

## ABSTRACTS

(Papers read before the Institute but not published in the Proceedings.)

**ON THE ECOLOGIC SIGNIFICANCE OF FROZEN GROUND.** D. A. LIVINGSTONE. (Read November 8th, 1954.) During field work on the Arctic Coastal Plain of Alaska observations were made on the role of ground frost in the lives of the plants and animals, including man. This region has a thick unconsolidated mantle of Pleistocene sediment, and the interactions of plants, animals and the inorganic substrate produce a tangle of circular causality which often defies analysis. A few of the simpler phenomena, such as the vegetation-polygonal ground-thaw lake system, are illustrated by color slides and explained as far as possible in simple physical terms.

**THE INFLUENCE OF pH UPON THE TOXICITY OF FLUOROACETIC ACID.** K. R. ROZEE AND J. G. ALDOUS. (Read November 8th, 1954.) When a resting suspension of yeast cells is exposed to a given concentration of fluoroacetic acid the resulting inhibition of oxygen consumption depends upon the pH of the medium. This relationship is observed over a range in pH which marks the limits of the dissociation of fluoroacetic acid (pH 2.0-4.0). Thus the inhibitory action appears to be directly related to the concentration of undissociated fluoroacetic acid in the cell's environment.

This inhibition of cellular function is also characterized by being reversible, the degree of reversibility being dependent upon the pH of the fluid with which the cells are washed. As long as the pH of the washing fluid is more alkaline than that in which the cells were originally exposed to the fluoroacetic acid there will be some recovery of cellular function. Complete recovery is always obtained if the pH of the washing fluid is greater than 5.0.

These results suggest that the inhibition of oxygen consumption is due to an interaction between the cell and the molecular species of the poison. The union so formed may be broken by merely causing these molecules to dissociate.

**THE PLASMA PROTEINS OF THE DOG IN VITAMIN B<sub>6</sub> DEFICIENCY.** W. W. HAWKINS AND E. GORDON YOUNG. (Read December 13th, 1954.) Young dogs which were deprived of vitamin B<sub>6</sub> developed anaemia. Others on the same regimen with desoxypyridoxin added developed marked lymphocytopenia. Electrophoresis indicated no changes in the level or distribution of the plasma proteins.

These results add to the existing evidence that in vitamin B<sub>6</sub> insufficiency protein synthesis in general is not impaired, and that the effect upon the haemoglobin is a specific one. They also suggest that a possible relationship between lymphocytes and plasma globulins is not quantitatively important.

**THE ACTION OF HOMOLOGOUS SERIES OF ALIPHATIC COMPOUNDS ON THE INTRACELLULAR CATALASE OF YEAST.** J. GORDIN KAPLAN. (Read December 13th, 1954.) At a previous meeting of this Institute, the hypothesis was advanced that the enzyme catalase existed within the living cell adsorbed at an interface of unknown nature: enzyme alteration consisted in the desorption of the enzyme into its soluble, highly specific state, causing the great increase in activity, first noted by von Euler. This hypothesis led to the prediction that the ability of surface-active agents to cause enzyme alteration should be correlated with their ability

to reduce the energy at some model interface, such as the air/water. The prediction was confronted with the expert witness of experiment by comparing the biological (altering) and surface activities of straight chain alcohols, aldehydes and ketones. It was found that, within or among these homologous series, concentrations which were equiactive with respect to yeast catalase, were equicapillary with respect to our model interface. The prediction has thus been confirmed, and these results are taken as evidence in favour of the interfacial hypothesis.

DESIGN FOR A SHEAR DEFORMATOR. S. J. MAZUR. (Read December 13th, 1954.)

EQUIVALENT ELECTRIC CIRCUITS FOR ELECTROMAGNETIC MACHINES GORDON R. SLEMON. (Read January 10th, 1955.) Design and operation problems in several fields of engineering such as power transmission, vibration analysis and acoustical systems have for many years been studied with the aid of model electric networks generally called network analysers. Application of such analysers in the design of transformers and rotating machines has however been hampered by the lack of a general method by which adequate equivalent electric networks could be developed for magnetic systems.

