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ABSTRACTS PRESENTED AT THE ANNUAL MEETING

BOTANY SECTION

WAYNE C. ROSING, *Presiding*

In Vitro Culture of Immature Cotyledons of Different Cultivars of Glycine max (L.) Merrill. P. S. KAHN & S. M. BHATTI, Tennessee State University.

The objective of this study was to determine the callability of immature cotyledons from different cultivars and to determine the effect of media composition on callus induction. Immature pods from 12 different cultivars at various stages of development from field and green house were surface sterilized in 100% Clorox for 30 minutes. Seeds were removed and surface sterilized in 50% Clorox for 3 minutes and washed 5 times with double distilled sterile water. Each cotyledon from these seeds was cut into half and inoculated on Murashige-Skoog (MS) medium modified with different concentrations of sucrose, 2,4-D (2,4-dichlorophenoxy acetic acid), NAA (naphthalene acetic acid) and deproteinized coconut milk. Observations were taken weekly and fresh weight of callus was taken after 6 to 12 weeks. Cultivars Crawford and Columbus produced significantly more callus than cultivars Essex, Forrest and Hill. Auxin 2,4-D produced sig-

nificantly more callus than the NAA. Addition of coconut water in the medium enhanced the callus growth. (Supported by USDA/CSRS grant No. 7903-1-PS2)

The Vascular Flora and Vegetation of the Bear Creek Natural Area, Stewart County, Tennessee. JACQUELINE C. STACK and EDWARD W. CHESTER, Austin Peay State University.

Bear Creek is an 800 acre area located along the southern boundary of Land Between the Lakes in Stewart County, Tennessee. The creek flows eastward into the Cumberland River, and is located on the south by north-facing slopes and bluffs and on the north by mostly cultivated bottomlands. Floodplains and swampy areas occur near the river. The site elevation varies from 606 feet to 361 feet above sea level. Based upon field and herbarium, the vascular flora is composed of approximately 700 taxa. The 109 families represented are dominated by the Asterales, Poaceae, Cyperaceae, Fabaceae and Lamiaceae. Circular plot counts of 4,146 stems from the most natural forests showed that the ridges are dominated by sugar maple, hop hornbeam, pignut hickory, slippery elm and dogwood. North-facing slopes are predominantly American beech, sugar maple, pignut hickory, yellow poplar and blackgum, while streambank-ravines are made up mostly of sugar maple, box elder, yellow poplar, sweet gum and sycamore.

Bacitracin Reversal of Hormone Stimulated Elongation in Oat Coleoptiles and Lettuce Seedling Hypocotyls. B. P. STONE, Biology Department, Austin Peay State University.

IAA stimulation of cell elongation in isolated oat coleoptiles was reversed by the presence of bacitracin in the incubation medium. GA enhancement of lettuce seedling hypocotyl elongation was inhibited by bacitracin. The observed hormone stimulation of cell elongation apparently requires glycoprotein synthesis since bacitracin inhibited glycoprotein synthesis in both oat coleoptile and lettuce seedlings.

Effect of Gibberellic Acid On Soybean Callus Growth. S. M. BHATTI and P. S. KAHLON, Tennessee State University.

Callus from four different cultivars of *Glycine max* L. (Mer-rill) was subcultured on Murashige Shooq (MS) medium supplemented with 1 mg/l NAA (Naphthalene acetic acid), 1 mg/l kinetin, 5% coconut milk and four different concentrations of gibberellic acid (G.A.). The four genotypes were represented by cultivars Columbus, Davis, Pickett and Tracy. Fresh weight of callus was taken five weeks after subculturing. The data show genotypic differences in response to media composition. Cultivar Columbus produced maximum growth in the medium without G.A. Even low concentration of G.A. (10^{-8} M) produced considerable toxicity as measured by reduction in fresh weight. Increased weight was obtained for cultivar Pickett when coconut milk and G.A. were added to the medium. However, no beneficial effect of G.A. was observed for cultivars Davis and Tracy. (Supported by USDA/CSRS grant no. 7903-1-PS2)

Normal and dwarf Pharbitis: Seedling emergence. HAROLD A. SIMMONS, Union University.

Pharbitis nil Violet (=normal) is a twining vine and Kidachi (=dwarf) is a gibberellin deficient mutant. IAA, GA, ABA, cytokinin, and cAMP (100 ppm) were used to test effects on seedling emergence. Seeds were scarified in concentrated H_2SO_4 , rinsed, soaked (12 hours) in a test solution, positioned in trays, and covered with $\frac{1}{2}$ inch of vermiculite. Seedling emergence was chartered every 12 hours under continuous light and at 21 C.

Both ABA and cytokinin delayed emergence and reduced successful emergence (60%) of the normal strain.

For the dwarf strain, only ABA delayed emergence; however, 100% emergence was then obtained at 120 hours. Cytokinin both delayed emergence and affected the number of seedlings successfully emerging (50%).

The proposal that GA and ABA share steps in a biosynthetic pathway is supported by these data. ABA is inhibitory to the normal but not the dwarf strain, and may be converted to non-inhibitory compounds in the GA-deficient dwarf.

Fine Structure of Ascosporegenesis in *Chaetomium Brasiliense* Baptista and Pontual. WAYNE C. ROSING, Middle Tennessee State University.

Mature ascospores of *C. brasiliense* are broadly ovate, being subapiculate at one end and rounded at the other. Spore formation begins when a cylinder of double membrane encloses the eight ascus nuclei within a common mass of sporoplasm. This "ascus vesicle" then invaginates between adjacent nuclei cutting out uninucleate spore primordia, each bounded by a double membrane.

The nucleus of an unwallied spore lies within a cone-shaped array of microtubules. A spindle pole body at the tip of this cone seems to occupy the subapiculate end of the spore. The base of the cone occupies the rounded end.

Spore wall formation begins with the appearance of dark granules between the spore-delimiting membranes. These granules increase in number and fuse to form an electron-dense primary wall. A somewhat lighter secondary wall then forms between the spore plasma membrane and the previously deposited primary wall to complete spore formation.

CHEMISTRY SECTION A

JIMMY H. DAVIS, *Presiding*

Atmospheric Adiabatic Lapse Rates. HENRY F. BLANCK, Austin Peay State University.

Many physical chemistry textbooks include a discussion, derivation, or problem relating to the barometric formula $p = p_0 e^{-Mgz/RT}$. However, no mention is made of the dry adiabatic lapse rate equation, $-dT/dz = Mg/c_p$, found in space

science and meteorology textbooks. It is derived using the reversible adiabatic expansion equation, $c_p dT = V dp$, and the change in pressure with altitude, $dp = -\rho g dz$. The dry adiabatic lapse rate ($-dT/dz$) is independent of pressure and altitude. Related Equations produce rather accurate temperature and pressure profiles for "adiabatic" portions of atmospheres (e.g. Venus to an altitude of 40 km). Although the barometric formula does introduce the Boltzmann distribution and does give a reasonably good pressure profile of atmospheres over wide altitude ranges, it does not introduce the concept of a constant entropy process and hence does not predict a decrease in temperature with increasing altitude and over-estimates the pressure for "adiabatic" portions of these atmospheres. We consider the barometric formula, the dry adiabatic lapse rate equations, and discussion of atmospheres worthy of inclusion in physical chemistry courses and textbooks.

