

**THIRTEENTH ANNUAL MEETING
OF THE COLLEGIATE DIVISION
TENNESSEE ACADEMY OF SCIENCE**

SATURDAY, NOVEMBER 24, 1962

GEORGE PEABODY COLLEGE FOR TEACHERS

PRESIDENT: KATHERINE TAYLOR

SPONSOR: ALBERT L. MYERS

BOTANY SECTION

Room 3, Home Economics Building
Garrett Asher, Chairman

Leaf Area Determination. Nancy Easley, University of Tennessee.

In completing a project, sponsored jointly by the Atomic Energy Commission and the University of Tennessee, it was necessary to quickly and efficiently determine the production potential of tree stands by the measurement of the leaf area on each tree. Through experimentation, it was found that the area of an individual leaf for various species was directly proportional to the product of its longest length and widest width. Totals of areas for series of leaves determined in this manner, as compared with area totals determined with a planimeter, were accurate to within 1.5% error in all cases. This leaf area total was plotted against leaf number, and a trend to a mean area was found. Linear regressions were found relating leaf area totals to fresh and dry weights of the leaves.

Species of Fall Plankton in a Small Highland Rim Lake and in Its Outflow. Garrett B. Asher, Tennessee Polytechnic Institute.

A series of limnological investigations were conducted on a small lake approximately ten miles northeast of Cookeville, Tennessee. This report deals with a comparison of the plankton populations in the lake and in its effluent.

The Effect of Rotenone on Plankton in Pine Creek. Paul Martin Thompson and James D. Little, Tennessee Polytechnic Institute.

While investigating fish populations in a stream entering Center Hill Reservoir, an incidental series of studies were undertaken to determine the effects of the fish toxin, rotenone, on total plankton populations.

Distribution of Various Species of Trees in Relation to Altitude. Thomas Hamilton, Tusculum College.

For three consecutive years, transect studies have been made in the Great Smoky Mountains National Park. These have shown that a variation in the distribution of species of trees exists, and this results in a transition in forest types. This transition is in direct relation to the altitude of the mountains studied. In the lowest area (elevation 1900 feet above sea level) a deciduous forest is present, and in the highest area (6643 feet above sea level) a coniferous type forest prevails.

Studies on Caloric Content in Evergreen and Deciduous Trees. James H. Kerr, University of Tennessee.

Caloric values for several samples from two or three individuals of seven species of woody plants were determined in a Parr, adiabatic, oxygen bomb calorimeter. Comparisons of energy "concentration" were made between samples of the same individual, between individuals, and among species. The total caloric content in all individuals was calculated and the totals compared. The conifers tested generally contained more heat energy per unit of dry weight than did the deciduous trees. In general, heat energy is greater in material of smaller diameter, and leaf material contains more heat energy per unit weight than does woody material.

Determination of the Content of Calcium, Magnesium, Potassium, and Phosphorus in the Yellow Birch. Dennis M. McCarthy, University of Tennessee.

In the early summer of 1961, eight yellow birch trees, *Betula lutea*, Michx., ranging in diameter (DBH) from 1 to 13.1 inches, were cut from an elevation of 4,900 feet in the Great Smoky Mountains. Detailed measurements of boles and branches were recorded, and samples were brought back to the laboratory for

determination of the concentrations of calcium, magnesium, potassium, and phosphorus. By calculating the dry weights of the trees through volume and density, it was then possible to determine the total weight of each element in each tree. The data showed the existence in the yellow birch of a linear relationship between DBH and the weight of the chemical elements within trees when expressed on a logarithmic base.

Transport of Heavy Metal Ions Across the Yeast Cell Membrane. Audrey Whaley, Siena College.

The relative affinities of the yeast cell for Co^{60} and Mn^{54} in the presence of various carboxylate anions, such as citrate and oxalate, were studied. Since heavy metal ions are transported across the yeast cell membrane in the presence of glucose, as well as sodium, potassium and phosphate ions, the relative uptake and inhibition of uptake of Mn^{54} and Co^{60} by the yeast cell could be determined. Eventually, it is hoped that greater knowledge may be gained concerning the binding powers of heavy metal ions with the citrate and oxalate ligands relative to the yeast cell and yeast cell membrane. This investigation was supported by an NSF Undergraduate Research Program.

Survey of Prairie Elements in the Vascular Flora of the Central Basin. John D. Freeman, Austin Peay State College.

A comparative survey was initiated to determine the extent to which prairie plants occur among the vascular plants of the Central Basin of Tennessee. For basic reference, a card file of plants occurring in the Basin was prepared from various lists. This file then was checked against the floras of typical prairie regions to determine those showing definite or probable prairie affinities. Following this, the research involved the collection, identification, cataloguing and mounting of specimens from all parts of the Basin, particularly the Cedar Glades which are most likely to have prairie plants. Thus far, a considerable number of plants have been collected which are typical of western prairies. Much more work must follow in order to fully understand the complex of prairie plants established in the Central Basin. This investigation was supported by an NSF Undergraduate Research Participation Program, Biology Department, Vanderbilt University.