The approach described in this paper is based on the mathematical concepts of matrices and also includes within its development the intrinsically nonlinear nature of the iron used in electromagnetic apparatus. In essence, the method consists of first reducing the magnetic field of the machine to a circuit of lumped magnetic elements. All simplifying assumptions are introduced at this stage. This magnetic circuit may be represented by a set of mesh-flux equations. By a simple group of matrix operations it is shown that the electric circuit which is equivalent to the magnetic circuit is described by a similar set of nodal-voltage equations.

The form of the equivalent electric circuit is therefore the dual of that of the magnetic circuit and may usually be found without mathematics by topological methods. The inductances in the electric circuit are related to their corresponding reluctances in the magnetic circuit by

$$[L] = N^2/[S]$$

where  $[L]$  are the inductances,  $[S]$  are the magnetic reluctances and  $N$  is the number of turns in the electric to magnetic circuit linkage. This direct correspondence of elements allows all non-linear effects to be preserved and studied in the electric circuit form. At the expense of added complexity the circuit can be made as accurate as the situation requires by appropriate subdivision of the magnetic field into magnetic circuit elements.

The method may be applied to rotating as well as stationary magnetic systems by the use of certain ideal transformers with unequal voltage and current ratios. Examples described include polyphase synchronous, induction and commutator machines and several types of single-phase motor.

THE METABOLISM OF 2, 2'-DIHYDROXYDIETHYL SULPHIDE AND OF 2, 2'-DICHLORODIETHYL SULPHIDE IN THE RAT. J. A. McCARTER. (Read January 10th, 1955.) The parenteral administration of 2, 2'-dihydroxydiethyl sulphide to the rat was followed by the excretion in the urine of

labelled derivatives of the substance. Hydroxyethylthioglycolic acid and thiodiglycolic acid were identified among these derivatives and accounted for nearly all of the labelled sulphur of the urine.

The application of 2, 2'-dichlorodiethyl sulphide to the skin of the back of the rat was also followed by the excretion in the urine of labelled derivatives of the substance. Hydroxyethylthioglycolic acid was the only substance identified and it accounted for only a small part of the labelled sulphur of the urine.

With the exception of hydroxyethylthioglycolic acid it is unlikely that the excreted substances derived from 2, 2'-dichlorodiethyl sulphide are produced by a pathway involving 2, 2'-dihydroxydiethyl sulphide.

**ENZYMIC IDENTIFICATION OF AGAR AND CARRAGEENIN IN MARINE ALGAE.** W. YAPHE AND BEVERLEY BAXTER. (Read January 10th, 1955.) The Algal polysaccharides agar and carrageenin were hydrolysed by specific enzymes isolated from marine bacteria. The enzymes were used to identify the polysaccharides extracted from a number of red algae. Agar was demonstrated in *Gelidium cartilagineum* (Difco agar), *Pterocladia* sp. (Davis, New Zealand agar), *Gracilaria confervoides*, *Ahnfeldtia plicata*, *Agardhiella tenera*. Carrageenin was present in *Chondrus crispus*, *Furcellaria fastigiata*, *Gigartina acicularis*, *Iridophycus* and *Hypnea musciformis*.

**THE STARK EFFECT IN SILVER.** C. L. PIGGOTT. (Read February 14th, 1955.) The stark effect for the  $5^2D_J$  levels of silver, along with the neighboring  $4^2F$  and  $7^2P$  terms, has been investigated experimentally and the complete line patterns observed. The theoretical displacements of the levels have been calculated using hydrogenic matrix components of the dipole moment and are in excellent agreement with the experimental results. Theoretical intensities as calculated are also in good qualitative agreement with experiment.

**A POLLEN CHRONOLOGY FOR THE CENTRAL BROOKS RANGE, ALASKA.** D. A. LIVINGSTONE. (Read February 14th, 1955.) A three-zone pollen chronology has been established for an area in northern Alaska. This is the first such chronology for the mainland of arctic America, and it indicates that the vegetational changes of the arctic equivalent of post-Mankato time have been much less severe than those of temperate latitudes. An attempt is made to correlate the pollen chronology with the provisional drift stratigraphy for Alaska.