The Crystal and Molecular Structure of Carbonyl(chloro)(teracya nothylene)bis-(dimethylphenylphosphine) iridium. JIMMY H. DAVIS, Union University; CHRISTINE D. MENZEL, Westinghouse Electric, Alamo, TN.; GALEN D. STUCKY, E. I. DUPONT, Wilmington, Delaware.

The crystal structure of the title complex has been determined from diffractometer data. The crystals are monoclinic, space group $P2_1/n$, with $a = 9.660(7)$, $b = 20.234(18)$, $c = 12.889(9)$ Å, $\beta = 91.23(6)$, $Z = 4$. The geometry about the iridium atom is trigonal bipyramidal with the carbonyl group and the chlorine atom at the apices. The tetracyanoethylene group is greatly distorted from planarity and the olefinic bond length has increased to 1.499(16) Å. A comparison with the structures of other iridium-tetracyanoethylene complexes reveals no correlation between the electronegativity of the halogen constituent and the length of the olefinic bond. Attempts to oxygenate coordinated tetracyanoethylene are described.

Theory of Pollutant Dynamics in Groundwater. K. N. CARTER, Jr., and D. J. WILSON, Vanderbilt University.

The dynamics of pollutants moving in aquifers with moving groundwater and undergoing pseudo-first-order decomposition were studied. The horizontal movement of a solute is governed by

$$\frac{\delta c}{\delta t} = \left(\frac{\delta}{\delta x} \frac{\delta}{\delta y} \right) D \left(\frac{\delta}{\delta x} \right) c - r \Delta c - kc$$

where c is the concentration of solute, D is the diffusion tensor, v is the velocity field, r is a retardation factor, and k is the rate constant for decay.

This equation was solved numerically for the case where v is the velocity field around a cylinder (obtained by Darcy's Law and conformal mapping). D is diagonal, and a constant point source of pollutant is initiated at time zero. These results were compared with the known solutions for the case of constant uniform flow. The equation was also solved by an approximate Green's function technique for similar conditions except that the velocity field was given by $v = (v_x + \epsilon y)j$, flow in the x -direction with a constant y -gradient.

Solvent Sublation of Dye-Surfactant Complexes. J. L. WOMACK and D. J. WILSON, Vanderbilt University.

The solvent sublation of aqueous solutions of dye-surfactant complexes into 2-octanol was studied. The systems used were methylene blue chloride-sodium tetradecyl sulfate-salt and sodium methyl orange-hexadecyltrimethyl-ammonium bromide-salt. In both cases removals of dye were rapid and complete in the presence of a modest excess of surfactant and the absence of much added salt. Increasing salts concentrations inhibited removal rates severely. The data were not described either by a simple mechanism based on the Langmuir isotherm nor by a mechanism assuming that dye-surfactant ion pair formation is a mobile equilibrium. They were described adequately by a mechanism assuming that dye-surfactant ion pair formation is a mobile equilibrium involving one dye ion and two surfactant ions.

An Overview of Tennessee's Novel Higher Education Based Business and Industrial Service System. REUBEN E. HARRIS, The University of Tennessee.

In 1963 the State of Tennessee formally charged The University of Tennessee

"to establish liaison with public and private institutions of higher education, research organizations and foundations and industry to the extent that the research facilities and capabilities of educational institutions are available to and concerned with the problems of business and industry . . ."

In response to this charge, The University of Tennessee has developed an industrial service program which has gained national recognition. A brief description of the operational philosophy and practices followed in administering the program and a summarization of the program activities during Fiscal Year 1980-81 will be provided to illustrate the significance of the program to Tennessee higher education and to the business and industry within the State.

Theoretical Prediction of Aromaticity. L. J. Schaad and B. A. Hess, Jr., Vanderbilt University.

In the past decade several methods of predicting aromaticity have been developed which are much superior to, but as easy to calculate as, the old Hückel delocalization energy. These will be described briefly.

Removal of Chlorinated Organics from Aqueous Systems. K. T. VALSARAJ and D. J. WILSON, Vanderbilt University.

Solvent sublation, a surface chemical technique, was used to remove chlorinated benzenes and polychlorinated biphenyls from aqueous systems. The technique consists of floating a small volume of solvent (2-octanol in this case) over a large volume of water in a column, then aerating with fine bubbles generated by passing air through a fritted glass disk at the column base. Removal was monitored by extracting water samples with hexane and analyzing the hexane extracts by electron capture gas chromatography. Removal is relatively rapid and complete. A method was developed to estimate the parameters in the Langmuir isotherms for the absorption of relatively large chlorinated hydrocarbons at air-water interfaces. A procedure was also developed to estimate the time constant for diffusion of solutes from the bulk liquid to the air-water interface of the rising bubbles. These then permitted the development of a mathematical model for the process with no adjustable parameters.

CHEMISTRY SECTION B

S. K. AIREE, *Presiding*

*Gamma-ray Spectroscopic Determination of the Separation of Curium from Americium** S. S. MCGUIRE, D. E. BENKER, and J. E. BIGELOW, Oak Ridge National Laboratory.

Low-energy gamma-ray spectroscopy has been used to determine how effective americium and curium are separated from each other via in-cell cation exchange operations at the Transuranium Processing Plant (TRU) at the Oak Ridge National Laboratory. The principal isotopes used in the measurements were ^{241}Am , ^{243}Am , and ^{244}Cm . Evaporated samples of the feed and product fractions were observed with a 200-mm₂ by 10-mm intrinsic germanium x-ray detector that was interfaced to a Nuclear Data 6600 computer system. The resolution of the system at 42.82— and 75.67-keV was 390 eV and 460 eV (WFHM), respectively. Using sample strengths of ~200 kBq (alpha) and data acquisition times of ~3.6 ks, estimates of the americium decontamination factor associated with the product curium fractions were obtained during the runs. Values for these factors were typically in the range of 10^2 to 4×10^3 . Details of this approach will be discussed and compared with previously employed procedures.

Theory of Thermal Runaway in Coaxial Tubular Reactors. P. C. SUNDARESWARAN and D. J. WILSON, Vanderbilt University.