CHEMISTRY SECTION

Room 208, Home Economics Building
Doris McDonald, Chairman

Triarylmethane Dyes as Gamma Ray Dosimeters. James Callam McKenna, The University of the South.

An investigation was made of the effect of cesium-137 gamma rays upon triarylmethane dyes and of the possibility of using water solutions of these dyes as dosimeters which would be more sensitive to smaller doses than the Fricke dosimeter. The dye solutions were irradiated at fixed positions near two encapsulated 20 curie sources, and the fading of the dyes as a result of irradiation was measured with a Beckman DU spectrophotometer. Samples of dye solutions made in the summer of 1961 were run on a Beckman DB spectrophotometer, and the resulting absorption curves compared with graphs made in the summer of 1962 to determine any fading due to prolonged light exposure. Dyes which had faded were discarded; the sensitivity of the others to a fixed gamma dose was measured. Four of the dyes most sensitive to gamma rays, and four others previously found to be sensitive, were irradiated at different time intervals to determine whether the dyes gave linear responses to dose. One dye, alphasaurine 2G, gave very promising results. The sources were calibrated with a Fricke dosimeter.

A Study of I^{131} Concentration in the Environment. David Lane Mason, Austin Peay State College.

This report concerns the methods and results of recent attempts to correlate internal radioactivity to the fallout contamination from fissionable products. This work was conducted at the in vivo Gamma-Ray Spectrometer Facility, Oak Ridge National Laboratories. Radioactive iodine was used as a representative isotope because of its relative abundance and its concentration in the thyroid and in milk. For the quantitative determination of iodine, a multichannel analyzer with a NaCl(Tl) scintillation crystal is described.

The Distribution of S³⁵ in Various Fractions of Milk Following Oral Administration of H₂S³⁵O₄ to Dairy Cows. David A. Taylor, University of Tennessee.

Following a single oral dose of 4.5 μ c of H₂S³⁵O₄ to each of three Jersey cows, sixteen milkings were separated into rennet curd, rennet whey, acid curd and acid whey. The concentration of S³⁵ in these fractions was compared with the concentration in whole milk over the 8-day experimental period. The greatest concentration of S³⁵ in the milk or the whey fractions appeared in the second milking, but the curd samples had more S³⁵ per gram of material in the third milking. After freezing and thawing of the milk, the distribution of the S³⁵ in the fractions was altered.

Ternary Phase Studies of the System Methanol-Benzene-Cupric Chloride. David E. Campbell and T. F. Dorn, The University of the South.

The two organic solvents-one inorganic solid type of ternary phase diagrams were studied during the summer of 1962. From the data on the phase diagram of CuCl₂, methanol, and benzene at 30° C, it was concluded that the compound in equilibrium was CuCl₂ • CH₃OH rather than CuCl₂ • 2CH₃OH as previously reported. At the present time, we have insufficient data concerning the same diagram at 20° C. The problems of sampling, distilling, etc. have been solved for the phase diagram of CuCl₂, methanol and dioxane, but no results can be reported at this time. Further work with this ternary phase diagram is planned.

Studies of Rates of Aquation of Some Complexes of Cobalt and Chromium. William Bradford Lee, The University of the South.

In order to study the mechanism of certain halide complexes of cobalt, the rates of aquation of such complexes were studied. The effect of varying HClO₄ concentrations on the rate of aquation was the major consideration. Rates of aquation were computed from the data by titrating uncomplexed halide with AgClO₄. The following are the results for (1) CoCl(NH₃)₅Cl₂ at 30° C at HClO₄ concentrations of 10⁻⁴M, 10⁻²M, 10⁻¹M, 1M, 2M and 3M; K₁O⁺=1.9, 1.9, 1.0, 0.67, 0.50, and 0.32M/min. and (2) CoBr(NH₃)₅Br₂ at 30° C at HClO₄ concentrations of 10⁻¹M, 1M, 1.5M and 2M; K₁O⁺=1.4, 1.2, 1.5, 1.4M/min. Thus, the HClO₄ concentration has an effect on CoCl(NH₃)₅Cl₂.

Effect of Configuration on the Rate of Anhydriation of Alditols. Benjie T. Outlaw, University of Tennessee Medical Branch.