**VARIATION OF VISCOSITY WITH RATE OF SHEAR FOR A POLYELECTROLYTE OF HIGH MOLECULAR WEIGHT.** C. R. MASSON AND D. A. I. GORING. (Read February 14th, 1955.) The viscosity of aqueous solutions of high molecular weight carrageenin was markedly shear-dependent. The shear-dependence increased with decrease in the concentration of added electrolytes. Because of curvature, extrapolation of  $[\eta]$  to zero rate of shear was not possible. The Huggin's interaction coefficient,  $k'$ , increased with decrease in rate of shear;  $k'$  also increased with increase in concentration of added electrolyte. In water, maxima of  $\eta_{sp}/c$  were observed at concentrations of carrageenin equivalent to the ionic impurities in the distilled water used. At higher concentrations the data fitted the Fuoss equation at rates of shear of 200 and 100  $\text{sec}^{-1}$  but not below 100  $\text{sec}^{-1}$ . The constants A and D both increased with decrease in rate of shear.

**FLOWER DEVELOPMENT ON THE LOWBUSH BLUEBERRY.** HUGH P. BELL AND JANE BURCHELL. (Read March 14th, 1955.) In the lowbush blueberry floret primordia appear during June. Floral parts appear in acropetal succession during July. Ontogenetically the carpels are at first appendicular and later receptacular. The epigynous floret, in miniature, is formed by the first of August. During this month some reproductive tissue is differentiated in both ovary and stamens. The characteristic resting stage is assumed during the autumn. Mitosis was observed in material collected during January and by late winter a number of ovules had two adjacent archesporial cells, the outer one later becoming functional. Definite differentiation starts during March. Active growth, including the initiation of meiosis becomes general during April. Meiosis is completed in the anthers during the first week of May and about a week later in the ovules. Subsequent development in the ovule is the Polygonum type. The flower is mature by the last week in May.

**VAPOR-LIQUID CHROMATOGRAPHY OF CARBONYL COMPOUNDS.** W. D. JAMIESON. (Read March 14th, 1955). A method is described by which it is possible to effect qualitative and quantitative analyses of multi-component mixtures of aldehydes and ketones. With slight modifications, the technique is generally applicable to the semi-micro separation and estimation of components of mixtures of either polar or non-polar organic compounds. Simple apparatus is used and an analysis requires about 0.050 ml. total sample, which is continuously partitioned between a flowing carrier gas phase and a stationary liquid phase as it is eluted along a packed and thermostatted column. The efficiency of separation is determined largely by differences in partition coefficients. Methyl-n-propyl ketone, present to the extent of about one or two per cent in samples of di-n-propyl ketone, has been estimated routinely with a relative precision of  $\pm 5\%$ .

**FRACTIONATION OF COD MUSCLE ALBUMINS BY PRECIPITATION WITH ZINC ION. I. ADENOSINETRIPHOSPHATE-CREATINE TRANSPHOSPHORYLASE.** J. R. DINGLE AND J. M. NEELIN. (Read March 14th, 1955.— A flexible technique of selective precipitation with zinc acetate was adapted for the enrichment of the enzyme, adenosinetriphosphate-creatine transphosphorylase, as demonstrated in cod muscle albumins. Further purification of the enriched enzyme by removal of non-protein contaminants led to decrease in activity which was not reversed nor prevented by several modifications of the technique.

**3, 6-ANHYDRO-D-GALACTOSE AS A CONSTITUENT OF CARRAGEENIN.** ALBERT N. O'NEILL. (Read March 14th, 1955.— The K fraction of carrageenin was subjected to mercaptolysis by dissolving it at 0° in concentrated hydrochloric acid and by stirring the solution with addition of ethyl mercaptan for ninety-six hours. The solution was neutralized, deionized and concentrated, whereupon crystalline D-galactose diethylmercaptal was obtained. It was characterized by conversion to D-galactose and oxidation to mucic acid. Additional amounts were obtained by successively concentrating the solution until it was essentially free of D-galactose diethylmercaptal. Continuous extraction of the residual solution with ether yielded 3,6-anhydro-D-galactose diethylmercaptal, m. p. 112-113°,  $[\alpha]_D^{25}$  -10° (c 1.0, water). This was characteriz-

ed by conversion to 3,6-anhydro-D-galactosephenylosazone and to 2,4,5-tri O-p-nitrobenzoyl-3,6-anhydro-D-galactose dimethylacetal. Further confirmation was obtained by comparison with an authentic specimen of 3,6-anhydro-D-galactose diethylmercaptal synthesized from methyl  $\alpha$ -D-galactopyranoside through the intermediates methyl 6-O-tosyl- $\alpha$ -D-galactopyranoside and methyl 3,6-anhydro- $\gamma$ -D-galactopyranoside.