The temperature distribution in a tubular chemical reactor immersed in a thermostat and containing a coaxial cooling tube at the temperature of the thermostat is examined. A chemical reaction having enthalpy change ΔH and activation energy E_a provides a distributed, temperature-dependent source of heat. If the reaction is exothermic the possibility of thermal runaway exists. The (nonlinear) heat flow equation is linearized in terms of $T-T_0$ (T_0 = temperature of thermostat) and solved by separation of variables. The steady-state solution is investigated to determine the energetic and geometrical conditions under which thermal runaway can occur.

Acetonitrile Recovery from Liquid Chromatography Effluent. MARTIN V. STEWART, J. W. SMILEY, SHARON A. CHURCHILL, and MICHAEL D. RICHARDSON, Middle Tennessee State University.

The continuing consumption of gallons of acetonitrile as an aqueous acetate-acetic acid buffered elution solvent for liquid chromatography has encouraged serious consideration to establishing a departmental solvent recovery program. While the literature abounds with acetonitrile purification procedures, none are completely appropriate for our particular application. Difficulties encountered include the hydrolysis of acetonitrile upon aqueous chemical treatment, the formation of a binary azeotrope with water, and the persistence of impurities indigenous to lower grades of the original acetonitrile. A series of distillation and chemical treatment steps applied to pooled samples of the effluent afford acetonitrile which is dry, has a uv cutoff of less than 190 nm, and is suitable for reuse in liquid chromatography. One aspect of this project includes the participation of undergraduate students as part of a distillation and extraction techniques laboratory course. Support by the MTSU Subcommittee on Research is gratefully acknowledged.

Barium Starch Xanthate As A Heavy Metal Ion Scavenger. GLEN H. BREMER, The University of Tennessee at Martin.

Effective wastewater treatment processes are needed to meet the stringent effluent standards that are being set for the electroplating industry by the Environmental Protection Agency. The magnesium salt of a highly cross-linked starch Xanthate has been used as a heavy metal scavenger with mixed results.

This paper is the results of a study of the effectiveness of a new barium salt of the Xanthate as compared to that of the magnesium salt for a heavy metal ion scavenger.

Vinyl Cations As Intermediates In Friedel-Crafts Type Reactions. CHARLES HARDING and TIM BREWER, The University of Tennessee at Martin.

Vinyl cations (linear, disubstituted carbonium ions) have only recently begun to be recognized as important intermediates in many types of reactions. Earlier we reported the first example of an aluminum chloride catalyzed reactions of a vinyl halide (α -chlorostyrene) with an aromatic substrate and suggested the possibility of a vinyl cation intermediate. The study has been expanded to include additional vinyl halides and new reaction conditions have been explored. The results of these studies will be discussed.

NMR & Related Studies of Octane-Ethanol Solutions. T. R. HARRISON & S. K. AIREE, The University of Tennessee at Martin.

NHM Spectra of a series of solutions containing ethanol and n-octane or isooctane (2,2,4-trimethylpentane) were made using Varian T-60. As the percent of the hydrocarbon increased, splitting of the hydroxylic proton was observed due to the inhibition of the fast proton exchange reaction from hydrogen bonding. Concentrations of solutions were determined using refractive index calibration curves. A computer program was written and utilized to correlate concentrations of alcohol-hydrocarbon solutions using NMR peak areas. Preliminary studies were done to see if certain mass spectrum peaks can be used for predicting concentrations and to determine partial-molar enthalpies from heats of combustion data of these solutions.

ENGINEERING SECTION

HALL C. ROLAND, *Presiding*

Low Temperature Vapor Pressures Calculated Using The Clapeyron Equation. DAVID W. YARBROUGH and SHIH-FU SHIAO, Tennessee Technological University.

A procedure has been developed for numerically integrating the Clapeyron Equation to obtain vapor pressures from the normal boiling point to temperatures below the triple point. The procedure involves simultaneous Clapeyron Equation integration and use of an enthalpy cycle to obtain the heat of vaporization or sublimation as a function of temperature. Published spectroscopic, thermal, and volumetric data were used to make vapor pressure calculations for tetrafluoromethane at temperatures from the normal boiling point to 30 K.

Final Heat Transfer Analysis of the OC-6 Graphite Irradiation-Induced Creep Test Capsule. AMIR S. MOBASERAN and HALL C. ROLAND, Nuclear Engineers Department, University of Tennessee, Knoxville.

ABSTRACT

Knowledge of irradiation-induced creep in nuclear graphite is of paramount importance in the design of high-temperature gas-

cooled reactors (HTGR's). This necessitates the characterization and standardization of different types of graphite which require conduction of rather complex and costly irradiation experiments. This paper is concerned with the thermal design of a cylindrical irradiation-induced creep test capsule, designated the OC-6 capsule. The main purpose of the design is to make the capsule capable of maintaining a constant temperature of 1200 C within two graphite specimen columns, contained in the capsule, while being positioned in the Oak Ridge Research Reactor (ORR) core. Gamma heating is the only heat source in the capsule. The main goal of the thermal design has been achieved by incorporating some fixed- and variable-width annular gas gaps within the capsule and around the specimen columns, as well as a thermal radiation reflector around each column. The required gas widths, and their lengths, have been calculated. The overall level of temperature control has also been calculated for various He-Ne gas mixtures (sweep gap) which flow through the gas gaps.

Sampling of Hazardous Wastes at the Hollywood Dump Site. P. R. JAFFE*, F. L. PARKER, D. J. WILSON, Vanderbilt University.

The purpose of this study was to determine the number of samples required to obtain hazardous waste quality parameters within certain confidence limits. The study was done with data we took at the Wolf River at Memphis, Tennessee, downstream of the "Old Hollywood Dump," where, among others, the pesticide industry has been discharging their waste products for over ten years. Several grab samples of water and bottom sediments were taken over a reach of about 5500 m at the Wolf River upstream and downstream of the dumpsite; the analysis showed that the site behaves as a point source. The compounds identified in the samples are heachlorobenzene, heptachlor, chlordane, aldrin, endrin, and dieldrin.

To check if these compounds were well mixed, since all of them are hydrophobic and might have an uneven vertical distribution due to higher concentrations at the surface and/or due to absorption on suspended sediments which would lead to higher concentrations near the bottom, a Nested Design was set up. The results of this design from ten surface, ten mid-depth, and ten bottom samples, which we took at one location, showed that the chlorinated hydrocarbon pesticides studied were vertically well mixed, but that the variance of the instantaneous distribution is significant. The probability distribution of a grab sample was studied and found to be log-normal.

Micro-Computer Applications to Fluid Flow and Heat Transfer Problems. HALL C. ROLAND, University of Tennessee.

The rapid development of micro-computers, with larger memories now being provided at very little additional cost, has brought about much wider applications for them in the various fields of engineering. In many cases it is now possible, indeed more practical, to run some problems in the office or home which once were reserved for rather large computers in central computing centers.