The acid-catalyzed anhydriation of alditols (polyhydroxy alcohols) usually leads to the formation of cyclic ethers having tetrahydrofuran rings. The ease with which a pentahydroxy pentane or a hexahydroxy hexane undergoes anhydriation depends upon the configuration of the product. Those products are most readily formed in which the hydroxymethyl or dihydroxyethyl side-chain is on the opposite side of the plane of the ring from the hydroxyl groups in the ring. Those products which have all substituents on the same side of the ring are formed with most difficulty. Of the products which have one hydroxyl group on either side of the plane of the ring, those with this hydroxyl group beta and cis to the side-chain are more readily formed than those which have the hydroxyl group alpha and cis to the side-chain.

PHYSICS SECTION

Room 6, Home Economics Building

Terry Fortune, Chairman

A Theoretical Treatment of Electrons in the Magnetosphere. Terry Fortune, Memphis State University.

A particle of a certain energy, which is known to exist in the Van Allen radiation belt, is treated theoretically. The results obtained in this manner are compared with the data compiled by Van Allen and his associates. This work was done during the summer of 1962 at Columbia University with the aid of a fellowship from NASA.

The Gyator, an Electric Network Element. Charles R. Edwards, University of Tennessee.

The ideal resistor, capacitor, inductor and transformer generally have been accepted as the four basic network elements; these components always result in a network which is linear, constant and passive. Conceivably, there is a fifth element which is linear, constant and passive; unlike the other elements, however, it does not possess the property of reciprocity. This new

element has been given the name of ideal gyator and is defined by a unique set of voltage and current equations. With the inclusion of the gyator, the system of network elements is completed and network synthesis is simplified.

Infrared Calibration. Hilman Joe Hargis, The University of Tennessee.

The frequency of a recorded spectral line can be determined by comparing the angular position of the unknown line with the angular positions of recorded standard lines whose frequencies are known. The choice of lines to be used as standards depends partially upon the ones available for the region of interest. The emission lines of Neon and the absorption lines of calcium monoxide are presently in use as standards in our laboratory. With these lines as standards, the calibration procedure is independent on the grating drive in the instrument. The gratings at the University of Tennessee's high resolution vacuum spectrometer can be rotated about a vertical axis with the use of either of two drives. The positioning drive is used for rapid repositioning. This drive has a maximum speed of thirty degrees per minute and can be used to rotate the grating 360°. For a detailed examination of a spectral region, the scanning drive is used. Twelve speeds are available on the scanning drive: one-twelfth degree per hour to ten degrees per hour. The accuracy of the positioning drive is not sufficient for our purposes; the scanning drive is used to find the angular separation of standard lines. The grating constant and the angular position of the standard lines then can be determined by simultaneous solution of two grating equations. Applications of this calibration technique are presented.

Spatial Reconstruction of Bubble Chamber Events from Stereoscopic Photographs. James Lentz, University of Tennessee.

To perform a kinematic analysis on an interaction occurring in a bubble chamber, it is necessary to extract information from the photographs concerning the momentum and direction of the particle tracks associated with the event. This information is obtained by reprojection of three stereo photographs of the interaction. The techniques involved in this reprojection and subsequent calculation of the appropriate kinematic quantities are discussed.

An Ebert Monochromator. Larry J. Stephens, Memphis State University.

This report concerns aspects of the physics, mathematics and engineering involved in the construction of an Ebert Monochromator. The following are discussed specifically: (1) The theory of an Ebert Monochromator and certain problems; (2) The derivation of the angles through which the diffraction gratings must be turned to sweep the spectrum from 2,500 Å to 7,500 Å; (3) A discussion of the aberration and astigmatism introduced by the slits and mirror; and (4) A few uses for the Ebert Monochromator.

The Color-Sensitive Vidicon Tube in a Portable TV Camera for Use Under Extreme Conditions. Larry Perry, University of Tennessee.

There is a need for the reduction in size of presently available television equipment for use under field conditions in extreme latitudes without the failure of components. This report presents the applications and theory of a new, complete television system approximately one-eighth the size of that now in use. It is capable of resolving a picture of 450 lines minimum when transmitted by a self-contained transmitter. The camera is sensitive to all parts of the color spectrum, including those portions which are invisible to the human eye.

Examples of Hyperfragments Produced in K⁻ Meson Interactions with Nuclei. Douglas N. Mashburn, Oak Ridge National Laboratory—(Cooperative student from the University of Tennessee).

When K⁻ mesons interact with nuclei they may produce hyperons. These hyperons may remain bound in nuclei replacing a neutron. Such a bound system is called a hyperfragment. Three hyperfragments Λ H⁺, Λ He⁺ and Λ H⁰ have been observed. Examples of each are presented, and the production and decay modes are described.

Some Aspects of the Interaction of K⁻ Mesons with Helium Nuclei. John Humpherys, University of Tennessee.

The interaction of K⁻ mesons with nuclei is a rich source of Λ^0 and Σ hyperons. The properties of these particles

discussed briefly and examples are shown of reactions in which they are produced. In addition, certain of the special features of K- interaction with helium, such as the $\Sigma-\Lambda$ conversion process which is responsible for the low Σ/Λ ratio, are discussed.

