Source rock for some gem deposits—Michael B. Katz (Arts Theatre).
- 2.00 .. Symposium: "Problems and Prospects of Tropical Farming" Session IV: Socio-Economic Factors.

### Saturday, 20th December:

- 8.30 .. Frequency distribution of clay and associated minerals in the Alluvial soils of Ceylon—J. W. Herath and R. W. Grimshaw.
- 8.50 .. Expanded clay aggregate from Ceylon for use in structural concretes—J. W. Herath and R. W. Grimshaw.
- 9.05 .. Refractory Raw Materials of Ceylon and appraisal for Ceramic Industries—J. W. Herath.
- 9.25 .. A Study of the heavy minerals in the Nattandiya-Marawila Madampe Glass Sand Deposits—L. J. D. Fernando.
- 10.30 .. PHYTOPLANKTON: THE SUCCESS OF THE SMALLEST PLANTS—G. E. FOGG, F.R.S.
- 11.30 .. Presidential Address: "Environmental Limits to Existence of Life"—N. N. de Silva (Physics Theatre).
- 1.30 .. A Study of the significance of Latex in *Hevea* sp.—D. M. Fernando and M. S. Tambiah.
- 1.50 .. Yields of Latex and Sieve Tube Diameter in *Hevea* sp. A preliminary study—D. M. Fernando and M. S. Tambiah.
- 2.10 .. Urbanization of the Dry Zone (excluding the Jaffna Peninsula). Some observations—B. L. Panditharatna (Jointly with Section F).

**Sunday, 21st December:**

- 8.00 .. Some preliminary studies on *Epilachna indica* infesting the bitter gourd plant of Ceylon—P. M. Wijeyaratna.
- 8.30 .. Studies on the effects of a chemosterilant, on the haemolymph of *Sphaerodema rusticum*—P. M. Wijeyaratna.
- 8.50 .. Breeding habits and morphological changes of the developing tadpole of *Bufo melonostictus*—N. de Silva.
- 9.10 .. Laboratory culture of the Tea Red Spider Mite, *Oligonychus coffeae* (Nietn.)—A. Kathiravetpillai.
- 9.30 .. Changes in oxygen uptake and Respiratory Quotient during Post-Embryonic Development of the Leaf-Insect, *Phyllium crurifolium* (Phasmida: phylliidae)—W. W. D. Modder and K. Sivarajah.
- 9.50 .. The Biology of a new species of eugregarine, *Gregarina fernandoi* n.sp. from the field cockroach, *Leucophaea*—M. Sabaratnam.
- 1.30 .. Axillary Branching in Potato—U. Pethiyagoda (Jointly with Section B).
- 2.00 .. Some Trematodes of Vertebrates hitherto unreported from Ceylon with a description of a new species of *Bilorchis* and a Revision of the Genus—D. W. W. Kannangara (Jointly with Section A).
- 2.20 .. *Paratelpusa ceylonensis* and *Paratelpusa rugosa* as second Intermediate hosts of *Paragonimus*, with observations on other parasites in the Fresh Water Crabs in Ceylon—D. W. W. Kannangara (Jointly with Section A).
- 2.40 .. Changes observed in the *Rhacophorus leucomystax maculatus* (Gray) during Metamorphosis—Therese Joseph and A. D. P. Jayatilaka (Jointly with Section A).
- 3.00 .. Prawns of the Thondaimannar Lagoon. A study of the different species, their migrational behaviour, pattern of distribution, breeding and economic potential—K. Chitravadivelu and K. Selvavinayagam.

**Monday, 22nd December:**

- 8.30 .. Some effects of an Insecticide 'Dursban' and a Weedicide 'Linuron' on the microflora of a submerged soil—K. Sivasithamparam (Jointly with Section B).

- 8.50 .. An Investigation of Microfungi in a Grassland soil—I. Balasooriya and Malini Perera.
- 9.10 .. Succession of Microfungi on the Root surface of *Oryza sativa* var. H4—I. Balasooriya and Rohini Abeygoonesekera.
- 12.30 .. Business Meeting.

**ABSTRACTS**

**THE ELIMINATION OF RESIDUAL ILMENITE IN THE PULMODDAI NON MAGNETIC TAILINGS**

L. J. D. FERNANDO

(Geological Survey Department, Colombo 2)

The magnetic installation at Pulmoddai consists of a battery of six primary separators, three secondary and two tertiary machines. The tailings from the tertiary separators have been found to contain a high proportion of residual ilmenite amounting from 10 to 14 per cent, and occasionally over this figure; this is the high titania ilmenite of low magnetic susceptibility. So long as the production of ilmenite was the main objective, the loss of this ilmenite did not present a serious problem, but with the installation of the Dry Mill for the recovery of rutile from the tailings, the presence of the residual ilmenite in the Mill feed has caused serious production problems. Extensive tests have been carried out on the recovery of this ilmenite using various types of magnetic separators; these include—

- (a) a Humboldt Cross-belt separator;
- (b) an Exolon Induced-roll separator; and
- (c) a Coupled pole separator manufactured by the Nippon Magnetic Dressing Company.

The test results, including mineralogical assays and chemical analysis of the various products, are furnished and discussed.

The principal mineral variables are magnetic susceptibility, density, distribution and relative grain size. While some control can be exercised over the distribution and grain size, for instance by screening, there is little or no control over magnetic susceptibility, density etc. The operating variables on the other hand include—

- (a) input or feed;
- (b) magnetising current;

- (c) speed of the rotors;
- (d) air gap; and
- (e) the position of the splitters.

By suitable combination of these variables it has been established that it is possible to reduce the residual ilmenite to between 3 to 4 per cent with recoveries of the ilmenite varying from 60 to 70 per cent. On the basis of these results an improved flow-sheet is suggested.

## CORDIERITE GNEISSES—SOURCE ROCK FOR SOME GEM DEPOSITS

MICHAEL B. KATZ

(Department of Geology, Peradeniya)

Preliminary field and petrographic studies on the cordierite gneisses and related Mg and Al-rich rocks found in southwest Ceylon (Cooray, 1962) reveal the following mineral assemblages:

- (1) Quartz-Plagioclase-Cordierite-Biotite  $\pm$  Garnet-Sillimanite-Spinel-Sapphirine-Microcline.
- (2) Quartz-Microcline-Cordierite-Biotite  $\pm$  Andalusite-Sillimanite-Muscovite-Corundum-Sapphirine.
- (3) Microcline-Cordierite-Sillimanite-Biotite-Sapphirine  
From the same general area Lacroix (1891) and Hapuarachchi (1968) have described a hypersthene-bearing assemblage.
- (4) Quartz-Plagioclase-Microcline-Cordierite-Hypersthene-Biotite-Spinel
- (5) Sillimanite-Corundum.

The mineral sapphirine is reported for the first time in Ceylon. In addition zircon and opaque iron-titanium oxides are ubiquitous accessories and rutile, monazite, apatite and graphite are occasionally present. Assemblage (1) is most common, (2) represents a lower pressure series and has been described earlier by Lacroix (1891), (3) and (5) are both silica-deficient, Mg and Al-rich and Al-rich respectively, and (4) appears to be a higher grade assemblage. All of these mineral assemblages denote rather unusual Al and Mg-rich compositions and are best portrayed on the  $\text{SiO}_2$ - $\text{Al}_2\text{O}_3$ -MgO triangle.

The presence of many of these minerals in the gem fields of the Ratnapura area such as corundum, spinel, sillimanite, andalusite, cordierite, garnet and even kornerupine (closely related to sapphirine) as immature gravels and coarse sands implies a nearby source rock (Wadia and Fernando, 1945). Although the bedrock geology of the Ratnapura area is not completely known; cordierite gneisses and associated rocks are known in the vicinity. The field occurrences of these distinctive bluish cordierite gneisses may serve as guides for the exploration of gem deposits.

## References

- Cooray, P. G. (1962). *Quart. J. geol. Soc. Lond.*, **118**, 239-73.  
 Hapuarachchi, D. J. A. C. (1968). *Geol. Mag.*, **105**, 317-24.  
 Lacroix, A. (1891). *Rec. geol. Surv. India*, **24**, 157-200.  
 Wadia, D. N. and Fernando, L. J. D. (1945). *Rec. Dept. Min. Ceylon*, Prof. Pap. 2, 14-44.

## FREQUENCY DISTRIBUTION OF CLAY AND ASSOCIATED MINERALS IN THE ALLUVIAL SOILS OF CEYLON

J. W. HERATH

(Geological Survey Department, Colombo 2)

AND

R. W. GRIMSHAW

(Department of Applied Mineral Sciences, University of Leeds, Leeds 2)

Studies on clay mineral types in the alluvial soils of Ceylon show interesting differences in the soil clay materials of the various regions. The most widely recognised geographical feature of the Island is its climatic division into wet and dry regions which merge in an intermediate zone. Clay mineral studies using modern physical and chemical methods of analysis show that the soils of the Island can be divided into three provinces which closely follow the climatic divisions.

In the wet zone region kaolinite is usually the dominant soil clay mineral. Mica (trioctahedral), mixed layer mineral (biotite/vermiculite) and vermiculite are present. Other minerals present include gibbsite in appreciable amounts, goethite, boehmite, quartz, ilmenite and monazite. The minerals of the Alluvial soils of the Dry Zone region show

quite different features. Gibbsite is totally absent and montmorillonite is invariably present in appreciable amounts. Kaolinite, however, is usually the dominant clay mineral. Dolomite is often present in the form of nodules associated with feldspar, goethite and ilmenite. The mica again is of the biotite type and no vermiculite has been detected.

In the intermediate climatic zone, montmorillonite is usually present, whilst kaolinite remains the main clay mineral; gibbsite occurs in minor amounts and dolomite may be present in areas bordering the Dry Zone. Mixed layer mineral and vermiculite are rare.

It is concluded that this classification is of agricultural importance where the soil clay properties may be related to their mineral constitution. The use of Differential Thermal Analysis technique alone was sufficient to place a particular soil material in one of the proposed mineral provinces. However, it is shown that X-ray analysis must not be overlooked, for, by this means the important mixed layer minerals in the biotite-vermiculite-montmorillonite series can be identified.

#### EXPANDED CLAY AGGREGATE FROM CEYLON FOR USE IN STRUCTURAL CONCRETES

J. W. HERATH

*(Geological Survey Department, Colombo 2)*

AND

R. W. GRIMSHAW

*(Department of Applied Mineral Sciences, University of Leeds, Leeds 2)*

Of the many methods that have been used to reduce the weight of buildings and building materials, one which appears to have found increasing favour in recent years is the use of light-weight aggregates in concrete. Recent research on the industrial clays of the Island has revealed that certain clay materials could be successfully bloated to form light-weight aggregate. According to the mineralogical composition the clay materials of the Island are divided into two main groups—the gibbsite-kaolinite clays developed in the wet climatic zone and the kaolinite-montmorillonite clays developed in the dry climatic zone. It is shown that commercially valuable clay deposits for use in the manufacture of expanded clay aggregate are confined to the dry climatic zone. Certain clay materials from this region could be bloated to a bulk density of 25-30 lb/ft<sup>3</sup> for aggregate sized from 0.25 to 0.5 in. when heated without any additive to temperatures of 1100°C.

#### REFRACTORY RAW MATERIALS OF CEYLON AND APPRAISAL FOR CERAMIC INDUSTRIES

J. W. HERATH

*(Geological Survey Department, Colombo 2)*

The newly established high temperature industries have promoted research and surveys into resources of refractory raw materials in the Island.