Several applications are discussed, together with suggestions for increasing speed and decreasing need for storage space when using micro-computers. An example is given for one of several type problems in which micro-computers will probably supplant current methods taught and/or practiced in the area of heat transfer. An example is given of a reasonably large and complicated program recently used in problem solution.

GEOLOGY-GEOGRAPHY

DIL BHATIA, *Presiding*

Karst Depressions and Their Drainage Basins—A Morphometric Study. H. H. MILLS, Department of Earth Science, Tennessee Technological University.

Using maps with a scale of 1:2400 and a contour interval of 5 ft. the size and shape of 127 sinkholes and their individual drainage basins in the vicinity of Cookeville, Tennessee, were described quantitatively. Multiple regression analyses showed that sinkhole variables related to depth of the sinkhole showed only weak relationships to basin variables (multiple-R values ranging from 0.223 to 0.413), whereas variables related to planimetric size showed much stronger relationships (R values ranging from 0.733 to 0.788). Hence, sinkhole depth is little affected by drainage-basin morphology, probably being mainly a product of local lithologic and structural conditions. Sinkhole planimetric size, however, is strongly affected by this factor, suggest-

ing a casual relationship. An "irregularity index" showed that sinkholes with larger drainage basins tend to have more irregular, dissected margins than do those with smaller basins. It thus appears that lateral expansion of sinkholes resulting from headward erosion of streams is more active where basins (and therefore streams) are larger, which may account for the larger size of sinkholes in larger basins.

Springs in Montgomery County, Tennessee. M. D. DAMRON and D.M.S. BHATIA, Austin Peay State University.

Sixty-eight perennial springs were located and studied, of which nine are large, twenty-two are medium, and thirty-seven are small in size. Their size classification is based on an estimate of water flow.

The spring water is used for various purposes ranging from natural scenic sites, domestic and/or agriculture use, fish ponds, campground locations, community water source, church sites, and location of past or present industry.

The history of some of these springs is very colorful: original land grants sites, plantations run with slave labor, confederate camp sites, focus of community settlement, and iron and leather industry locations.

Facies and Diagenesis in the Fort Payne Formation. D. N. LUMSDEN, J. R. ANDERSON and P. G. GREGORY, Memphis State University.

The Fort Payne Formation (Mississippian, Osagean) Crops out over much of central Tennessee. For this study, 4 complete sections were measured and sampled, 3 in Central Tennessee and one in East Tennessee (Jellico). Thin sections, insoluble residue, and X-ray diffraction analysis were used to determine gross facies distribution and the sequence of diagenetic alterations of the Fort Payne. Central Tennessee lithofacies types are dolomitized lime mudstone (11%), wackstone (much dolomitized) (35%), packstone-grainstone (10%), dolostone (27%) and chert (16%). The east Tennessee outcrop is dominated by cherty dolomites (70%), lime mudstone (14%) and shale (16%). The Fort Payne thins, becomes more cherty, more dolomitic, more argillaceous and more micritic to the east. The sequence of diagenetic change appears to be dolomitization-chertification and in some cases, dedolomitization. Samples with 95% or more dolomite have significant secondary porosity.

Geologic Reflections of Syria. ROBERT L. WILSON, University of Tennessee, Chattanooga.

The area represents two essentially different cycles of sedimentation resulting from tectonic activity. From middle Jurassic to Eocene the rocks are characterized by marine conditions which are the result of a steady influx of shallow marine and coastal sedimentation.

Beginning with the Oligocene there was a gradual retreat of the sea and the younger rocks are exclusively continental in nature.

The present relief was formed by tectonic movements which occurred in the early Pleistocene. It was during the last Pleistocene that the present drainage systems were established and the modern landscapes formed.

Albedo And Surface Temperature Variations On East Tennessee Strip Mines. F. L. CHARTON, Roane State Community College.

Strip mining may produce wide variability in the types and colors of materials exposed on the surface. In such cases, the results often are sharply contrasting albedos and temperature patterns. Low albedos on darkened spoil materials may produce excessively high temperatures which retard or prevent effective revegetation. The problem is particularly severe on abandoned strip mines where the original top soil has been lost.

Geology and the legislature in antebellum Tennessee. JAMES X. CORGAN, Austin Peay State University.

Between 1831 and 1861 sixteen legislative acts established, terminated, continued, or redirected the geological activities of state employees in Tennessee. Legislative acts and other actions of the legislature suggest that, for studies in the history of Tennessee geology, the ante-bellum era can be divided into six time units: before 1831, a time of non-support for geology; 1831-1835, widespread but unfocused support; 1836-1845, a time of strong industrial support; 1846-1853, a doldrum period of weak support; 1853-1858, a time of extremely strong, well balanced support; and 1859-1861, a time of weakening support.

Description and Significance of the Gravity Field in the Reelfoot Lake Area. RICHARD G. STEARNS, Vanderbilt University.

Three large anomalies dominate the regional pattern: the

Covington pluton (high), the Ridgely high, and a low near Dyersburg. Many lesser features are evident on a residual map, which collectively show two directional trends, north-northeast and west-northwest. Some anomalies relate to surface features such as individual bends and reaches of the Mississippi River, and the Ridgely to Tiptonville uplift, indicating tectonic control of some river courses and topographic features. Changes in trends of residual anomalies coincide with limits of areas having abundant earthquakes, the most abundant earthquakes occurring in the area of northeast trending anomalies centering at Ridgely.

Coincidence of some gravity anomalies with magnetic anomalies indicates plutons, the most certain of which are the Covington pluton and one near Bogota. Some and perhaps most anomalies relate to faults; such as at Reelfoot Scarp and Ridgely. Probably the edge of Reelfoot Rift follows residual anomalies trending northeast from Covington pluton.

Gravity anomalies to geologic features through a large range of sizes. Small anomalies result from clay-filled abandoned Mississippi River channels and near-surface faults off-setting a few tons of feet of sand against lighter clay. Larger anomalies result from larger fault offset of Paleozoic dolomite against lighter Cretaceous sand and clay. In nearly all cases, gravity alone is not definitive. Other information must be correlated such as earth resistivity for shallow features, and magnetic and seismic information for deeper features.

Guatemala: The Geography of Energy. RALPH O. FULLERTON, Middle Tennessee State University.

Guatemala, perhaps more than any other Central American country, is making significant advancements in developing its energy resources. At present, the government has placed its energy development, especially in the area of hydro-electricity and oil, as one of the major national priorities. Purchases of foreign oil have represented a serious drain on the Guatemalan economy, increasing \$54 million in a ten-year period.

Electrical energy demand is expected to increase at a yearly rate of 11.7 per cent. Between 1980-1990, this will represent an increase from 549 to 1109 megawatts. To meet this demand, five major hydro-electric projects are now under construction in the country. These projects are Aquacapa, Chixoy, Santa Maria II, Chulac, and Xalala.