Spectrophotometric evidence has indicated that 3,6-anhydro-D-galactose residues constitute about 24% of the K fraction of carrageenin.

**STRESSES IN AN ELASTIC FOUNDATION UNDER A LOADED PLATE.** J. E. CAMPBELL. (Read April 11th, 1955.) The problem investigated is the theoretical determination of the vertical pressures transmitted through a thick elastic plate to an underlying foundation when a surface load is applied to the plate. The solution is based on the assumption that the surface deflection of the foundation is proportional to the vertical force per unit area between it and the lower surface of the plate. The stresses and displacements are expressed in terms of an Airy Stress function and integration, using Fourier transforms, yields a general solution. Particular values of this solution are obtained using the original deflection assumption and the remaining boundary conditions at the upper and lower surfaces of the plate. An evaluation of the equations yields information which when plotted gives a complete picture of the stresses transmitted to the foundation. The results are valid for almost any surface loading, plate material; and a foundation of type ranging from quicksand to bed-rock.

**THE DETERMINATION OF MORPHINE IN BLOOD AND TISSUES.** D. P. MACLEOD AND J. C. SZERB. (Read April 11th, 1955.) Due to the relative insolubility of morphine base in organic solvents, it is a difficult alkaloid to isolate. For this reason there has been no method sensitive enough to measure the small quantities of morphine in the brain after subcutaneous injections of relatively large amounts of morphine.

A method is presented which employs an anhydrous benzene precipitation of impurities followed by extraction of the chloroform dissolved residue with dilute acid. The morphine is determined finally by colorimetry, using Folin and Ciocalteu's phenol reagent. The method is sensitive enough to detect one microgram per gram brain tissue and one microgram per milliliter blood.

**THE TROUT POPULATION OF A NOVA SCOTIA LAKE AS AFFECTED BY HABITABLE WATER, POISONING OF THE SHALLOWS AND STOCKING.** F. R. HAYES AND D. A. LIVINGSTONE. (Read April 11th, 1955.) A stocking, partial poisoning and creel census experiment was carried out on a stratified lake in an effort to increase the crop of speckled trout, *Salvelinus fontinalis*. Except for a single year in which adult trout were planted a negligible proportion of the introduced trout was recaptured. Application annually for five years of about one half part per million of derris dust to the three meter zone of the lake during summer stratification produced a heavy kill of coarse fish without harming the trout. Shiner, *Notemigonus crysoleucas*, perch, *Pera flavescens* and chub, *Semotilus atromaculatus* were eliminated from the lake. Sucker, *Catostomus commersoni*, was drastically reduced. Killifish, *Fundulus diaphanus*, and eel, *Anguilla bostoniensis*, were not appreciably reduced, despite large annual kills. Smelt, *Osmerus mordax*, stickleback, *Gasterosteus aculeatus* and trout, *Salvelinus fontinalis*, were killed in very small numbers during one or more poisoning years.

Three independent estimates of the effect of the experiment upon the trout production of the lake are put forward: (a) The decrease in mass of the fish competing with trout for food when calculated from the annual kills, amounts to 40 kg. The pre-poisoning mass of trout was calculated from the results of a capture-recapture census. It was 85 kg. If trout replaced its competitors quantitatively, the standing crop of trout would be increased by a factor of 1.5. (b) The volume-time of water (percent of lake volume multiplied by fraction of the year) which would be made available to trout by removing competitors from the part of the lake where summer temperature conditions would limit trout to between 50 and 100 percent of their full activity is calculated. If trout occupied this volume-time at the same density as they did the more favourable water, the standing crop of trout would be increased by a factor of 2.4. (c) The total yield of the lake to anglers showed a steady increase following poisoning, the improvement ratio being about 2.3, from less than one lb. per acre to nearly two lbs. per acre. These three estimates agree very well, considering the errors inherent in the method.