Available materials include the heavy minerals zircon and monazite (beach sand concentrates); recent unconsolidated residual or alluvial highly kaolinitic clays including clay materials relatively rich in gibbsite; Jurassic carbonaceous shales; Pre-Cambrian quartzites vein quartz dolomite magnesite and graphite.

The geological features of the deposits are described and the chemical composition, mineralogical constitution and the verification characteristics of the clay materials together with the carbonaceous shales are discussed and it is shown that their melting points are in the region 1605—1717°C (Orton cone 27-32), within the fusion temperatures of refractories.

It is concluded that Ceylon is well provided with refractory and semi-refractory raw materials for an expanding ceramic industry and that the reserves of raw materials available offer interesting possibilities for the development of a sound refractory products industry.

#### Acknowledgements

It is desired to acknowledge with grateful thanks the help of D. B. Pattiaratchi, Chairman, Ceylon Ceramic Corporation, who permitted the reproduction of results of the pyrometric cone equivalent tests (P.C.E.) carried out at Israel Ceramic and Silicate Institute.

#### A STUDY OF THE HEAVY MINERALS IN THE NATTANDIYA—MARAWILA—MADAMPE GLASS SAND DEPOSITS

L. J. D. FERNANDO

*(Geological Survey Department, Colombo 2)*

Silica sand is the most important raw material in the manufacture of glass, forming 60-70 per cent of the raw mixture or 'batch'. Extensive deposits of these sands aggregating several million tons are found as

isolated deposits on the coastal plain of the Island and one of the best known is the Nattandiya—Marawila—Madampe deposit. The sands are poorly graded and are only suitable for the manufacture of bottle-ware and other common types of glass because of various impurities which impart a colour to the glass. Until recently the colour was thought to be due to the presence of the heavy mineral ilmenite.

With a view to the possible up-grading of the silica sands detailed studies of the heavy minerals present in the glass sand deposit were carried out using the conventional methods of mineral separation. For this purpose bulk samples of sand from fifteen pits were used—nine of these pits were in the southern deposit (Nattandiya—Marawila) and the remaining six in the northern deposit (Madampe). The heavy minerals identified include sillimanite, spinels of various types, ilmenite, leucoxene, garnet, rutile, zircon and monazite more or less in that order of importance. Chemical and petrographic data are furnished and the possibilities of up-grading the sands are discussed.

#### A STUDY OF THE SIGNIFICANCE OF LATEX IN *HEVEA* SP.

D. M. FERNANDO

(Rubber Research Institute of Ceylon, Agalawatte)

AND

M. S. TAMBIAH

(Department of Botany, University of Ceylon, Colombo)

The different theories for the function of latex are discussed. The favourable growth of recently evolved high yielding cultivars in areas marginal for agriculture is described. An analysis is made of the yields, dry rubber content and growth of a single popular clone, PB 86, from different districts in Ceylon: correlation made with rainfall and temperature incline towards the view that latex functions as an internal system regulating water within the plant. The ability of the plant to survive and grow satisfactorily under drought conditions appears to improve with increased capacity for latex production. The breeding and selection of *Hevea* for yield would also result in extending the cultivable range of the crop. The possibility of thus moving *Hevea* cultivation to areas considered marginal for profitable growth of other crops appears definite.

#### YIELDS OF LATEX AND SIEVE TUBE DIAMETER IN *HEVEA* SP. — A PRELIMINARY STUDY

D. M. FERNANDO

(Rubber Research Institute "Dartonsfield", Agalawatte)

AND

M. S. TAMBIAH

(Botany Department, University of Ceylon, Colombo)

A study of modern cultivars of *Hevea* synthesized in Ceylon revealed larger Sieve—tubes in higher yielding clones. Sieve—tube diameter and yields are compared and the usefulness of this anatomical feature for selection is discussed.

#### URBANIZATION OF THE DRY ZONE: (EXCLUDING THE JAFFNA PENINSULA) SOME OBSERVATIONS

B. L. PANDITHARATNA

(University of Ceylon, Peradeniya)

Ceylon's Dry Zone in contrast to the other regions (South West Lowlands, Central Highlands and the Jaffna Peninsula) is least populated and urbanized. Based on local government classification of urban areas, Dry Zone's urban population in 1963 was merely 11.3 per cent of Ceylon's total urban population. Only in three towns population exceeded 20,000 and only five towns had population more than 10,000.

However, recent administrative and development activities have reactivated Dry Zone's urbanization and impacted on (a) the growth of historic-administrative cores, and (b) stimulated increasing concentration of population and of specialization of non-agricultural activities in a large number of central places.

Dry Zone's reactivated urbanization introduces a relatively new dimension to Ceylon's social geography, and it is therefore timely to study the trend and the implications. It is the theme of this paper to analyse the following:—

- (a) The processes and patterns of reactivated urbanization of the Dry Zone;
- (b) The rates, scale and differential levels of urbanization;
- (c) Implications and problems; and
- (d) The spatial interaction and behaviour in the differentially developed zones of the Dry Zone.

**SOME PRELIMINARY STUDIES ON *EPILACHNA INDICA* (COLEOPTERA: COCCINELLIDAE) INFESTING THE BITTER GOURD PLANT (*MOMORDICA CHARANTIA*) OF CEYLON**

P. M. WIJAYARATNA

(Department of Zoology, University of Ceylon, Colombo 3)

*Epilachna indica* is a common pest of some of Ceylon's home grown-vegetable crops. The present study attempts to elucidate; (a) The oviposition and life of cycle of *Epilachna indica*, and (b) The food preferences in the families Cucurbitaceae and Solanaceae. A feeding rhythm has also been observed. The results are reported. A chemical basis, for host plant selection, is suggested.

**STUDIES ON THE EFFECTS OF A CHEMOSTERILANT, ON THE HAEMOLYMPH OF *SPHAERODEMA RUSTICUM* (HEMIPTERA: BELOSTOMATIDAE)**

P. M. WIJAYARATNA

(Department of Zoology, University of Ceylon, Colombo 3)

Total haemocyte counts have been made of the blood of the normal adult *Sphaerodema*. Similar studies have been carried out for adults treated with the chemosterilant, Apholate. The results are compared.

**BREEDING HABITS AND MORPHOLOGICAL CHANGES OF THE DEVELOPING TADPOLE OF *BUFO MELONOSTICTUS***

NEVILLE DE SILVA

(Ceylon Coconut Board, Colombo 1)

Period of breeding—amplexus—and duration—abnormalities observed during this period. Number of eggs laid by an average sized female.

Egg laying pattern—and the time taken upto neurula stage:—from the time of emergence from the egg string.

Development of the Neurula—the average time taken from Neurula upto the froglet stage. Abnormalities during this developmental period.

Discussion of graph which co-relates the rate of development—Time Vs. length—

**LABORATORY CULTURE OF THE TEA RED SPIDER MITE, *OLIGONYCHUS COFFEAE* (NIETN.)**

A. KATHIRAVETPILLAI

(Tea Research Institute of Ceylon, Talawakele)

The tea red spider mite is of economic importance in relation to tea. However relatively little information is available on the breeding of mites under local conditions. A simple and inexpensive technique has been evolved that would facilitate the breeding of the red spider mite under laboratory conditions. This involved employing Rodriguez's (1953) detached-leaf culture method which has been widely employed elsewhere to rear small insects. Tea leaf discs of a suitable diameter were punched out and maintained in a fresh condition in a 2% sucrose solution in petri dishes and mites reared on the leaf discs by depositing individual mites on them. In this manner it was possible to observe the various stages of the life cycle. Using this method, the life-history of the red spider mite has been worked out in the laboratory.

**CHANGES IN OXYGEN UPTAKE AND RESPIRATORY QUOTIENT DURING POST-EMBRYONIC DEVELOPMENT OF THE LEAF-INSECT, *PHYLLIUM CRURIFOLIUM* (PHASMIDA: PHYLLIIDAE)**

W. W. D. MODDER AND K. SIVARAJAH

(Department of Zoology, University of Ceylon, Peradeniya)

A study of post-embryonic development in laboratory stocks of the leaf-insect, *Phyllium crurifolium*, has included oxygen uptake and respiratory quotient (RQ) determinations with whole insects at different stages of development, from hatching to the 6th stadium. Warburg respirometry was employed. Oxygen uptake is expressed as mm<sup>3</sup>/mg live weight/hr.

Both oxygen uptake and RQ are found to be independent of the sex of the experimental nymphs.

The oxygen uptake level is highest at hatching, but falls over the next 10 days to about half this level.

Oxygen uptake values appear in the form of peaks at the moults. The 1st moult peak is markedly higher than the 2nd moult peak, while the peaks at the 2nd, 3rd, 4th and 5th moults are nearly of the same height.

Oxygen uptake during the inter-moult periods is less than at the moults. There is a progressive decline in inter-moult oxygen uptake from the 1st to the 6th stadia.

Over the six stadia the RQ is nearly constant, at a level which is indicative of carbohydrate utilisation. However a slight progressive depression in RQ during successive stadia was noted.

The significance of these changes in oxygen uptake and RQ is discussed.

**THE BIOLOGY OF A NEW SPECIES OF EUGREGARINE, *GREGARINA FERNANDOI* N.SP., FROM THE FIELD COCKROACH *LEUCOPHAEA***

M. SABARATNAM

(Department of Zoology, University of Ceylon, Colombo)

The development structure and life history of a new species of eugregarine is described from the gut of the cockroach *Leucophaea*, collected from the University premises. The cockroaches were reared in the laboratory and experimentally infected and the pH of the gut was determined. Studies on encystment and sporulation were also made. Important tests were carried out to elucidate the cytochemical nature of the parasite.

**PRAWNS OF THE THONDAIMANAR LAGOON—A STUDY OF THE DIFFERENT SPECIES, THEIR MIGRATIONAL BEHAVIOUR, PATTERN OF DISTRIBUTION BREEDING AND ECONOMIC POTENTIAL**

K. CHITRAVADIVELU AND K. SELVAVINAYAGAM

(Hydro-Biological Survey Research Council, M.M.V. Karaveddi)

The paper is one of the series in the Hydro-Biological Survey of the Thondaimanar Lagoon. Of the seven species of prawns listed, the paper is mainly concerned with *P. indicus*, *P. semisulcatus*, *M. dobsoni*, and *M. elegans*. Their relative abundance, length frequency distribution from month to month, together with changes in hydrography and hydrology of the lagoon, mainly that of halid content, drying up and the nature of the lagoon bed have been investigated.

The growth pattern worked out and the possible spawning period deduced based on the model progression of length. Their migrational behaviour and breeding grounds, based on the length frequency distribution speculated and the economic potentialities of the lagoon as a prawn fishery assessed.

**SOME EFFECTS OF AN INSECTICIDE ('DURSBAN') AND A WEEDICIDE ('LINURON') ON THE MICROFLORA OF A SUBMERGED SOIL**

K. SIVASITHAMPARAM

(Agricultural Research Station, Sita Eliya, Nuwara Eliya)

The widespread use of selective chemicals for the control or elimination of agricultural pests has created a variety of new agronomic, biological and public health problems. Inasmuch soil micro-organisms play a key role in soil fertility, the residual effects of such chemicals are of considerable importance.