ZOOLOGY-GEOGRAPHY SECTION
Room 2, Home Economics Building
Katherine Taylor, Chairman

A Possible Mutation for Hairlessness in the Mouse. Katherine Taylor, Tusculum College.

Approximately one year ago, it was noted that the offspring from two mice of the Tusculum College Laboratory Strain were losing hair over extensive body areas. This trait was evidenced only at the weaning stage and during pregnancy in the females. Matings have been made to determine whether a possible genetic sequence has given rise to this characteristic. The results indicate certain types of inheritance are involved. Further experiments are being conducted to determine the elusive genetic significance of this hairless condition.

Collembola of the Great Smoky Mountains National Park. R. B. Davis and W. T. Copeland, East Tennessee State College.

Collections of forest detritus were made in the Great Smoky Mountains National Park, Tennessee-North Carolina, and processed through the Berlese apparatus. Over 50 species and subspecies of Collembola have been identified.

Benthonic Insect Larvae and Nymphs in a Highland Rim Trout Stream. Joseph F. Webb and James D. Little, Tennessee Polytechnic Institute.

With the aid of a one square-foot bottom sampler, insect larvae and nymphs have been collected from the bottom of a 7.9 mile section of Pine Creek, DeKalb County, Tennessee. The species have been identified and their relative abundance has been determined.

Esophagostomum columbianum, a Hookworm of Sheep. Kenny Walker, Travecca Nazarene College.

Esophagostomum columbianum, although little noticed, is possibly one of the most important nematodes found in slaughterhouse animals. It is not mentioned in most textbooks of parasitology, probably because it is common only in a certain part of our country. This report includes (1) the obtaining of infested material, (2) removal and identification of the nematode, (3) its morphology and life cycle, and (4) the disease produced, including symptoms and treatment.

A Comparison of the Sensitivity to Ultraviolet Light of Different Portions of the Habrobracon Embryo. Douglas H. Janss, Southwestern College at Memphis.

Three, fifteen and twenty-four hour embryos of *Habrobracon* sp. are subjected to five different dosages of UV (2537 Å) radiation on either their anterior or posterior concave surfaces. The numbers of embryos hatching from these three age groups are plotted against the five individual UV dosages. From these data, comparisons are being made of the UV sensitivity of the two body regions of the embryos. In an attempt to determine those organs or systems absorbing the UV, the results also are being correlated with developmental events at those embryonic stages tested.

Nitrogen Balance in Irradiated Mice given Foreign Bone Marrow. William Wilson, Knoxville College.

Metabolism studies are being conducted which are associated with problems of radiation protection in mammals. In an attempt to provide information concerning the mechanism involved in homologous disease, the nitrogen balance in irradiated mice given foreign bone marrow were compared with normal mice. Preliminary experiments show no significant differences in nitrogen balance between irradiated pairs treated with bone marrow. In both isologous and homologous animals, moderate positive nitrogen balance was present after the fourth post-treatment day. Homologous animals treated with bone marrow lost in weight while the isologous animals treated with bone marrow gained in weight. It is conceivable the dietary nitrogen is stored differently in the two groups.

Velocity Polars for the Black and Turkey Vultures in Gliding Flight. Howard Carney, George Peabody College for Teachers.

Captured, wild Black Vultures and Turkey Vultures were weighed and their wing areas measured to determine wing loadings. Each bird then was followed in a glider after the bird was released from an airplane. From measurements taken in the glider, the rate of descent of the birds in gliding flight was computed at various flight speeds. Similar measurements also were obtained from movies of trained birds flying on a graduated flight range. After correcting the measurements for wing loadings, glide velocity versus sinking speed was graphed for each type of bird. This research supported, in part, by an NSF Undergraduate Research Participation Program, Biology Department, Vanderbilt University.

Speleology and Geographic Aspects of Cumberland Caverns. David Smith, Tennessee Polytechnic Institute.

Cumberland Caverns, located seven miles northeast of McMinnville, Warren County, Tennessee, are representative of a type of Tennessee and Kentucky karst topography. They are situated in St. Genevieve-Gaspar limestone at the southern tip of the karst region which runs from Kentucky into Middle Tennessee and then tapers diagonally toward the southeast corner of the state. Approximately fifteen miles of passages exist at depths of from twenty to two-hundred feet. Since their discovery in 1810 by a surveyor, Aaron Higgenbotham, exploration has continued to the present day, especially after 1947 when organized investigation began. Although chiefly a tourist attraction, Cumberland Caverns may have significant value in the event of nuclear war. Although this latter is still speculative, the location of the caverns within a triangle formed by Nashville, Chattanooga and Knoxville may make them of prime importance.

COLLEGIATE DIVISION OFFICERS FOR 1963

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