Concurrent with the hydro-electric developments, the government, in concert with foreign companies, is encouraging oil exploration within the country. There are four basins considered to have petroleum potential: the sub-basin of Petén Norte, the sub-basin of Petén Sur, the basin of Amatique, and the Pacific Basin.

Pleistocene Footprints from Centerville Cave, Hickman County, Tennessee. G. RICHARD WRIGHT, and BRIAN CRIST, Centerville; TIMOTHY L. RIDDLE and JAMES X. CORGAN, Austin Peay State University.

Centerville Cave (Town Cave #2) is a complex maze cave that underlies part of Centerville, Hickman County. Over three miles of passages have been mapped. Many are partially filled with fine-grained sediment that preserves an extraordinary variety of paw and claw marks. Bear markings are so widely distributed that they must have been made by many different individuals on many different occasions. Peccary hoof prints are much rarer. Both bear and peccard are also represented by skeletal remains. One peccary skeleton is almost totally replaced by gypsum. Centerville Cave is the only known North American site that yields Pleistocene peccary footprints. The age of bear paw prints, claw marks, and skeletal parts is uncertain but they are probably Pleistocene. A comparable occurrence of bear claw marks has recently been described from Arkansas.

MEDICAL SCIENCES SECTION

R. DEAN BLEVINS, *Presiding*

A New Chelate Antidote for Acute Uranyl Acetate Intoxication. MARK A. BASINGER and MARK M. JONES, Vanderbilt University.

There are instances in which it would be advantageous to be able to remove uranium compounds from the human body. The present study examined the use of Tiron (sodium 4,5 dihydroxybenzene-1-3-dissulfonate) for this purpose. Tiron, given i.p. was

found capable of antagonizing the lethal action of uranyl acetate given i.p. at levels up to 80 mg/kg, when the Tiron was given at 20 minutes, 1 hour and 3 hours after the uranyl acetate at a mole ratio of chelating agent to uranium of 10:1 for each Tiron injection. Tiron itself has a low inherent toxicity. In a comparative study, Tiron was found to be a superior antidote to the best of the other compounds reported for this purpose, sodium calcium, diethylenetriaminepentaacetate (DTAA).

Reduction of Lymphatic Cancer in Rats. R. L. TROELSTRUP, Tennessee Tech University; GINA HENDRIX, Tennessee State University.

Eight mature albino (Holtzman) rats with varying degrees of lymphatic tumors were divided into two groups balanced for sex of subject and extent of carcinoma. One group was allowed to drink only a .4 molar solution of sucrose that provided a daily dose of 3Mg/Kg of cyclophosphamide (Cytosin-Mead Johnson). The other group was given tap water. Drawings of tumor size were made every third day for a period of fifteen days. Blind sequential ratings on a 5-point scale indicated a highly significant effect from the drug [$F(1,6) = 40.29, p < .001$]. The results indicated a decrease in tumor growth with cytosin and an increase of cancer with water. These effects were progressive over time [$R(1,22) = 4.36, p < .05$]. No significant differences in weight changes were noted between the two groups or over time. The rapid effect of the drug may be due to the high rate of metabolic activity in rats.

Metallothionein Levels in Zinc and Cadmium Treated Fetal Rat and Female Adult Rat Isolated Hepatocytes. R. D. BLEVINS, East Tennessee State University and L. S. SASSER, Comparative Animal Research Laboratory.

Metallothionein (Mt) in fetal hepatocytes and adult female hepatocytes cultured in vitro and exposed to $10 \mu\text{g ZnCl}_2$ per ml of medium or $1 \mu\text{g CdCl}_2$ per ml of medium for 24 to 48 hours was investigated along with non-treated controls. Fetal livers for isolation of hepatocytes were taken 18, 20, and 21 days post-pregnancy of the mother. Metallothionein content of the tissue cultures was estimated by Piotrowski's Hg-saturation method and the use of chromatographic columns of Sephadex G-75. Results indicated that the *in vitro* cultured fetal hepatocytes do not produce more Mt when challenged with Zn^{2+} or Cd^{2+} . However, the adult female hepatocytes had significantly greater amounts of Mt when challenged with Zn^{2+} or Cd^{2+} than did the non-treated controls.

Treatment of Extensive Scalp Wounds: Ancient, Frontier, and Modern Techniques. DENISE I. PAV and JOE L. ROBERTSON, East Tennessee State University.

Ritual scalping was practised by Scythians, certain African tribes, and American Indians. Large scalp lesions were, further, produced by battle axes, swords, burns, and, from the second half of the nineteenth century, by industrial machines. Untreated denuded scalp lesions lead to necrosis and death. Treatment, ancient through modern, is long, tedious, and difficult. Various surgical treatments are discussed, with emphasis on a technique of James Robertson, eighteenth century layman of East Tennessee.

MATHEMATICS SECTION

ALVIN TIRMAN, *Presiding*

A DNA Paradox. A. SIMOSON, King College.

The set of all real numbers M between 0 and 1 written in binary form such that the relative frequency of 1's to the total number of digits is $\frac{1}{2}$ has a measure of 1. This startling result raises a natural question as to whether the suggested probability is "true". That is, if we randomly choose a number (necessarily an irrational number), will this number turn out to belong to M as expected? Identifying the base beads in the DNA strands with 0 and 1 and interpreting the resultant expansion as a practical irrational number can perhaps "validate" or "invalidate" our theory.

ZERO. ALVIN TIRMAN, Kingsport University Center, E.T.S.U.

Some properties of Zero are reviewed in a novel manner. The paper presents them in a way designed to amuse and to interest students taking courses in pre-calculus college math.

Scale Partitions of Positive Integers. JIM D. RIDENHOUR, Austin Peay State University.

A scalene partition of a positive integer n is defined as an ordered triple (a, b, c) such that $a, b,$ and c are positive integers whose sum is n and $a < b < c$ where c is no larger than $n/2$. If $s(n)$ denotes the number of scalene partitions of n , then $s(n)$ is the number of noncongruent scalene triangles of integral dimensions with perimeter n . Several properties of such numbers are given and a general formula for $s(n)$ is obtained. The formula for $s(n)$ depends upon the residue.

PHYSICS AND ASTRONOMY

ROBERT SEARS, *Presiding*

The Application of Laser in the Study of Silicon Solar Cells. MARY C. LU, Walters State Community College.

Since its discovery in 1958, the laser, with its inherent properties of coherence and high intensity, has become a significant electro-optical development. Today, it is one of the most important technologies in the science world. It has already shown its wide applications in space communications, localized surgery, graphic arts, and materials research.

This paper will briefly introduce the principle of laser, the types currently available, and its application in the fabrication of solar cells. A special emphasis will be placed on laser techniques used in the processing of high-efficiency silicon solar cells such as the utilization of HeNe laser in examining the effect of lithium passivation on grain boundaries in polycrystalline silicon and the removal of defects in ion-implanted silicon by laser annealing.