An investigation was carried out to ascertain the effects of the insecticide, Dursban, (0, 0, diethyl-0-3, 5, 6-trichloro-2-pyridyl phosphorothioate) and the weedicide, linuron, [3-(3, 4-dichlorophenyl)-1-methoxy-1-methylurea] on the microflora of a submerged soil.

Details of their effect on the numbers of fungi, bacteria and actinomycetes, and also on the ammonifiers; nitrifiers oxidizing ammonia to nitrite; nitrifiers oxidizing nitrite to nitrate; denitrifiers; aerobic nitrogen fixers; phosphate dissolvers; cellulose decomposers; sulfate reducers; and iron precipitators, will be presented.

**AN INVESTIGATION OF MICROFUNGI IN A GRASSLAND SOIL**

I. BALASOORIYA\* AND MALINI PERERA†

(Department of Botany, University of Ceylon, Peradeniya)

The aim of this investigation was to study the nature of microfungi in a grassland soil at Hantane, Peradeniya. Attempts were also made to determine whether there was a detectable seasonal variation of the fungal flora. Soil samples were collected at monthly intervals during the period April 1967-April 1968. The moisture content, carbon content and the pH of these soil samples were determined and the samples were analysed for microfungi using the dilution plate technique and Warcup's soil plate technique. A total of 56 fungal species were isolated. Fungal activity appeared to be highest in August 1967 immediately after the rains, when the soil moisture content was high. There was no detectable variation of the fungal population throughout the year but the number of fungi isolated increased with increase in soil moisture content.

\*Present address—Department of Botany, Vidyalkara University, Kelaniya.

†Present address—Aquinas University College, Colombo.

## SUCCESSION OF MICRO-FUNGI ON THE ROOT SURFACE OF *ORYZA SATIVA* VAR. $H_4$

I. BALASOORIYA\* AND ROHINI ABAYGOONESEKERA

(Department of Botany, University of Ceylon, Peradeniya)

The roots of paddy plants (*Oryza sativa* var.  $H_4$ ) from a paddy field at Uda Peradeniya were sampled throughout the growing season and the micro-fungi on the roots were isolated using Harley and Waid technique. The results indicate that there are four distinct fungal populations characteristic for the four stages of the paddy plant viz. early growth, tillering, earing and senescence. The fungal activity on the root surface appeared to be highest during the period of earing.

\*Present address—Department of Botany, Vidyalankara University, Kelaniya.

## SECTION E : PHYSICAL SCIENCES

(King George's Hall A)

### Friday, 19th December:

- 8.20 .. Average Characteristics of Pc2 and Pc3 Geomagnetic Micro-pulsations as observed on the Geomagnetic Equator—A. Aiyamuthu.
- 8.40 .. Rotation and Meridian Circulation in Non-magnetic Stars—M. Maheswaran.
- 9.00 .. Spread of Infectious Hepatitis in the Family Group. A Report of Biochemical Investigations—N. Nagaratnam, Dawn F. de Silva, S. Sentheshanmuganathan, H. R. Peiris and N. Nagarajah (Jointly with Section A).
- 9.20 .. The construction of a magnetic balance and its use in the measurement of magnetic properties of solids—R. Narayanaswamy, R. B. Elkaduwa and H. W. Dias.
- 9.40 .. Variation of Rainfall over Ceylon during the 50 year period (1911-1960)—I. D. T. de Mel.
- 10.00 .. Temperature co-efficient and Secular Change in Shortt Free Pendulum Clock No. 68—L. A. D. I. Ekanayake.
- 11.00 .. Effect of Latex on the Physical Properties of Cement and Concrete—A. Thevarash and M. Selvaratnam (Jointly with Section C).

### Saturday, 20th December:

- 8.00 .. A comparative study of chemical analysis of different varieties of Tea—W. A. B. de Silva.
- 8.15 .. An Investigation of the Proteins of Tea—U. L. L. de Silva.
- 8.30 .. Studies on the chemical constituents of Tea Waste (A) Chlorophylls—A. L. Jayawardena and A. S. L. Tiri-manna.

- 8.45 .. Studies on the chemical constituents of Tea Waste (B) Carotenoids—A. L. Jayawardena and A. S. L. Tirimanna.
- 9.00 .. Studies on the chemical constituents of Tea Waste (C) Polyphenols—A. L. Jayawardena and A. S. L. Tirimanna.
- 9.15 .. Studies on the chemical constituents of Tea Waste (D) Terpenoids—A. L. Jayawardena and A. S. L. Tirimanna.
- 9.30 .. A study on the Enzyme Oxidation of Tea Polyphenols and the Inhibitory Effect of Tannins on the Enzyme Reaction—K. P. W. C. Perera.
- 9.45 .. Acetate Metabolism during tea manufacture—K. Sivapalan.
- 10.00 .. Effects of artificial wilting of tea shoots and strawberry leaves on the metabolism of nucleotides and phosphate esters—R. R. Selvendran.
- 2.00 .. Adsorption studies on "Snake Stone"—M. Selvaratnam and P. H. S. S. Ariyapala.
- 2.15 .. Studies on the Faradaic Impedance of Solid Electrodes—S. G. Canagaratna and S. A. G. R. Karunatilaka.
- 2.30 .. Kinetic Analysis using the Persulphate/Iodide reaction—S. G. Canagaratna and S. Pathmanathan.
- 2.45 .. Pro-oxidant and Antioxidant Mechanisms in technological systems—G. Scott.
- 3.00 .. A rapid method for separation of Phenylalanine in Serum by Thin Layer Chromatography and Establishment of the Clinical Norm for Ceylonese Subjects—S. Sentheshanmaganathan, Sita Rodrigo and S. Kamalanathan (Jointly with Section A).

**Sunday, 21st December:**

- 8.00 .. Chemical Investigation of the Endemic plants of Ceylon—M. U. S. Sultanbawa.
- 8.15 .. Extractives of *Calophyllum calaba* L. (Guru—Kina—S) Guttiferae—R. Somanathan and M. U. S. Sultanbawa.

- 8.30 .. Extractives of *Argyrea populifolia* Choisy (Giritilla—S) Convolvulaceae—A. A. L. Gunatilake and M. U. S. Sultanbawa.
- 8.45 .. Extractives of *Wormia triquetra* (Diya Para—S) Dilleniaceae—G. Subramaniam and M. U. S. Sultanbawa.
- 9.00 .. Extractives of *Artocarpus nobilis* Thw. (Del. bedi del—S) Moraceae—R. Mageswaran and M. U. S. Sultanbawa.
- 9.15 .. Extractives of *Mesua thwaitesii* Planch & Triana (Diya na—S) Gutiferae—S. Salliah and M. U. S. Sultanbawa.
- 9.30 .. Alkaloids of *Holarrhena mitis*—N. Amuthasakaran and G. P. Wannigama.
- 9.45 .. Isolation of Mangiferin from *Mangifera zeylanica*—Padma Herath, E. Karunanayake, S. S. Selliah and G. P. Wannigama.
- 10.00 .. Hemicellulose in Coconut Kernel—K. Balasubramaniam, R. D. Sothary and A. A. Hoover.
- 1.30 .. Psilotropin, A. New Sesquiterpene dilactone from *Psilotrophe cooperi*—L. B. de Silva and T. A. Geissman.
- 1.45 .. The Bitter Principle of *Melia dubia* Cav.—L. B. de Silva, W. Stocklin and T. A. Geissman.
- 2.00 .. Business Meeting.
- 2.45 .. In vivo studies of photosynthetic intermediates—G. R. Roberts, A. J. Keys and C. P. Whittingham.
- 3.00 .. A study of the Carotenoid Pigments of Ceylon Chillies (Capsicum Species)—A. S. L. Tirimanna (Jointly with Section B).
- 3.15 .. Quantitative Estimation of Total Capsaicin (Hot Principle) in Ceylon Chillies (Capsicum Species)—A. S. L. Tirimanna (Jointly with Section B).
- 3.40 .. Presidential Address: "Electrodics"—M. A. V. Devanathan (Physics Theatre).

**Monday, 22nd December:**

- 9.00 .. Studies on the Selenium Analogue of Dithizone: 'Selanazone' and its Metal Complexes—R. S. Ramakrishna and H. M. N. H. Irving.

- 9.15 .. Studies on the composition and stability of the Thallium (I) Complex of Thiosalicylic Acid—R. S. Ramakrishna and M. E. Fernandopulle.
- 9.30 .. Spectrophotometric and Electrometric studies on the Vanadyl Complex of Thiosalicylic Acid—R. S. Ramakrishna, M. E. Fernandopulle and B. Nalliah.
- 9.45 .. The identification and quantitative determination of some trace elements present in Ceylon beach sands—J. P. R. Fonseka.
- 10.00 .. Experimental confirmation of steric hindrance preventing the attainment of coplanarity of the nitro-group with the aromatic nucleus—N. B. Chapman, S. Sotheeswaran and K. J. Toyne.

## ABSTRACTS

### AVERAGE CHARACTERISTICS OF Pc2 AND Pc3 GEOMAGNETIC MICROPULSATIONS AS OBSERVED ON THE GEOMAGNETIC EQUATOR

M. AIYAMUTHU  
(Jaffna College, Vaddukoddai)

Pc2 and Pc3 Geomagnetic Micropulsations were recorded in Colombo during the period 18/8/66 to 21/9/66 to study their average diurnal characteristics. The visual analysis of the chart records indicate that:—

- (1) the amplitude of the Pc2 and Pc3 pulsations is of the order of 0.03 gamma compared to the tenths of gamma observed in the auroral zones.
- (2) Pc3 oscillations are mainly daytime phenomena, the maximum activity being observed near local noon.
- (3) in the Pc2, 3 range there are four bands of activity centred about 21 seconds, 29 seconds, 38 seconds and 50 seconds respectively; there is an indication of another band of activity round about 10 seconds.
- (4) the individual bands of activity have their longest periods during the night and not during daytime as observed by many authors (Kato and Saito, 1959; Duncan, 1961; Saito, 1960); this apparent decrease in the period of oscillation during the

night observed by these authors could be explained in terms of the enhanced activity of the 21-second band relative to the 29-second band during the night.

## References

- Duncan, (1961). Some studies of Geomagnetic Micropulsations, *J. Geophys. Res.*, **66**, 2087-2094.
- Kato and Saito, (1959). Preliminary Studies on the daily behaviour of rapid pulsations, *J. of Geomagnetism and Geoelectricity*, **10**, 221-225.
- Saito, (1960). Period Analysis of geomagnetic Pulsations by a Sonograph Method, *Sci. Rept., Tohoku Univ., Ser. 5*, Geophys. **12**, 106-113.

## ROTATION AND MERIDIAN CIRCULATION IN NON-MAGNETIC STARS

M. MAHESWARAN

(Department of Mathematics, University of Ceylon, Peradeniya)

It is well known that many Upper Main Sequence Stars rotate with appreciable angular velocities. Also, it has been established that thermal equilibrium breaks down in the radiative regions of rotating stars and slow, large scale circulations will be set up in these regions (Mestel, 1965). This circulation will in turn distort the angular velocity field, which would give rise to a new circulation pattern. Thus a feed-back cycle will be set up between the rotation and circulation. This problem is almost impossible to tackle and, in the literature, authors have restricted themselves to cases where steady states may exist. The conditions for steady states will depend on whether a magnetic field is present or not. In non-magnetic, axi-symmetric stars, a requirement for steady circulation is that the angular momentum be constant along stream lines of the meridian circulation (Mestel, 1965). Recently, a criterion for the stability of rotation in stars has been derived (Goldreich and Schubert, 1967). The present author shows that any solution that may be obtained using the above condition for the steady state of rotating non-magnetic stars will be subject to the Goldreich-Schubert instability and, thus, no stable steady state solutions may be obtained for the rotation of non-magnetic stars. This leads to interesting results in regard to the problem of mixing in Upper Main Sequence stars. It is also suggested that if steady states exist in stars, it is likely that magnetic fields are present.