A COMPARISON OF THE PROPERTIES OF VARIOUS PREPARATIONS OF SODIUM ALGINATE. D. L. VINCENT, D. A. I. GORING AND E. GORDON YOUNG. (Read April 11th, 1955.) Fifteen specimens of sodium alginate from various brown algae, including species of *Laminaria*, *Fucus*, and *Ascophyllum*, have been examined for optical rotation, ionic mobility, rate of sedimentation, viscosity, and content of ash. Samples varied from 61.7 to 99.6 per cent in content of alginate. Rate of sedimentation was strongly dependent upon concentration. Mobility varied only slightly. Viscosity varied widely and was the best criterion of state of polymerization. Particle weight varied from 42,000 to 222,000.

VELOCITY OF SOUND IN ACETIC ACID. A. D. B. WOODS. (Read May 9th, 1955) The velocity of sound in acetic acid is known to increase in the region between .5 and 3 megacycles/sec. It is the purpose of this work to obtain an accurate measure of this dispersion. A new method for the measurement of sound velocities has been developed whereby the liquid under test is compared with a dispersionless liquid such as water. The velocity of sound in acetic acid shows an increase of nearly 2% in the frequency region indicated above.

A SIMPLE DERIVATION OF THE MESON FIELD EQUATIONS. W. J. ARCHIBALD. (Read May 9th, 1955.) The Relativistic Hamiltonian of a particle is transformed into an operator which has the form of a 10 by 10 matrix. The 10 elements of the state function are the 10 components of the meson field. The field equations can be written so as to show a close similarity to Maxwell's equation for the electromagnetic field.

THE COMBINED AMINO ACIDS IN SEVERAL SPECIES OF MARINE ALGAE. DONALD G. SMITH AND E. GORDON YOUNG. (Read May 9th, 1955.) The distribution of the combined amino acids in whole plants of five species of marine algae has been determined by quantitative chromatography. In the brown algae, *Ascophyllum nodosum*, it was very similar to that in *Fucus vesiculosus*. The red alga, *Rhodymenia palmata*, and the green alga, *Ulva lactuca*, were similar in composition but differed markedly from the brown algae. *Chondrus crispus* was distinctive for its high content of arginine and for the presence of combined ornithine and citrulline.

MODEL INTERFACIAL SYSTEMS IN THE STUDY OF INTRACELLULAR CATALASE. J. G. KAPLAN, M. J. FRASER AND C. E. HARRICHARAN. (Read May 9th, 1955.) The ambition of all reputable biologists is to create life in a test tube. While we have so far been unsuccessful in this ambition, we have, as a first approximation, attempted to create a model of the intracellular enzyme of yeast, catalase. Our model, an oil/water interfacial system, consists of an emulsion of olive oil in water, stabilized by a commercially available cephalin of unknown and highly doubtful purity. Theory predicted that such an interface would possess a negative charge, and that a protein should adsorb to it when at the acid side of its isoelectric point, and should desorb when changed to the alkaline side of the i.e.p. That this is the case was demonstrated by making a model of our model, namely, a monomolecular film of this cephalin at the air/water interface, and injecting catalase into the aqueous substratum: catalase when at pH 4.6 could penetrate a cephalin monolayer even at 20 dynes/cm. surface pressure, but could be desorbed to a large extent, if the trough pH were adjusted subsequently to pH 9 (technique of Schulman and co-workers). Catalase was found to adsorb at the oil/water interface at pH 4.6, and could be desorbed at pH 9; it could also be deterged from the surface by agents previously used to "alter" the *in situ* enzyme of yeast. Finally, the thermodynamic constants of the activation process of the adsorbed enzyme were found to agree qualitatively with those of unaltered yeast catalase, whereas the enzyme before and after adsorption had a significantly lower energy of activation, like that of the altered yeast enzyme. The ratio of activities of bulk catalase: adsorbed catalase was very similar to that of altered catalase: unaltered catalase, which has the happy consequence of making the difference in  $\Delta F^\ddagger$  of the two systems very close. Such similarities could be fortuitous, but we prefer to think that Nature has decided to conform to our hypothesis, that soluble enzymes of the cell either *are*, or *should be*, adsorbed to intracellular interfaces.