*Preliminary Simulations of Health Risks from Long-Term Shallow-Land Burial of Low-Level Radioactive Wastes** D. E. FIELDS, C. A. LITTLE, C. J. EMERSON, G. HIROMOTO.

PRESTO (Prediction of Radiation Exposures from Shallow Trench Operations) is a computer code developed under United States Environmental Protection Agency funding to evaluate possible health effects from radionuclide releases from shallow, radioactive-waste disposal trenches and from associated areas contaminated by operational spillage. This model is designed to simulate transport of radionuclides from the disposal site and to predict exposures and risks for the 1000-year period following the end of burial operations.

Simulations have been performed for several variants of release scenarios at three sites having differing waste inventories, geophysical characteristics, and population distributions. Initial results tend in general to support the disposal option of shallow-land burial for many short-lived radionuclides. The dominance of one exposure mode over others for certain combinations of site and radionuclide characteristics is also apparent. Still other results suggest that undesirable health consequences may be reduced by adapting a time-dependent strategy of waste management.

Electric Field Induced Phase Transition in PdH. J. W. HAHNEKEN, D. R. FRANCESCHETTI, W. C. FORD, JR., Memphis State University.

The steady-state distribution of absorbed hydrogen in a Pd wire subject to an applied potential difference is examined. The absorbed hydrogen is treated as a lattice gas with attractive nearest neighbor interactions in the mean-field approximation. The electric field can induce a distinct phase boundary between a concentrated liquid-like beta phase and a dilute gas-like alpha phase and the locations of this phase boundary can be shifted by altering the applied potential difference. The position of the phase boundary was determined by integral equations which required the electrochemical potential to be a constant and the number of hydrogen atoms to be conserved. These equations were solved iteratively by numerical integration.

SCIENCE-MATH TEACHERS SECTION A

JACK RHOTON, *Presiding*

Quality Training in the Sciences: Quo Vadis?* DR. RUBY P. TORREY, Tennessee State University.

Since the late sixties, there has been a decline nationally in the number of students choosing the hard sciences as a major

area of concentration in college. Educators and scientists alike are asking, why? Living in the midst of an era of technologies unlike anything that has happened before, everyone is affected by the technological advances. Like it or not, they are here to stay. Hence, quality training in the sciences must be a top priority for all citizens. Scientific literacy is imperative.

Quality training in the sciences begins with science awareness during the pre-school years as a complement to the innate curiosity possessed by almost every child. This awareness requires that youth be given encouragement and support in their academic pursuits by pointing them in the direction of excellence. The forward thrust toward development must be theirs, but the training must give the direction.

According to our definition, the sciences include: chemical sciences, biological sciences, mathematical sciences, computer science, earth science, physics and astronomy.

Tennessee Energy Education Program. DR. A. PAUL WISHART, The University of Tennessee, Knoxville.

Energy education is not the sole responsibility of the science teachers or of science courses. The ideas relating to energy involve every teacher and student in each of the teaching areas within the schools. Since we are all consumers of energy in its many forms it is to our advantage to work in a cooperative manner to promote a high level of energy education from grades K-12 and also in our colleges and universities.

A major goal of energy education should be to make all people in the school and community more aware of the problems, issues, and possible solutions. Scientists, engineers and science teachers can be very helpful in providing basic information for others to use but this approach to energy education alone is not sufficient. The result of well-planned efforts in energy education by all educators should help in maintaining an acceptable standard of living for current and future generations in America. The option of surviving as a viable and strong nation may well depend on the success of energy education.

Computer Power—An NSF Curriculum Project for the '80's High School Students, Microcomputers, and Problem Solving. BILL BAIRD, University of Tennessee, Knoxville.

An NSF SEDR grant of \$208,000 to the University of Tennessee Computer Science Department in 1979 has now produced the first intergraded curriculum for teaching secondary students beginning programming skills in Pascal. COMPUTER POWER is being released by the Gregg Division of McGraw-Hill Publishing in September, 1981 for use on the Apple II micro-computer with 48K memory. A complete Teacher's Manual is the product of two years of classroom testing by co-authors consisting of high school teachers and computer science professionals. Student books will contain computer exercises in art, music, physics, and math, as well as readings in the current applications of computers in society. Initial evaluations indicate improved problem solving skills and high motivation for computer related careers by students who have completed the one-semester course. Demonstration of the software and courseware will be provided by Baird—one of the co-authors and test school teachers.

A Modified Testing Method with Immediate Reinforcement. JIM KEMP, Middle Tennessee State University.

A modified testing technique which allows the student to "find" correct responses to difficult questions has merit in raising test scores, improving learning continuity, increasing motivational level and improving long range learning. This technique employs duplicate answer sheets, a modified scoring method, is applicable to any written situation and can be used by any teacher.

Achievement Test Scores in Science. BETTY W. GIESEMANN, Bryan College.

A recent national study of achievement test scores in mathematics and the sciences indicate that test scores in these areas have declined for all students in the last ten years, but they have remained fairly constant for students who planned to enter college and major in these disciplines. A study of Bryan College UAP and ACT Test scores from 1973 to 1980 indicate relatively stable test scores in the area of the Natural Sciences—more stable in fact than in other area tests.

Some individual test scores are analyzed for correlation with grades in chemistry and physics; but, due to the small number of students there is no evidence of a significant correlation of test scores with grades.

The Psychological Principles in Learning Mathematics. PAUL H. LU, Walter State Community College.

Mathematics is, in essence, a way of thinking and reasoning. The teaching and learning of this subject inevitably involve psychological consideration. With the advancement of learning psychology, many learning principles have been made applicable to mathematics learning. The "new math", for example, is based on a learning theory that learning can be made more effective by understanding rather than by rote memory. The past tragedy was that this theory had been over-emphasized at the expense of other equally important learning principles. Thus, a multi-phasic understanding of the psychological process in math learning seems to be a need for mathematics educators. From his work as school psychologist, the author uses the common problems he found in the mathematics area to discuss the basic principles in learning mathematics.

Mathematics for Non-Physical Science Students. JOE S. EVANS and THOMAS FORREST, Middle Tennessee State University.

There is at present a national trend for mathematics departments to offer courses in linear algebra, calculus, probability and statistics, and computer science for students in managerial, social, or life sciences. Experiences with these courses, and a NSF Chautaugua course on calculus for the non-majors in the physical sciences will be discussed.

Making Models of the Atom. MARIAN YOUNG, Montgomery Central High School, Cunningham.

A discussion of how students can make models of atoms in the third dimension. This method is utilized to teach concepts pertaining to the atomic nature of matter. This tool is extended to teach concepts relating to atoms combining to form molecules, isotopes, and nuclear fusion.