## References

- Goldreich, P. and Schubert, G. (1967). *Astrophysical Journal* **150**, 571.
- Mestel, L. (1965). "Stars and Stellar Systems VIII—Stellar Structure. Chapter 9: Chicago: University Press.

## THE CONSTRUCTION OF A MAGNETIC BALANCE AND ITS USE IN THE MEASUREMENT OF MAGNETIC PROPERTIES OF SOLIDS

R. NARAYANASWAMY, R. B. ELKADUWA AND H. W. DIAS  
(Department of Chemistry, University of Ceylon, Peradeniya)

There are several methods employed in measuring the magnetic properties of solids and liquids. From these methods the Gouy method is the most generally used because of its construction and its operation.

An attempt to construct a Gouy balance was made with a view of using it to study the magnetic properties of substances including Ceylon minerals. The paper briefly describes the construction of this balance including its calibration and its use.

## VARIATION OF RAINFALL OVER CEYLON DURING THE 50 YEAR PERIOD (1911-1960)

I. D. T. DE MEL  
(Department of Meteorology, Colombo 7)

The average rainfall maps available up to now, have been for the 30 year period (1911-40). A new annual average rainfall map for the period (1931-60) has now been prepared. The isohyets were drawn on the data available from over 300 rainfall stations. The density of the network of stations satisfies the requirements laid down by the World Meteorological Organization.

A comparison of the two annual average rainfall maps for the two periods show no significant change in the annual average precipitation. There are however some points of interest. The southwest monsoon (May-September) average rainfall map and the October-February average rainfall map for the 30 year period (1931-60) were also prepared and compared with the maps for the earlier period (1911-40). The southwest monsoon average map shows that the rainfall during the months May-

September for the period (1931-60) is less than that for the same months during the period (1911-40). The October-February average map for the period (1931-60) shows little change.

The average for a 50 year period such as 1911 to 1960 would be preferable to that for a 30 year period. Over 5 decades, the changes of wet and dry periods evening out are higher and this average would be a better criterion. The average or mean, the median and the mode of 15 representative stations were worked out for the period (1911-60) and the values show fair agreement. In addition, the probability of these stations receiving within 10% of the 50 year annual average rainfall has been calculated and found to vary between 16% and 38%, being approximately 22% in the dry zone and approximately 26% in the wet zone.

## TEMPERATURE CO-EFFICIENT AND SECULAR CHANGE IN SHORTT FREE PENDULUM CLOCK NO. 68

L. A. D. I. EKANAYAKE  
(Department of Meteorology, Colombo 7)

This clock was set up at Colombo Observatory in August 1949. Between the Invar rod and bob the makers had fitted a brass compensator 1.25 inches in length but this left the pendulum slightly under-compensated as was shown in earlier papers. The mean daily rate  $R_N$  after  $N$  months run in 1951 was shown to be given by the expression.

$$R_N = .345 - .012 N - .02T$$

—where  $T$  is the mean monthly temperature (Centigrade) in the Free Pendulum chamber.

For 1952 — 53 the expression was

$$R_N = .780 - .009N - .02T.$$

The pendulum was losing two hundredths of a second per day for every  $1^\circ\text{C}$  rise in temperature. Experiments were carried out to alter this negative temperature co-efficient by drilling the pendulum and fitting compensators of different lengths. 3.25 inches proved too short, 4.92 inches too long. Finally in 1960 a brass compensator 4.25 inches in length was fitted, giving a small positive temperature co-efficient. For 1967-68 the rate of the clock is found to be given by the expression.

$$R_N = - .043 - .003N + .02T.$$

The constant terms in these expressions are of no significance, being governed by the initial rate of the clock for the run under consideration.

The temperature co-efficient is now positive, the pendulum gaining two hundredths of a second per day for every 1°C rise in temperature.

The co-efficient of N gives the secular change. In 1951 the daily rate of the pendulum was becoming more negative by 12 milli-seconds per day every month. In 1952-53 the value was 9 milli-seconds, and in 1967-68 the daily rate is becoming more negative by only 3 milli-seconds per day with the passage of each month. Such behaviour is attributed to the minute extension in length of the Invar rod under tension over the years. The secular change seems to diminish to one-third of its value every 16 years, and should become negligible in the next 16 years.

It is not proposed to make further alterations to the pendulum. Recently a thermostatic temperature control was fitted in the Free Pendulum chamber, and the Clock has been remarkably steady for months, as is shown by graphs, the error keeping within a quarter of a second from January 1969.

## EFFECT OF LATEX ON THE PHYSICAL PROPERTIES OF CEMENT AND CONCRETE

A. THEVARASAH AND M. SELVARATNAM

(Department of Chemistry, University of Ceylon, Peradeniya)

- The effect of
1. field latex
  2. centrifuged latex
  3. prevulcanized latex
  4. field latex grafted with methyl methacrylate monomer
  5. latex with other additives

on the physical properties of cement and concrete have been studied.

The compressive strength and tensile strength for the different types of latex-concrete mixtures have been measured as a function of concentration. The results are discussed with particular reference to their practical applications.

## A COMPARATIVE STUDY OF CHEMICAL ANALYSES OF DIFFERENT VARIETIES OF TEA

W. A. B. DE SILVA

(Tea Research Institute of Ceylon, Low Country Station, Ratnapura)

The two major kinds of tea may be broadly classified to Green Tea and Black Tea; both are obtained from green leaf to tea. While a process of enzymic oxidation leads to the formation of Black Tea qualities, the preservation of green colour by inactivating the enzymes brings about the Green Tea qualities. Inactivation is done by means of steaming or parching the fresh leaf.

Enzymic action is on polyphenols which are oxidised during fermentation. When tea is extracted successively with absolute and 60% alcohol, a separation is effected of the unoxidised from oxidised polyphenols. A comparative estimation of polyphenols in the two extracts gives a picture of the extent of fermentation in the samples. The absolute/60% ratio of polyphenol content is very much greater in Green Tea than in Black Tea.

Compared to other Green Teas, Japanese Green Teas and some of the Chinese Green Teas have a remarkably high amino acid content, notably in Theanine.

Among the Black Teas, a striking feature is that the African Teas seem to contain more Epicatechin gallate than Epigallocatechin gallate which is unlike Ceylon tea. Also the chromatograms of African Teas appear to show very intense spots corresponding to Caffeic acid and probably Glucogallin.

By the method of precipitation with gelatine, the amounts of tannin present in Black Teas of different geographical areas are being estimated. In Ceylon, the low grown teas have more tannin compared to the high grown teas, and the six African teas so far studied show a lower tannin content. It is hoped that these investigations would in some way provide a means to detect any possible adulteration of tea.

## AN INVESTIGATION OF THE PROTEINS OF TEA

U. L. L. DE SILVA

(Tea Research Institute, Low Country Station, Ratnapura)

Protein was at first quantitatively estimated (Lowry, Rosebrough, Farr and Randall, 1951) tea samples extracted with water in the presence of polyvinylpyrrolidone, (Polyclar AT), which was added in order to

remove polyphenols which react with the Folin-Ciocalteu reagent used for the protein estimation. This procedure was found to be unsatisfactory as the results were not reproducible. In an alternative procedure protein was concentrated by dialysis against "aquacide", separated by paper electrophoresis, eluted from the paper strips and then estimated. It was found that the protein content of the extracts showed a small decrease on withering, followed by a marked decrease on fermentation. It was also found that "coarse" leaf contained less protein than the young "flush" and that there was a variation of protein content between different clones.

Black tea brews were fractionated by passage through Sephadex G-50 (medium) columns, and a neat separation of proteins effected. Proof of the protein nature of the fractions was obtained by Kjeldahl determination of nitrogen, and by acid hydrolysis followed by paper chromatography of the hydrolysate to show the presence of amino-acids.

#### Reference

Lowry, O. H., Rosebrough, N. J., Farr, A. L. and Randall, R. J. (1951). Protein measurement with the Folin Phenol reagent, *J. Biol. Chem.*, **193**, 265-275.

### STUDIES ON THE CHEMICAL CONSTITUENTS OF TEA WASTE (A) CHLOROPHYLLS

A. L. JAYAWARDENA AND A. S. L. TIRIMANNA

(Natural Products Laboratory, Ceylon Institute of Scientific and Industrial Research, Colombo 7)

Black tea, immediately after manufacture, is subjected to an elaborate sorting procedure, during which approximately one per cent of the product is discarded as tea waste. This tea waste amounts to approximately four and a half million pounds per annum. These investigations on the chemical constituents of tea waste have been carried out with the ultimate objective of finding out whether tea waste could be of any economic use.

One of the main factors responsible for the blackness of tea is the concentration of chlorophyll and its transformation products. Wickremasinghe and Perera (1966) using one dimensional thin layer chromatography have shown the separation of six chlorophyll derivatives in black tea. This investigation has now been extended to the study of tea waste using two dimensional thin layer chromatography.

An exhaustive extraction of tea waste was carried out using a mixture of methanol and petroleum ether (b.p. 40-60°, 3:1, v/v). The chlorophylls and their transformation products were identified by their characteristic visible colours; the fluorescence in ultraviolet light, the relative positions on the chromatoplate and by colour reactions. More than fifteen compounds were separated, of which, the following were tentatively identified: phaeophytins a, a<sub>1</sub>, a', b, b<sub>1</sub>, chlorophylls a, a<sub>1</sub>, b, b<sub>1</sub>, phaeophorbide a, b, and chlorophyllides a, b.

Qualitative and quantitative studies of the total chlorophylls of tea waste obtained from estates of different elevations were carried out, and the results will be discussed.

#### Reference

Wickremasinghe, R. L. and Perera, V. H. (1966). The blackness of tea and colour of tip, *Tea Quarterly*, **37**, 75-79.

### STUDIES ON THE CHEMICAL CONSTITUENTS OF TEA WASTE (B) CAROTENOIDS

A. L. JAYAWARDENA AND A. S. L. TIRIMANNA

(Natural Products Laboratory, Ceylon Institute of Scientific and Industrial Research, Colombo 7)

Tirimanna and Wickremasinghe (1965) reported a study of the carotenoids of black tea using one dimensional thin layer chromatography. These workers detected the occurrence of fourteen carotenoids in black tea and described the probable role played by these compounds in the development of quality and flavour in black tea.

This investigation deals with the separation, identification and quantitative estimation of the carotenoids of tea waste obtained from estates of different elevations.

The carotenoid extract after saponification was subjected to chromatography and the principal pigments were identified by spectrophotometry, co-chromatography and by colour reactions. More than fifteen compounds were detected on the chromatoplate of which the following were tentatively identified:  $\beta$ -carotene,  $\gamma$ -carotene,  $\beta$ -carotenone, cryptoxanthin, cryptoxanthin-5, 6 epoxide, lutein, lutein epoxide, zeaxanthin, violaxanthin and neoxanthin.