#### ABSTRACTS OF PAPERS, 1954-55.

##### VALLEY CHAPTER.

REPORT ON THE HUBRECHT LABORATORIES. DAVID J. MCCALLION. (Read November 1st, 1954.) The Hubrecht Embryological Laboratories have been organized in the home of the late Professor Hubrecht, at Utrecht in the Netherlands, as a center for research in Embryology. In early 1954 an international team of research workers gathered there and carried out an intensive research program with the staff of the laboratories, the author being included in the visiting group. The success of this work has encouraged plans for a similar program in 1956.

APPLICATIONS OF AERIAL PHOTOGRAPH INTERPRETATION TO HISTORIC SITES RESEARCH IN NOVA SCOTIA. H. L. CAMERON. (Read December 6th, 1954.) A study of existing small scale aerial photographs gave some excellent detail of various historic sites. In 1950 standards R.C.A.F. survey photographs were used to construct a map of the Grand Pre area showing old dykes. The first Acadian enclosure has been tentatively identified and a number of other interesting features noted. In 1953 the R.C.A.F. carried out large scale aerial photography of the Old Louisbourg site as an experiment in photo coverage. Infra red aerial photos

taken at the same time revealed a number of hitherto unknown features. From this photo coverage a new large scale map of the site has been constructed. Study of the photos covering the southwest corner of the harbour led to underwater search which culminated in the recovery of a section of old anchor chain. It is hoped that this work will be continued at Louisburg next year and that the other historic sites will also be photographed at a large scale so that similar studies can be made.

**EFFECTS OF SHADE ON BLUEBERRY GROWTH. IVAN V. HALL.** (Read February 8th, 1955.) Dr. Hall presented a paper on the taxonomy of *Vaccinium*, basing his paper on the critical examination of specimens from approximately 150 randomly selected clones in three areas of Nova Scotia and New Brunswick. Existing taxonomic keys were used for the study, but failed to permit a complete identification of specimens. The majority of the clones were intermediate to the taxonomic characters described.

**SOME IDEAS, PARTIALLY UNORTHODOX, REGARDING INSECTS. A. D. PICKETT.** (Read March 7th, 1955.) The speaker deplored the tendency of some entomologists to grossly exaggerate the importance of the competition between man and insects. No doubt man does compete both directly and indirectly with insects but if the race is becoming keener it is due largely to man demanding a greater share of nature's bounty and not to any increase in the efficiency of insects. No doubt insects do respond actively to man's keener competitiveness which is exemplified by the development of resistance to insecticides and other adaptations.

More effective competition with insects is not likely to result from the production of more highly toxic or widely effective insecticides but through a scientific manipulation of environmental and biological deterrents to their development and reproduction.

**OCCURRENCES OF URANIUM. M. F. BANCROFT.** (Read March 7th, 1955.) This talk was based on the findings of three senior students who had written term papers on Uranium occurrences throughout the world, with particular attention given to deposits in Canada and in the U.S.A. Maps showing the location of deposits, a Geiger counter, and ores from different places were on display.

**SOIL MAPS. D. C. MacKAY.** (Read April 7th, 1955.) The purpose of a soil map is to indicate the location and extent of various kinds of soil in a given area. Obviously this presupposes the existence of a satisfactory method of classification. Some ten or twelve soil properties, of which soil texture is undoubtedly the most important, are used as criteria for classification.

The relationships between the members of the various categories in the classifications scheme are illustrated by discussing a group of local soils.

Three types of basic soil survey maps have been published:

- (1) Reconnaissance
- (2) Detailed-reconnaissance
- (3) Detailed

Few maps of the detailed type have been prepared as yet. To show that such maps might be of wider usefulness to biologists, data is presented on a study of the variability pattern of the soils on a small area. Thus, the chemical soil properties exhibited wide differences which were



closely correlated with the chemical composition of growing plants. Further, these differences were intimately related to the soil landscape as indicated on the published detailed map.

SOIL ANALYSIS, ITS VALUES AND LIMITATIONS. R. F. BISHOP. (Read April 7th, 1955.) It is well known that soils exhibit great variation in respect to their chemical, physical and biological properties and that different crops have different nutrient requirements. The empirical nature of various chemical methods used in soil testing is also recognized. Thus, if soil test values are to provide a sound basis for fertility diagnosis and fertilizer recommendations, they must first be correlated with field data.