Use of Personal Computers in the Classroom. SAM WILLIAMS, Jefferson Junior High School, Oak Ridge.

This presentation will stress the importance of educators understanding the speed at which the personal computer field is expanding. It is predicted that by the year 2000 the home computer will be as common as television. If this prediction is accurate, students now entering first grade will be required to understand and use computers to survive in a rapidly changing and highly technological world. It will be up to the public education to help train these students to understand and use computers.

Most educators are not familiar with computers and how they operate. So the first order of business is to train the teacher how computers can be used in the classroom to provide drill and practice, programming, simulation, and daily record keeping.

Teaching the Gifted. DAVID ASHBY, Kingsport City Schools.

Concern for the qualities of exceptional human beings arises out of an exceptional concern for the qualities of all human beings. Though physical, emotional and mental differences are a fact of life, we must not only tolerate these differences but value them as well if we are to use the power of gifted individuals to improve our lot in the world. No doubt, one of our most untapped resources lies in the minds of our gifted students. There are unlimited inventions, potential cures and scientific advancements awaiting an opportunity to benefit mankind. As Toynebee tells us, "it is only a few in each generation who form the creative minority, able to reward society with new responses to challenges of the day."

This paper will address the topic of giftedness, looking at goals for gifted students, types of giftedness, opportunities for divergent thinking production, aids to developing creativity, and ideas concerning gifted science activities on the secondary level.

TVA's Environmental/Energy Education Program—A World of Resources. DONNA A. LIFUR, Tennessee Valley Authority.

Discussion of TVA's Environmental/Energy Education Program including: University-based centers for environmental/energy education, which provide (a) teacher training, (b) regional assistance to schools, (c) program development, and (d) research directed toward environmental/energy education.

Special TVA resources including (a) Land Between the Lakes, Nolichucky, (b) Norris, and (c) Muscle Shoals, which provide special opportunities for environmental/energy investigations.

Development of a Conservation/Natural Resources Class and Related Camp. MR. PAT GRIMES, Livingston Academy.

Livingston Academy has a Natural Resources class that was established with the cooperation of the U.S. Soil Conservation Service. Over its three year period of operation research, field trips, labs, and conventional classes have been used to illustrate

not only conservation practices but future problems and possible answers. The course begins with a history of the conservation movement in the U.S., and encompasses soils, wildlife management, fishery study, forestry, sewage treatment, water quality, and basic ecological principles. The year after the class was begun an Eco-camp sponsored by the U.S. Army Corps of Engineers was developed to show practical application of the classroom work. Today it is the highlight of the class. In the future a program called Outdoor Experiences is to be added where students will take part in outdoor activities on a quarterly basis.

A Statistical Study Correlating General Chemistry and Advanced Chemistry for High School Students. ELAINE HALL, Westview High School, Martin.

Discussion of a study correlating general chemistry and advanced chemistry for high school students including: introduction to the statistical study and the origin and source of data; the correlation between general chemistry "grades" and advanced chemistry "grades"; the correlation between general chemistry "grades and algebra I "grades; a prediction model based on correlation for the predication of an advanced chemistry "grade" from one year of general chemistry; and the methods utilized to produce good results with general and advanced chemistry students.

How Does the Gas Station Attendant Get to Work? On a Bicycle! WM. R. CRANFORD, Jackson Central-Merry High School.

This presentation focused on high school physics today, how one teacher does it, and some methods used. The presentation emphasized what is seen today in the students, what they react to, and some ideas as to what is changing or not changing in the high schools.

ZOOLOGY SECTION

JOHN R. FREEMAN, *Presiding*

A Method of Determining Chronic Trace Metal Poisoning in Wild Fish. R. J. STRANGE and M. S. TISA, the University of Tennessee.

Despite the substantial literature on trace metal toxicity to aquatic animals, no specific methodology has been proposed for the determination of chronic trace metal poisoning in wild fish. The use of tissue residues has been suggested as an indicator of trace metal toxicity, but only for acute exposures. We developed a systematic approach for the determination of chronic trace metal poisoning based on two criteria: 1) comparison of organ tissue residues from fish in question to residues from the same species from waters with no suspected trace metal problem and 2) comparison of organ tissue residues from fish in question to residues from fish exposed to the metals in long-term laboratory studies. Applying these criteria to striped bass (*Morone saxatilis*) in Cherokee Reservoir, an East Tennessee impoundment with a history of unexplained fish kills, we concluded that recent striped bass mortalities were not due to chronic poisoning by zinc or cadmium.

Effects of Artificial Cover on Prey Availability for Young-of-year Black Basses. T. D. BROADBENT and R. J. STRANGE, The University of Tennessee.

Ten sections of the fluctuation zone of Lake Nottely, a 1692 ha lake in Northern Georgia, were successfully seeded with field rye to determine the effect of artificial cover on the availability of prey for three species of black basses (largemouth, smallmouth, and spotted bass). The 10 seeded and 10 unseeded (control) areas were sampled by night seining every two weeks from June 16 to August 17, 1981. The seeded sections contained 2.65 times more available prey of *Lepomis* species than the control. Young-of-year black basses and crappie were more abundant in seeded areas by 1.39 and 1.82 times, respectively.

Effects of Shoreline Revegetation on Black Bass. *W. B. KITTRELL and R. J. STRANGE, The University of Tennessee.

Revegetation of fluctuation zones was conducted on Lake Nottely, a 1692-hectare TVA impoundment located in northern Georgia, throughout the summer of 1980. This study was undertaken as a management technique for improvement of young-of-year black bass. Ten experimental sites seeded with field rye and 10 corresponding control sites were sampled through night seining at two-week intervals from June through August of 1981. Numbers of bass from the experimental sites collected in June

and July were significantly higher than those collected from control areas, though numbers decreased to similar levels near the end of the summer. Young-of-year bass in the revegetated areas were up to 15% heavier and 9% longer than bass in the control areas during the summer sampling period.

Development of Instream Chambers for Burrowing Mayflies: Application to Site-Specific Toxicity Monitoring. T. C. YEHL and E. L. MORGAN, Tennessee Technological University.

Fish instream chambers have been historically used as an assessment tool for toxic chemical spills and drainage. Site-specific fish bioassays are regularly employed as a means to evaluate toxic wastes, the development of an instream bioassay chamber designed for aquatic insects would help expand the instream fish bioassay into a simplified in-situ microcosm or multiple species bioassay. Instream chambers which accommodated *Hexagenia* spp. were designed and used to assess water quality at two instream sites and in a simulated laboratory test. Generally, this study supports the observation that *Hexagenia* sp. are easily managed in artificial chambers and provides evidence that site-specific applications generate valuable information in combination with simplified microcosm toxicity tests. Tests, Results, and design effectiveness will be discussed in light of site-specific toxicity testing.