Quantitative estimations using a spectrophotometric method revealed an appreciable concentration of total carotenoids in tea waste. The possible commercial implications of this finding will be discussed.

#### Reference

Tirimanna, A. S. L. and Wickremasinghe, R. L. (1965). Studies on the quality and flavour of tea. *Tea Quarterly*, **36**, 115-121.

### STUDIES ON THE CHEMICAL CONSTITUENTS OF TEA WASTE (C) POLYPHENOLS

A. L. JAYAWARDENA AND A. S. L. TIRIMANNA

(Natural Products Laboratory, Ceylon Institute of Scientific and Industrial Research, Colombo 7)

The 'astringency' of a cup of tea is due to the presence of polyphenols. In recent years this subject has been extensively dealt with by various workers. This investigation deals with the separation and identification of the polyphenolic compounds and their oxidation products in tea waste obtained from estates of different elevations.

Two dimensional paper chromatographic techniques were applied. The compounds were identified by co-chromatography and colour reactions. More than thirty five compounds were detected, of which, the following were tentatively identified: glucogallin, theogallin, chlorogenic acid, cis-chlorogenic acid, neo-chlorogenic acid, coumarylquinic acids, p-coumaric acid, caffeic acid, rutin, catechin, gallic acid, ferulic acid, caffeine, epigallocatechin, epicatechin, gallocatechin, epigallocatechin gallate, leucoanthocyanins, kaempferol, quercetin, the arubigenins, the aflavin and the aflavin gallate.

The results of a comparative study of the polyphenolic constituents of tea waste from different estates will be discussed.

### STUDIES ON THE CHEMICAL CONSTITUENTS OF TEA WASTE (D) TERPENOIDS

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(Natural Products Laboratory, Ceylon Institute of Scientific and Industrial Research, Colombo 7)

Extensive studies on the volatile compounds of black tea have been carried out by various workers using gas chromatographic techniques. Recently, two dimensional thin layer chromatographic techni-

ques have been used in a comparative study of the terpenoids and carbonyls of Ceylon black teas (Tirimanna 1968). These studies have now been extended to tea waste obtained from estates of different elevations.

The volatile oil of tea waste was prepared by steam distillation under normal atmospheric conditions and separated into acidic, basic and neutral fractions. The neutral fraction which contained the main constituents responsible for tea aroma was then subjected to two dimensional thin layer chromatography. More than twenty terpenoid compounds of tea waste were detected on the chromatoplate by the vanillin-sulphuric acid reagent and the following were tentatively identified by co-chromatography and colour reactions: linalool oxide, geraniol, linalool, linalyl acetate, geranyl acetate, nerol, nerolidol, terpinene, terpenol, terpenolene, ocimene and myrcene.

Comparative studies of the terpenoid compounds in different samples of tea waste were carried out and the possible economic uses will be discussed.

#### Reference

Tirimanna, A. S. L. (1968). Studies on the flavour of Ceylon teas, *Proc. Ceylon Ass. Advmt Sci.*, **1**, 59-60.

### A STUDY ON THE ENZYMIC OXIDATION OF TEA POLYPHENOLS AND THE INHIBITORY EFFECT OF TANNINS ON THE ENZYME REACTION

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The flavanols and some other polyphenolic substances occurring in the fresh tea leaf are oxidised to orthoquinones by the action of polyphenol oxidase. In order to investigate the various substrates responsible for the formation of the coloured products, a preliminary study was made of the enzymic oxidation of individual flavanols and other phenolic compounds which were separated by paper chromatography, after which the chromatograms were sprayed with fresh enzyme extract. The results indicated that at least six individual compounds, including myricetin-3-glucoside and rutin, developed remarkable colours during enzymic oxidation. Autoxidation of some of these compounds produced pink coloured products identified as tricetinidin (3' : 4' : 5 : 5' : 7-penta-hydroxyflavylium salt).

Methods were devised using other and hide powder-acetone for the isolation from fresh tea leaf of (—) epigallocatechin, (—) epigallocatechin gallate, (—) epicatechin gallate, (+) galocatechin, (—) epicatechin (+) catechin, corilagin and leucoanthocyanins.

Enzymic oxidation on mixed substrate systems were studied using the Warburg manometric method. The reaction products at various stages were identified by paper chromatography. The aflavin, and its gallate was found to be the main oxidation products.

Tannins isolated from tea and *Terminalia catappa* were found to inhibit the enzyme reactions during fermentation of tea leaf. The inhibitory effects of high concentration of tannins was significant, and fermentation could be stimulated by dilution of the tannin suspension and also by other methods.

## ACETATE METABOLISM DURING TEA MANUFACTURE

K. SIVAPALAN

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It has been suggested that L-leucine could be one of the precursors of some of the compounds contributing to tea flavour (Wickremasinghe, 1967). An earlier report (Wickremasinghe and Sivapalan, 1966) presented evidence that leucine was transformed to volatile compounds during tea manufacture and that one of the intermediates in the transformation sequence was mevalonic acid. The transformation of L-leucine to volatile compounds, requires, among other factors the presence of a leucine transaminase, co-enzyme A and manganese. All three of these have been shown to be present in tea shoots (Wickremasinghe *et al.*, 1969).

It is known that mevalonic acid which is an important intermediate in the biosynthesis of terpenes and sterols could also be formed in plant tissues from acetic acid. The present study examines the participation of acetate during tea manufacture.

Acetate-1-C<sup>14</sup> and acetate-C<sup>14</sup>(U) were fed to excised tea shoots and the transformations of the labelled acetate studied at different stages of manufacture. The constituents studied were the organic acids, amino acids, polyphenols, sugars, terpenes and sterols. Their conversions are discussed.

The separation and identification of radioactive mevalonic acid at the fermentation stage is reported. Evidence for the conversion of mevalonic acid to terpenes is provided by the detection of radioactivity in the steam volatile fractions, and the observation that the major part of this radioactivity could be traced to compounds having the properties of terpenes.

It is suggested that the pathways of biosynthesis of terpenes and sterols during tea manufacture include the leucine and the acetate pathways, both via the mevalonic acid intermediate formation.

## References

- Wickremasinghe, R. L. (1967). Fact and speculation in the chemistry and biochemistry of tea manufacture. *Tea Q.*, **38**, 205-209.
- Wickremasinghe, R. L. and Sivapalan, K. (1966). The role of leucine in tea flavour. *Proc. Ceylon Ass. Advmt. Sci.*, **47**, Abstr.
- Wickremasinghe, R. L., Perera, B. P. M. and Silva, U. L. L. de (1969). Studies on the quality and flavour of tea—4. Observations on the biosynthesis of volatile compounds. *Tea Q.*, **40**, 26-30.

## EFFECTS OF ARTIFICIAL WILTING OF TEA SHOOTS AND STRAWBERRY LEAVES ON THE METABOLISM OF NUCLEOTIDES AND PHOSPHATE ESTERS

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The nucleotides and phosphate esters from a trichloroacetic acid extract of tea and strawberry leaves were isolated using the method of Isherwood and Barrett (1967) and Selvendran and Isherwood (1967). This method removes most of the interfering solutes including orthophosphate, by two stage chromatography on cellulose columns using organic solvents. The phosphate compounds in the purified extracts were analysed by anion exchange chromatography and enzymatic methods. The extracts from both tissues have been shown to contain CMP, 5'-UMP, 3'-UMP, UDP, ADP, CTP, UTP, ATP, UDP-sugars, glucose-6-phosphate (G-6-P), fructose-6-phosphate (F6P), glucose-1-phosphate (G-1-P), fructose-1, 6-diphosphate (FDP), glucose-1, 6-diphosphate and sucrose-6-phosphate. A comparative study showed that the concentrations of most of the phosphate compounds in both tissues were of the same order of magnitude.

Withering for 19hr. had very marked effect on the concentrations of the nucleotides. Thus on withering, the nucleoside diphosphates increased, whereas the nucleoside triphosphates decreased markedly. AMP remained at a very low constant level. UDPG decreased. The major phosphate esters (G6P, F6P and G-1-P) decreased considerably on withering, presumably because of the irreversible loss of carbohydrates.

These changes are generally in the expected direction and are consistent with the view that the metabolism of the leaves is markedly affected by permeability changes which take place during withering.

#### References

- Isherwood, F. A. and Barrett, F. C. (1967). *Biochem. J.*, **104**, 922.  
Selvendran, R. R. and Isherwood, F. A. (1967). *Biochem. J.*, **105**, 723.

#### ADSORPTION STUDIES ON "SNAKE STONE"

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(Department of Chemistry, University of Ceylon, Peradeniya)

Snake stones are claimed to have the property of adsorbing the venom from a snake bite wound. The poisonous nature of venoms is due mainly to enzymes. Adsorption of the simple enzyme diastase on snake stones has been studied. The diastase concentration has been estimated by following the rate of hydrolysis of starch, which is found to be 1st order with respect to diastase. The results show that snake stones indeed do adsorb diastase, though to a lesser extent than activated charcoal. Preliminary studies on the adsorption of snake venom on snake stone and activated charcoal are also presented.

#### STUDIES ON THE FARADAIC IMPEDANCE OF SOLID ELECTRODES

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There is a dearth of data on the faradaic impedance of solid electrodes. Recently, (Devanathan and co-workers, 1966) some work has been done on the impedance of silver/silver halide electrodes. We have investigated the faradaic impedance of the Ag/Ag<sup>+</sup> system using the bridge method. The Schering's bridge was selected because it is the most accurate

of the available bridges. The silver electrode was a silver wire which was fixed in a glass tube by means of araldite so that only the end was exposed. The counter electrode was a platinum disc which had been plated with silver. The area of this electrode was about 100 times the area of the silver wire. The frequencies investigated ranged from 200 c.p.s. to 100,000 c.p.s. In order to ensure that harmonics did not interfere with the determination of the balance point for the fundamental the signal from the bridge was fed into a tuned amplifier. The concentration of Ag<sup>+</sup> in the electrolyte ranged from 0.1M to 0.001M, and the background electrolyte was 2M in NaNO<sub>3</sub>.

The impedance of the cell was obtained as values of the equivalent resistance and capacitance in series. An attempt is made to analyse the data according to a Randles' equivalent circuit by the method of Sluyters (Sluyters, 1960). The data do not correspond exactly to the above circuit. According to recent work this implies that there is adsorption of Ag<sup>+</sup> ions. Values of the transfer coefficient and the rate constant for the electrode reaction are reported, but these values must be regarded as tentative since the Randles' equivalent circuit is not exactly valid.

#### References

- Devanathan, M. A. V. (1966). Personal communication.  
Sluyters, J. H. (1960). On the impedance of galvanic cells—I. *Rec. trav. Chim.*, **79**, 1092-1100.

#### KINETIC ANALYSIS USING THE PERSULPHATE/IODIDE REACTION

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In recent years the scope of kinetic methods of determining the concentrations of substances has begun to be recognised. The persulphate/iodide reaction is catalysed by a number of transition metal ions. We report investigations in which it is shown that the concentrations of a few transition metal ions in the 10<sup>-5</sup>M — 10<sup>-6</sup>M range can be determined by their catalytic effect on the persulphate/iodide reaction.