Morphologic Variation in the Raccoon, Procyon lotor. MICHAEL L. KENNEDY and STEVEN L. LINDSAY, Memphis State University.

Morphologic variation was assessed in 393 specimens of the raccoon (*Procyon lotor*) with univariate and multivariate analysis. A matrix of correlation among 20 skull characters was computed and the first three principal components extracted, which accounted for 84.2% (component I = 67.4%; II = 10.6%; III = 5.9%) of the variation in the character set among males and 86.5% (component I = 71.5%; II = 9.1%; III = 6.2%) among females. Three-dimensional projection of localities onto principal components show that for both males and females the large individuals occur in the western and northern states, and the smallest animals occur in the Florida Keys. Size gradations are seen with most raccoons being similar to those in nearby geographic areas.

Spring Food Habits of the Wild Turkey (Meleagris gallopavo) in Western Tennessee. FARROKH RAFIL-TABATABAIA and MICHAEL L. KENNEDY, Memphis State University.

Food habits of wild turkey (*Meleagris gallopavo*) were studied on Shelby Forest Wildlife Management Area during the springs of 1979-1981. Gizzards of 87 specimens were examined for food contents. Sugar hackberry seeds (*Celtis laevigata*) made up approximately 54% of the food materials examined, green forbs (*Triticum aestivum*, *Setaria* spp., *Oxalis* spp.) 18%, and acorns (*Quercus* spp.) and hickory nuts (*Carya* spp.) 9%. Sugar hackberry seeds occurred in 77% of the specimens examined, green forbs 70%, and acorns and hickory nuts 29%. Sugar hackberry was determined as the principal food item during the three year period.

Taxonomic Status of the Pygmy Shrew (Sorex hoyi) in Tennessee. GEORGE D. BAUMGARDNER and MICHAEL L. KENNEDY, Memphis State University.

Taxonomic status of the only known Tennessee specimens of the pygmy shrew (*Sorex hoyi*) was examined using morphometric analyses. Three external and 25 cranial measurements were obtained from 12 Tennessee specimens, housed in the Memphis State University Museum of Zoology, and 48 representatives of the three eastern subspecies of *S. hoyi*, *thompsoni*, *winnemana*, housed at the U. S. National Museum. Tennessee specimens were examined and compared to the knowns using various univariate and multivariate statistical techniques. All analyses showed the Tennessee animals to be most similar to individuals of *S. h. winnemana*, to which they are assigned.

Variation in White-tailed Deer from Tennessee. PHYLLIS K. KENNEDY and MICHAEL L. KENNEDY, Memphis State University.

Liver and kidney samples of 57 white-tailed deer from six counties in western Tennessee were electrophoresed using a horizontal starch gel method. Of 15 protein systems examined, five were slightly polymorphic. The amount of variation observed was considerably less than that noted in white-tailed deer from other parts of the southeastern United States.

The Coyote (Canis latrans) in Western Tennessee. RICHARD A. SMITH and MICHAEL L. KENNEDY, Memphis State University.

The taxonomic status, degree of parasitism, and impact on the

native fauna of the coyote-like canid in western Tennessee were studied from 1979-1981. A total of 74 skulls were collected and subjected to discriminant function analysis. Contents of 54 digestive tracts were analyzed for parasites and food habits. In addition, 54 hearts were examined for heartworms. Over 90 percent of the skulls examined clustered with known coyote specimens. Approximately 75 percent of the digestive tracts contained nematodes and about 50 percent cestodes. Heartworms were determined in over 50 percent of the specimens examined. The most common food items over all seasons were rodents, livestock, fruit, and rabbits.

The Effects of Ethanol and Testosterone on Tail Regeneration in Fish. J. L. ROBERTSON and D. I. PAV, East Tennessee State University.

One of the ways that guppies exhibit sexual dimorphism is the growth of an elongated tail in males. Administration of exogenous testosterone accelerates that tail growth process. Studies of wound healing have shown that tail regeneration in fish is slowed by exposure to 0.5% ethanol in the aquarium. This work indicates that these effects cancel each other when both substances are administered simultaneously.

COLLEGIATE DIVISION

DR. RICHARD RARIDON, *Presiding*

Springs in Robertson County, Tennessee. ASHLEY A. ROGERS and D. M. S. BHATIA, Austin Peay State University.

In Robertson County, Tennessee, seventeen perennial springs were located and classified according to their estimated size and use. There are six large, seven medium and four small springs. One large and four small springs are no longer in use; seven springs provide water for domestic and agricultural purposes. The spring at Orlinda known as "Element Springs" is used as a reserve water supply for the community, since the availability of city water negates its original purpose. Yates Cave and the associated spring is a place for private parties. The Bell Witch Cave and its spring is a local scenic attraction, well known in the middle Tennessee region because of the legend of the Bell witch. Two springs could not be classified due to their inaccessibility.

The Centerville Natural Bridge. TERRY L. BERNER, JOHN M. SANT, PHILLIP R. KEMMERLY, Austin Peay State University.

Centerville Natural Bridge is located on the Southeast portion of the Centerville Quadrangle along the escarpment of the Western Highland Rim. Of the 36 recorded natural bridges in Tennessee all but two are found in Pennsylvania sandstone of the Cumberland Plateau and Mississippian carbonates of the Highland Rim. The Centerville bridge, however, occurs in the Wayne Group in limestone of Silurian age. The bridge measures 31.5' in height from its base to the top of the Lintel, with a clearance of 9.6'. The width is 23.5' with a span of 16.3'. Two systematic joint set trendings reflect the uplift of the Highland Rim. N 60-70 W trend and the other a N 30-40 W trend. The bridge parallels that of the latter joint set.

A Continuing Study of the Reaction of Trichloroacetic Acid and Elemental Copper in a Dimethyl Sulfoxide Medium. T. L. PUCKETT, William Jennings Bryan College.

A study of the reaction of trichloroacetic acid and elemental copper using a dimethyl sulfoxide (DMSO) medium revealed unique rates of reaction. Certain proportions of these compounds react with an almost explosive force (see *Chemical & Engineering News*, Vol. 59, Number 28, page 4). Reactions of copper and trichloroacetic acid in DMSO are in the order of 1500 or more times as fast as in water. One of the systems studies yielded a product with the apparent empirical formula of $Cu[S(CH_3)_2]Cl$. Atomic absorption spectroscopy and mass spectrometry analyses suggest this to be an organometallic complex with a single DMSO molecule and DMSO dimer attached. Further studies of the reaction are necessary to determine the reaction pathways and products.

A C-13 NMR Study of the Condensation of Triethyl Phosphonoacetate with Aromatic Aldehydes. WILLIAM O. WILKISON and CHARLES N. ROBISON, Memphis State University.

In the original reports of this condensation reaction it was suggested (by S. Patai) that most aromatic aldehydes react by a normal Knoevenagel reactions to give the expected triethyl