#### PRO-OXIDANT AND ANTI-OXIDANT MECHANISMS IN TECHNOLOGICAL SYSTEMS

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Although the effect of sulphur cross-links on the ageing behaviour of rubber has been known empirically for many years, it is only recently

that the chemical mechanism of their behaviour has been studied. This has been found to be related to the behaviour of chemical plasticisers (peptisers) for rubber on the one hand and to the function of sulphur-containing antioxidants on the other.

The complex superposition of pro-oxidant and antioxidant mechanisms involved will be reviewed on the basis of present evidence and its relevance to the development of new antioxidant systems will be discussed.

#### A RAPID METHOD FOR THE SEPARATION OF PHENYLALANINE IN SERUM BY THIN LAYER CHROMATOGRAPHY AND ESTABLISHMENT OF THE CLINICAL NORM FOR CEYLONESE SUBJECTS

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AND

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Phenylketonuria is one of many inborn errors of metabolism and it is characterised by the failure to metabolise properly the amino acid, phenylalanine. The serum phenylalanine rises, and therefore early detection of the inborn error of metabolism is essential if the infant is to benefit from the special diet normally introduced in such cases.

The basic screening test is the detection of excess of phenylpyruvic acid in urine with ferric chloride. This test should be carried out with fresh urine, since atmospheric oxygen destroys the ketoacid. Therefore the determination of phenylalanine in blood is a better index for phenylketonuria.

The methods available at present are the fluorometric method of Ambrose (1969), colorimetric method of Albanese (1944) and the enzymic method of Mc Gilvery and Cohen (1948).

In this paper a rapid method, for the separation of phenylalanine from other amino acids in serum, is described. Phenylalanine was separated from the serum on thin layer using Silica Gel-G as the adsorbent and n-Butanol/Acetic acid/Water:4/1/1, as the developing solvent; the spots were detected by spraying with ninhydrin and drying the plate

at 105°C for 10 mts. The quantitative estimation was made possible by comparing the intensity of the spots of the unknown with the intensities of known quantities of phenylalanine. The method was so sensitive that even quantities as low as 0.5 µg could be detected. The volume of serum required was 4 µl (0.004 ml) and the time taken for the entire estimation was less than three hours.

The clinical norm for Ceylonese children, using this method, is reported. The values of serum phenylalanine ranges from 0 to 16 mg % with a mean of  $7.07 \pm 4.86$ . Two positive cases of phenylketonuria belonging to the same family, are reported.

Of the 24 amino acids tested, only phenylalanine gave an RF value of 0.67 while the others had values from 0 to 0.72.

#### References

- Albanese, A. A. (1945). Colorimetric estimation of phenylalanine in some biological products. *J. Biol. Chem.*, **155**, 291-298.  
Ambrose, J. A. (1969). A shortened method for the fluorometric determination of phenylalanine, *Clin. Chem.*, **15**, 15-23.  
McGilvery, R. W. and Cohen, P. P. (1948). The decarboxylation of phenylalanine by *Streptococcus faecalis*. *R. J. Biol. Chem.*, **174**, 813-816.

#### CHEMICAL INVESTIGATION OF THE ENDEMIC PLANTS OF CEYLON

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##### Part I—General with G. P. Wannigama

A striking feature of the Ceylon flora is the high proportion (about a fourth) of endemics. Therefore a systematic chemical investigation of the endemic plants of Ceylon has been initiated. In this programme it is proposed to investigate by solvent extraction various parts of a given plant, such as bark, timber, leaves, flowers, fruits, roots etc., and to isolate and characterise pure compounds.

Similarity in structural type of isolated compounds will be a basis of a chemical taxonomy to support or modify the existing botanical classification. Observation of structural regularities of compounds from different plants will provide material to confirm and even modify presently accepted theories of biogenesis.

It is proposed to evaluate the medicinal value of extracts of endemic plants as well as of pure compounds isolated from them. The medicinal value of endemic plants is rated as being inferior to that of the non-endemics within a genus. There is a prejudice against the medicinal use of an endemic species and foreign exchange is often spent in purchasing a species from India. Minor forest products such as resins, incense and certain oils (e.g. oil of elemi) could be collected from endemic plants without having to rely on the imported product.

It is hoped that when the medicinal and economic importance of endemic plants is established, steps will be taken to conserve these plants against the inroads of civilisation and also to commence a programme for their planned cultivation.

#### Part II—List of Endemic Plants with W. M. Bandaranaike

The revised list of endemic plants that has been prepared shows the presence of 830 endemic species distributed in 342 genera and 95 families. In this list the total number of endemic species in each family and genus with respect to the total number of plants in the respective family and genus as given by Abeywickrema is indicated. Among the endemic families there are 23 tropical families and 26 tropical-sub-tropical families. About 161 plants have local names. Of these medicinal uses have been recorded for about 33 species. From the Forest Inventory of Ceylon the following information of the importance of the endemic plants for timber purposes has been obtained.

	Total number of trees	Number of endemics
Wet Zone	144	71
Dry Zone	81	10
Intermediate Zone	6	1
Montane	6	3

#### Part III—Distribution of Endemic Plants with Mrs. S. C. Weerasekera

The available literature on the distribution of endemic plants has been classified by districts. The total number of families and Genera in the different districts are summarised below:—

	Families	Genera
Anuradhapura District	22	29
Badulla District	43	83
Batticaloa District	18	2
Chilaw District	2	2

	Families	Genera
Colombo District	31	44
Galle District	31	55
Hambantota District	19	24
Jaffna District	13	13
Kalutara District	40	81
Kandy District	65	165
Kegalle District	31	48
Kurunegala District	18	20
Mannar District	3	3
Matale District	40	70
Matara District	29	44
Nuwara Eliya District	72	186
Polonnaruwa District	3	3
Puttalam District	8	8
Ratnapura District	51	121
Trincomalee District	7	7
Vavuniya District	1	1
Moist Low Country	12	15
Unlocated Species	13	14

#### Part IV—Local Names of Plants found in Ceylon with Miss S. Alagiah and Mrs. S. C. Weerasekera

The available local names (Sinhala, Tamil etc.) have been collected into one list with their botanical names.

#### EXTRACTIVES OF *CALOPHYLLUM CALABA* L. (GURU KINA—S), GUTTIFERAE

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(Department of Chemistry, University of Ceylon, Peradeniya)

Extractives of the bark and timber of *calophyllum calaba* L have been obtained with light petroleum (40–60°C) and chloroform. From the light petroleum extract of the bark taraxerol, taraxerone and  $\beta$ -sitosterol have been characterised. In addition a Xanthone and another triterpenoid compound have been isolated in a pure state.

From the light petroleum extract of the timber guanandin and  $\beta$ -sitosterol-stigmasterol mixture were isolated. The chloroform extract of the timber gave jacareubin, euxanthone, 6-desoxyjacareubin, scriblitofolic acid, buchanaxanthone and 1, 5, 6-trihydroxyxanthone. The

structures of the above have been established by means of u.v., i.r. and n.m.r. data. In addition the chloroform extract of the timber has provided three other xanthenes whose structures are being investigated.

#### EXTRACTIVES OF *ARGYREIA POPULIFOLIA* CHOISY (GIRITILLA—S) CONVULVULACEAE

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Extractives have been obtained from the fruits and root stalks and stem of *Argyrea populifolia* Choisy with light petroleum (60-80°C) chloroform and rectified spirit.

The sodium hydroxide soluble fraction of the light petroleum extract of the fruits gave:

ASP—N<sub>1</sub> emp. formula: C<sub>17</sub>H<sub>28</sub>O<sub>2</sub> m.p. 99-100°C

From the sodium hydroxide insoluble fraction of the light petroleum extract:

ASP—N<sub>1</sub> emp. formula C<sub>21</sub>H<sub>40</sub>O m.p. 72-73°C

ASP—N<sub>2</sub> (terpenoid) m.p. 240°C

ASP—N<sub>3</sub> (terpenoid) m.p. 255-60°C

crystallised out. The remaining oil showed the following properties: n<sub>D</sub><sup>26</sup> 1.4705; Acid number: 27.4; Saponification value: 186.6; Iodine number: 68.6

After saponification of the above oil, small amounts of ASP—N<sub>1</sub>, N<sub>2</sub>, and N<sub>3</sub> were again obtained and in addition ASP—N<sub>4</sub> m.p. 80-81°C,  $\beta$ -sitosterol m.p. 137°C and a mixture of carotenoid compounds were obtained.

The hot petroleum ether soluble fraction from the chloroform extract of the fruits gave all the above compounds and a mixture of iridone type of compounds. The available physical data (m.s., n.m.r., i.r. and u.v.) of the above compounds will be discussed. In addition another compound ASC—1, m.p. 210-15°C yellow needle shaped crystals was obtained.

From the light petroleum extract of the root stalks and stem, a colourless solid mixture was obtained. The following compounds were isolated by chromatography on neutral alumina.

ARP—N<sub>1</sub> emp. formula C<sub>22</sub>H<sub>40</sub>O m.p. 85-86°C

ARP—N<sub>2</sub> 82-83°C

and  $\beta$ -sitosterol m.p. 137°C

The physical data on the above compounds will be discussed.

From the chloroform extract of the root stalk and stem ARP—N<sub>1</sub>, ARP—N<sub>2</sub>,  $\beta$ -sitosterol and ASP—N<sub>1</sub> (obained from the fruit) were isolated.

#### EXTRACTIVES OF *WORMIA TRIQUETRA* ROTTB. (DIYAPARA—S) DILLENIACEAE

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(Department of Chemistry, University of Ceylon, Peradeniya)

Extractives have been obtained from the bark, timber and flowers. Light petroleum ether extract of the bark, timber and flowers has given a compound m.p. 265-268°C. Its structure is discussed on the basis of m.s., n.m.r., i.r. and u.v. data. Another compound m.p. 59°C has also been obtained in pure form from the timber.

$\beta$ -sitosterol mixed with stigmasterol has been isolated from bark, timber, flowers and sepals.

An alcohol m.p. 82°C has been isolated from the sepals. Its structure is discussed from m.s., n.m.r., i.r. and u.v. data.

A terpenoid compound m.p. 124°C has been isolated from the sepals. Its m.s., i.r., and u.v. are discussed.

#### EXTRACTIVES OF *ARTOCARPUS NOBILIS* THW. (DEL, BEDIDEL—S) MORACEAE

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(Department of Chemistry, University of Ceylon, Peradeniya)

Extractives of the timber have been obtained with light petroleum (60-80°C), benzene and chloroform and rectified spirit. From the light petroleum and benzene extracts artocarpin m.p. 174°C isoartocarpin 265-268°C (dee) and another yellow crystalline compound m.p. 255°C have been isolated. The n.m.r., i.r. and u.v. of the above are discussed.

From the chloroform extract a brown solid has been obtained in a pure state.

It has been shown that cyanomaclurin, which is responsible for the characteristic dark blue colour with hot dilute sodium hydroxide solution of jak wood (*Artocarpus heterophyllus* Lam.) is absent in the timber of *Artocarpus nobilis* Thw. from four different areas of Ceylon. This is therefore a convenient method to distinguish these two timbers.

#### EXTRACTIVES OF *MESUA THAWAITESII* PLANCH AND *TRIANA*, (DIYA NA—S) GUTTIFERAE

S. SELLIAH AND M. U. S. SULTANBAWA

(Department of Chemistry, University of Ceylon, Peradeniya)

Extractives have been obtained from the bark and timber of *Mesua thwaitesii* Planch and *Triana* with light petroleum (60-80°C), benzene and methanol.

From the cold light petroleum extract of the timber  $\beta$ -sitosterol has been isolated.

The benzene extract of the timber has yielded euxanthone, 1, 5-dihydroxy xanthone two other xanthenes.

The structures of these compounds are discussed.

#### ALKALOIDS OF *HOLARRHENA MITIS*

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*Holarrhena mitis* R. Br. (Sinh. Kiriwalla) of the Apocynaceae family is an endemic plant of Ceylon. The bark juice is used as a remedy for dysentery. Chemical investigation of the bark has shown the presence of conessine and N-demethylated conessines (Bhavanandan and Wannigama, 1960). In view of the importance of *Holarrhena* alkaloids in the production of steroid hormones (Goutarel, 1964), we have pursued our study of the alkaloids of *Holarrhena mitis*.

The method of extraction of the total alkaloids has been improved. Conkurchine has been isolated as a salicylal derivative.

The total alkaloids were N-methylated with formaldehyde-formic acid, conessine removed as the hydrogen oxalate and the remaining bases treated with hot petroleum ether. The residue was adsorbed on alumina and eluted successively with solvents of increasing polarity. Tetramethyl

Holarrhimine was obtained on eluting with benzene-chloroform mixtures. A large part of the bases could only be eluted with chloroform and chloroform-methanol. This fraction is believed to contain kurcholossine or other alkaloids with two or more oxygen atoms per molecule.

#### References

- Bhavanandan, V. P. and Wannigama, G. P. (1960). Isolation of conessine from *Holarrhena mitis* R. Br. *J. Chem. Soc.*, 2368-2369.  
Goutarel, R. (1964). Les alkaloides des Apocynacées, intermédiaires en synthèse stéroïdique. *Bull. Soc. chim. France*, 1665-1672.

#### ISOLATION OF MANGIFERIN FROM *MANGIFERA ZEYLANICA*

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AND G. P. WANNIGAMA

(Department of Chemistry, University of Ceylon, Peradeniya)

*Mangifera zeylanica* Hook, f. (Sinh. Etamba, Wal-amba) of the Anacardiaceae family is endemic to Ceylon. The bark of this plant is used in the treatment of diarrhoea. From this bark, we have isolated a xanthone identical with magniferin isolated from *Mangifera indica*, and other plant species from Switzerland, Japan and Madagascar. The identity of our xanthone with magniferin has been established by chemical, physical and analytical studies on the xanthone as well as its hepta-acetate.

Our results are in agreement with the 2- $\beta$ -D-glucopyranosyl-1, 3, 6, 7-tetrahydroxyxanthone structure for mangiferin (Bhatia, Ramanathan and Seshadri, 1967).

#### Reference

- Bhatia, V. K., Ramanathan, J. D. and Seshadri, T. R. (1967). Constitution of Mangiferin. *Tetrahedron*, 23, 1363-1368.

#### HEMICELLULOSE IN COCONUT KERNEL

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Preliminary studies do show that hemicellulose is present in the kernel. The hemicellulose could be extracted with alkali and precipitated with alcohol (Colowick and Kaplan, 1957). The hemicellulose so obtained was fairly resistant to acid hydrolysis. Procedure adopted to hydrolyse the material was as follows:

It was dissolved in 72% sulphuric acid at room temperature. The solution was then diluted to 1%  $\text{H}_2\text{SO}_4$  and refluxed for 12 hrs. The  $\text{H}_2\text{SO}_4$  was neutralised with barium carbonate. The barium sulphate was centrifuged off and the supernatant was concentrated in a rotary vacuum evaporator (Peach and Tracy, 1955).

Hydrolysis of hemicellulose fraction yielded besides reducing sugars, small amounts of amino acids and probably derivatives of lignin. The reducing sugars were separated by paper chromatography and the spots suggest mannose and small amounts of galactose. Small amounts of another reducing sugar with a high  $R_f$  value was also obtained (Smith, 1958).

From these results, it may be concluded that the hemicellulose of coconut kernel may be a galactomannan.

#### References

- Colowick, S. P. and Kaplan, N. O. (1957). *Methods in enzymology*, Vol. III. New York: Academic press, Inc.
- Paeck, K. and Tracey, M. V. (1955). *Modern methods of plant analysis*. Berlin: Springer-Verlag.
- Smith, I. (1958). *Chromatographic techniques* London: William Heinmann Medical Books Ltd.

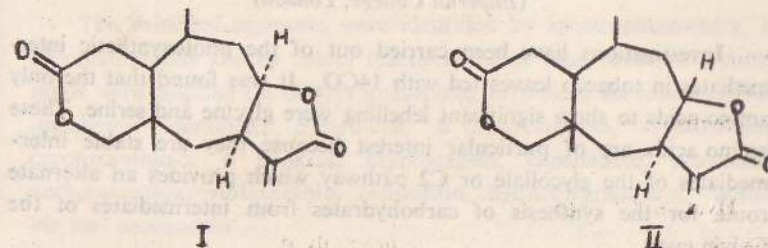
#### PSILOTROPIN, A NEW SESQUITERPENE DILACTONE FROM *PSILOSTROPHE COOPERI*

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In further study of Compositae of the tribe Helenieae, the common South-Western desert shrub *Psilotropin cooperi* (Gray) Greene has been examined for the presence of constituents of the sesquiterpenoid lactone class. A compound psilotropin (I) isolated from the plant and found by TLC examination of total extract to be the principal constituent of this class of compounds present, has been found to be a dilactone, stereoisometric with vermeerin (II) a constituent of *Geigeria aspera* Harve, a member of the tribe Inulae. Psilotropin I differs from vermeerin (II)

in the stereochemistry of the R-lactone ring. The stereochemistry of the S-lactone fusion is ambiguous and that of the C-10 methyl group has not been established.

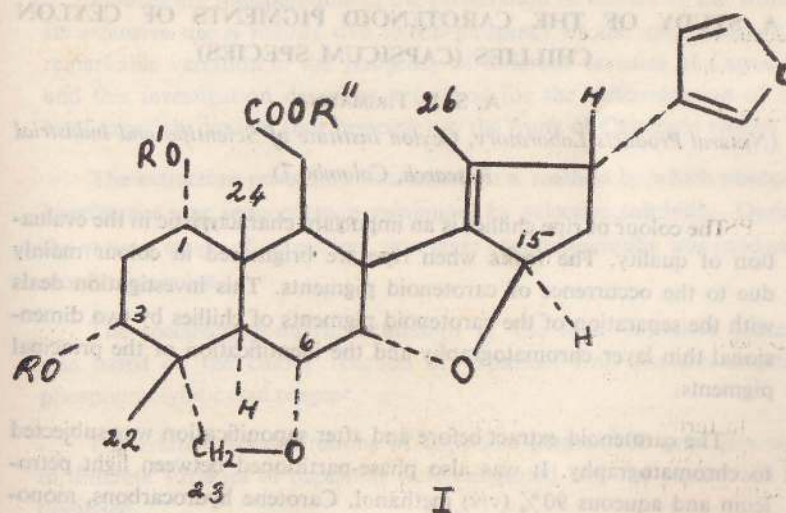


#### THE BITTER PRINCIPLE OF *MELIA DUBIA* CAV.

L. B. DE SILVA, W. STOCKLIN AND T. A. GEISSMAN

(Department of Chemistry, University of California, Los Angeles 90024 and Medical Research Institute, Colombo 8)

The family Maliaceae has received intensive study in recent years and has yielded a large number of compounds of the general class described by the term "limonoid". We have now examined the fruits of *Melia dubia* Cav. (Sinh. Lumumidell.) a common tree of the wet forests of Ceylon and found it to contain Salannin (I) as the principal limonoid constituent.



1.  $R = \text{CH}_3\text{CO}$ ;  $R^1 = \text{C}_4\text{H}_7\text{CO}$ ;  $R^{11} = \text{CH}_3$

## IN VIVO STUDIES OF PHOTOSYNTHETIC INTERMEDIATES

G. R. ROBERTS\*, A. J. KEYS AND C. P. WHITTINGHAM

(Imperial College, London)

Investigations have been carried out of the photosynthetic intermediates in tobacco leaves fed with  $^{14}\text{CO}_2$ . It was found that the only amino-acids to show significant labelling were glycine and serine. These amino acids are of particular interest because they are stable intermediates of the glycolate or C2 pathway which provides an alternate route for the synthesis of carbohydrates from intermediates of the Calvin cycle.

The intracellular distribution of amino-acids and other photosynthetic intermediates was also studied. It was found that glycine and serine moved out of the chloroplast very rapidly when compared to the phosphate esters, suggesting that intermediates of the glycolate pathway may play an important part in the transport of photosynthetically fixed carbon out of the chloroplast. The further metabolism of these amino-acids in the cytoplasm will be discussed.

\*Present Address—Tea Research Institute, Low Country Station, St. Joachim, Ratnapura.

## A STUDY OF THE CAROTENOID PIGMENTS OF CEYLON CHILLIES (CAPSICUM SPECIES)

A. S. L. TIRIMANNA

(Natural Products Laboratory, Ceylon Institute of Scientific and Industrial Research, Colombo 7)

The colour of ripe chillies is an important characteristic in the evaluation of quality. The fruits when ripe are bright red in colour mainly due to the occurrence of carotenoid pigments. This investigation deals with the separation of the carotenoid pigments of chillies by two dimensional thin layer chromatography and the identification of the principal pigments.

The carotenoid extract before and after saponification was subjected to chromatography. It was also phase-partitioned between light petroleum and aqueous 90% (v/v) methanol. Carotene hydrocarbons, mono-hydroxy xanthophylls, mono- and di-epoxides of carotene hydrocarbons,

and mono and di-epoxides of monohydroxy xanthophylls were found in the epiphasic layer, while di and poly-hydroxy xanthophylls and their epoxy derivatives were found in the hypophasic layer.

The principal pigments were identified by spectrophotometry, chromatography and by colour reactions. More than twenty five carotenoids were detected on the chromatoplate, of which, the following were tentatively identified:  $\beta$ -carotene, h. droxycarotene, cryptoxanthin, cryptoxanthin-5, 6 epoxide, cryptocapsin, capsolutein, zeaxanthin, antheraxanthin, violaxanthin, capsanthin, hydroxycapsanthin, capsorubin and neoxanthin.

The results of a comparative study of the carotenoid pattern in two cultivated varieties and in four packeted commercial brands will be discussed.

## QUANTITATIVE ESTIMATION OF TOTAL CAPSAICIN (HOT PRINCIPLE) IN CEYLON CHILLIES (CAPSICUM SPECIES)

A. S. L. TIRIMANNA

(Natural Products Laboratory, Ceylon Institute of Scientific and Industrial Research, Colombo 7)

Chillies are indispensable in the preparation of curries in the tropics. Its extensive use is mainly due to the pungency of the fruit. There is a remarkable variation in the pungency of different varieties of Capsicum and this investigation describes a method for the determination of the total capsaicin content (hot principle) in the fruits of Capsicum species.

The extraction procedure was based on a method by which phenolic interference was reduced to a minimum by selective solubility. During the various stages of extraction, thin layer chromatography was used as a monitoring index.

The spectrophotometric estimation of the total capsaicin content was based on the colour reaction of capsaicin with phosphotungstic-phosphomolybdic acid reagent.

The relative concentrations of capsaicin (mgms./100 gms. dry wt.) in different varieties of capsicum were calculated and the results will be discussed.

## STUDIES ON THE SELENIUM ANALOGUE OF DITHIZONE: 'SELANAZONE' AND ITS METAL COMPLEXES

R. S. RAMAKRISHNA

(Department of Chemistry, University of Ceylon, Colombo)

AND

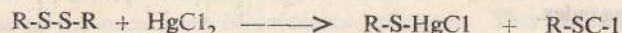
H. M. N. H. IRVING

(Department of Inorganic and Structural Chemistry, University of Leeds)

The synthesis of the selenium analogue of the important trace metal reagent dithizone (3-mercapto-1, 5-diphenylformazan) was undertaken in view of the particular interest attaching to the change of the Group VI donor atom on its physical and chemical properties and in the hope of obtaining a more selective analytical reagent. The new reagent 'Selanazone', is shown to exist as tautomeric forms analogous to the 'thiol-thione' forms of dithizone(1) and is readily oxidised to a 'diselenide' [Di(1, 5-diphenylformazyl) diselenide] from which the parent selanazone is recoverable by reduction with alkaline dextrose, sulphurous acid or hypophosphorous acid.

Selanazone also forms a range of brilliantly coloured metallic complexes which are soluble in organic solvents. It thus permits of the solvent extraction of the ions  $\text{Ag}^+$ ,  $\text{Mn}^{2+}$ ,  $\text{Fe}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{Hg}^{2+}$ ,  $\text{Pb}^{2+}$ ,  $\text{Tl}^+$  and  $\text{Bi}^{3+}$  from aqueous solution, the percentage extraction being governed by the prevailing pH.

The diselenide also forms extractable coloured complexes and it is a more selective reagent than selanazone or dithizone for the behaviour appears to be limited to  $\text{Ag}^+$ ,  $\text{Hg}^{2+}$ ,  $\text{Ni}^{2+}$  and  $\text{Pd}^{2+}$ . The stoichiometry of the complexes as determined by extractive titration suggests a mechanism for complex formation superficially resembling the known reactions of many disulphides(2) viz.



The electronic spectra of selanazone and the diselenide in a variety of organic solvents are presented and discussed in comparison with similar spectra for dithizone itself. The infrared spectra of the seleno compounds have been obtained in KBr discs and discussed in comparison with those of the corresponding oxygen and sulphur compounds. This study has confirmed an assignment for the  $\text{>C}=\text{S}$  stretching vibration in nitrogen containing this compounds to be around  $700\text{ cm}^{-1}$ .

## References

- H. M. N. H. Irving, unpublished studies.  
L. F. Lindoy, (1969). *Coordination Chemistry Reviews*, **4**, p. 41.

## STUDIES ON THE COMPOSITION AND STABILITY OF THE THALLIUM(I) COMPLEX OF THIOSALICYLIC ACID

R. S. RAMAKRISHNA AND M. E. FERNANDOPULLE

(Department of Chemistry, University of Ceylon, Colombo 3)

The precise nature of the complex formed between thallium(I) and thiosalicylic acid in aqueous media has been investigated potentiometrically and conductometrically. Thallium(I) is shown to form a 1:1 colourless complex. The stability constant ( $\log K$ ) of the complex has been computed using Calvin and Melchior's extension of Bjerrum's method.

The solid thallium(I)—thiosalicylic acid complex was formed in alkaline media in the presence of excess thallos ions. Analysis of the solid complex indicates that the stoichiometry is retained in the crystal-line state. The infrared spectrum of the solid complex has been obtained.

## References

- M. Calvin and N. C. Melchior, (1948). *J.A.C.S.*, **70**, 3270.  
J. Bjerrum, Metal Ammine Formation in Aqueous Solution. (1941).  
P. Hasse, Copenhagen.

## SPECTROPHOTOMETRIC AND ELECTROMETRIC STUDIES ON THE VANADYL COMPLEX OF THIOSALICYLIC ACID

R. S. RAMAKRISHNA, M. E. FERNANDOPULLE AND B. NALLIAH

(Department of Chemistry, University of Ceylon, Colombo)

The bright green coloured complex formed by interaction of Vanadyl ions and thiosalicylic acid in aqueous ethanol has been investigated by spectrophotometric, potentiometric and conductometric measurements. The complex shows a maximum absorbance at 620 nm, at an optimum pH range of 4.8-5.6. The method of continuous variation was used to show spectrophotometrically that this complex has a metal ligand ratio of 1:2. Potentiometric and conductometric studies of the complex confirmed its stoichiometry as obtained spectrophotometrically.

The stability constant of this complex has been determined using conventional methods of analysis of the potentiometric measurements.

# THE IDENTIFICATION AND QUANTITATIVE DETERMINATION OF SOME TRACE ELEMENTS PRESENT IN CEYLON BEACH SANDS

J. P. R. FONSEKA

(Geological Survey Department, Colombo 2)

The economic minerals which are exploited at present from Ceylon beach sands are ilmenite, rutile, zircon and monazite. Other minerals like baddelyite Sillimanite and thorianite are also present in smaller quantities. Recent studies undertaken by the Geological Survey Department, have revealed the presence in trace amounts, minerals containing hafnium, chromium, vanadium, niobium, tantalum, uranium, tin and lead.

The identification and quantitative determination of these trace elements present in Ceylon beach sands are discussed.

## EXPERIMENTAL CONFIRMATION OF STERIC HINDRANCE PREVENTING THE ATTAINMENT OF COPLANARITY OF THE NITRO-GROUP WITH THE AROMATIC NUCLEUS

N. B. CHAPMAN\* S. SOTHEESWARAN† AND K. J. TOYNE\*

(\*Department of Chemistry, University of Hull, England and †Department of Chemistry, University of Ceylon, Peradeniya)

In the course of other investigations with the 1, 4-disubstituted bicyclo (2, 2, 2) octanes (Chapman, Sotheeswaran and Toyne, 1965 and 1967), we synthesised the 1-(*orthometa*-, and *para*-nitrophenyl) bicyclo (2, 2, 2) octanes. The ultraviolet absorption spectra of these compounds and those of *ortho*-, *meta*-, and *para*-*t*-butylintrobenzenes were measured under the same conditions as those employed by Brown and Reagan (Brown and Reagan, 1947).

The absorption spectra of these compounds form a set of closely parallel curves. The *para*- and *meta*-nitro compounds form a discrete set. However the absorption curves for the *ortho*- compounds were significantly different. The paper discusses and compares the absorption characteristics of these compounds and also explains the significant difference observed in the ultraviolet absorption spectra of the *ortho*-nitro compounds.

## References

- Chapman, N. B., Sotheeswaran, S., and Toyne, K. J. (1965). Oxidative bisdecarboxylation of  $\alpha\beta$ -dicarboxylic acids. *Chem. Commun.*, No. 11, 214.
- Chapman, N. B., Sotheeswaran, S., and Toyne, K. J. (1967). To be published.
- Brown, W. G., and Reagan, H. (1947). Steric effects in the ultraviolet absorption spectra of aromatic nitro compounds. *J. Amer. Chem. Soc.*, **69**, 1032.

## SECTION F: SOCIAL SCIENCES

(Room No. 19)

### Friday, 19th December:

- 9.00 .. Symposium on "Planning Techniques". (Biology Theatre).
- 2.00 .. Symposium: "Problems and Prospects of Tropical Farming" Session IV: Socio-Economic Factors.

### Saturday, 20th December:

- 9.00 .. Problems and Prospects with respect to the International Monetary System. Their implications for Primary Producer Countries—C. A. B. N. Jayarajah.
- 10.15 .. Current Problem of Unemployment among Arts Graduates—K. Kularatnam.
- 2.10 .. Urbanization of the Dry Zone (excluding the Jaffna Peninsula). Some observations—B. L. Panditharatna (Jointly with Section D).
- 5.30 .. Symposium on "Population Problems in Ceylon" (Arts Theatre).

### Sunday, 21st December:

- 9.00 .. Commercial Banking in Ceylon. Past and Present—Nalini Jayapalan.
- 10.15 .. B. J. P. Alles.

### Monday, 22nd December:

- ✓ 9.00 .. Intermediate Technology and Development Planning in Ceylon—D. L. O. Mendis (Jointly with Section C).
- ✓ 10.30 .. "Which" in Administration—H. E. Peries.
- 11.30 .. Presidential Address: "National Economic Sovereignty and the World Bank"—L. R. Jayawardena (Physics Theatre).
- 12.30 .. Business Meeting.

## ABSTRACTS

### PROBLEMS AND PROSPECTS WITH RESPECT TO THE INTERNATIONAL MONETARY SYSTEM: THEIR IMPLICATIONS FOR PRIMARY PRODUCER COUNTRIES

C. A. B. N. JAYARAJAH

(Department of Economic Research, Central Bank of Ceylon)

The international monetary system, as it has developed in the years succeeding World War II, reflects three major problems. First, shifts in confidence between major international currencies has resulted in pressures on exchange rates, inviting retaliatory economic policy measures that are inimical to the expansion of international trade and payments. Second, the volume of gold and convertible foreign exchange available for financing international trade and payments has lagged behind optimum needs. Third, the mechanism by which deficits and surpluses on international trade and payments are reconciled, has not worked smoothly. The international monetary system has, therefore, moved from crisis to crisis, particularly over the last ten years.

An examination is made of the factors influencing international monetary problems today and their implications, with special reference to the less developed countries, the bulk of whom are primary producers.

The palliatives and long-term solutions that have been discussed in recent years are examined and an attempt is made to develop an optimal pattern of solutions that would be relevant to the international monetary problems of less developed countries, particularly primary producers.

### CURRENT PROBLEM OF UNEMPLOYMENT AMONG ARTS GRADUATES

K. KULARATNAM

(University of Ceylon, Colombo)

This Paper examines the present position and future trends of this problem, bearing in mind the question of the Arts Graduate principally as a resource to be utilised for the development of the economy of the country; the various feasible avenues of such utilisation are thereafter analysed and some recommendations made for their implementation in the light of the investments and results involved.

## COMMERCIAL BANKING IN CEYLON— PAST AND PRESENT

NALINI JAYAPALAN

The Ceylon Banking Commission Report provides a very interesting and future account of banking in the '30'. The changes in the structure of the Banking System and Development in banking policy since then, will be examined and discussed.

### "WHICH" IN ADMINISTRATION

H. E. PERIES

The paper starts with the observation that the most important, common characteristic of the "developing" countries is their comparatively short population doubling period—25 years or under to the 70 years or over of the prosperous developed countries. This, itself, is the result of having high death rates for several centuries, so that only groups which gave high priority to the production and care of the young, survived. It has been deeply entrenched in the behaviour patterns of these societies by natural selection, and only the most determined efforts can change this pattern in the short time available.

The rapid increase in population densities requires changes in the kind of technology needed to support and employ the population and, consequently, in the selection and training of the cadre for initiating and operating these. It is not, merely, a question of capital formation. In all our countries, governments have not conveyed these stark facts adequately to the population and have tried to obviate some of the consequences by administrative action.

A number of case studies are described and it is sought to elucidate the dangers inherent in this and to define the real costs, that is the losses and damage to the society as well as the cost of staff, office buildings etc. which may form only an insignificant part of the cost, so defined.

It points out the need for some method of concentrating on these measures which will give the best returns—that is some method of optimization as in operations research while seeking to secure the essential prerequisite for successful progress—a reduction of the birth rate to match the fall in the death rate.

