ABSTRACTS OF PAPERS PRESENTED AT THE 105TH ANNUAL MEETING

The 105th annual meeting of the Tennessee Academy of Science was held jointly with the 80th annual meeting of the Kentucky Academy of Science in Bowling Green, Kentucky. The sections used with the abstracts are those of the joint meeting and vary from the formal sections of the Tennessee Academy of Science. Most sections of the joint meeting were chaired by a representative of each academy. Only abstracts of papers presented by members of the Tennessee Academy of Science and the chairpersons representing the Tennessee Academy of Science for the respective sections are given.

BOTANY SECTION
Carol Baskauf, Chair

EXAMINATION OF PROTEIN FROM *GLYCINE MAX*. *Lazette Williams*, E. L. Myles, D. Baugh, and C. Caudle, Tennessee State University, Nashville, Tennessee.* Throughout human history, man has depended on plants for his very existence, but plants constantly are being plagued with several types of agents that result in lowered yield or reduced quality. Without plants, man (like other animals) may find themselves struggling to survive. Plant disease influences the nutritional cycle. Soybeans frequently are invaded by bacterial blight, that is caused by *Pseudomonas syringae* pv. *glycinea*. This pathogen produces tabtoxin, that specifically inhibits glutamine synthetase. This project is designed to test the effects of methionine sulfoximine on soybean. Methionine sulfoximine has the ability to mimic the effects of the pathogen. Three different cultivars were selected for this study: TSOY 9402; TSOY 9411; LGSD 9403. The seeds were placed in pea pellets and allowed to germinate in clay pots for 4 weeks. After 4 weeks postgermination, the stressor was sprayed at 12- and 24-μM concentrations. After 3 weeks, proteins were extracted from the leaves, using a phenol-protein-extraction procedure. These proteins were compared with the controls. The results showed, in higher-molecular-weight proteins (200-60 KDa), there was no change in the amount of protein synthesized under the different stress levels. There were significantly more newly synthesized proteins in the lower molecular weights (43-14 KDa) in all cultivars that were exposed to methionine sulfoximine. At 24 μM of methionine sulfoximine, there was an increase in the amount of protein that was synthesized. This may suggest that protein synthesis is an important factor in disease resistance. The synthesis may not be inhibitory to the pathogen, but it may activate the synthesis of defense chemicals. It is possible that increased protein in plants attacked by pathogens reflect the increased production of enzymes or other proteins that are involved in the defense reaction of plants.

THE RARE VASCULAR PLANTS OF THE FORT CAMPBELL MILITARY RESERVATION, KENTUCKY AND TENNESSEE. *Edward W. Chester, B. Eugene Wofford, Landon E. McKinney, and David Campbell, Austin Peay State University, Clarksville, Tennessee (EWC), The University of Tennessee, Knoxville, Tennessee (BEW), and Kentucky State Nature Preserves Commission, Frankfort, Kentucky (LEM), The Nature Conservancy, Nashville, Tennessee (DC).* A survey for listed taxa of vascular plants was conducted within accessible areas of the Fort Campbell Military Reservation from 15 March 1993 to 31 October 1994. The 42,687-ha Reservation occupies parts of Montgomery and Stewart counties, Tennessee, and Christian and Trigg counties, Kentucky. Portions of two Interior Low Plateaus subsections (Pennyroyal Plain and Western Highland Rim) are included and result in considerable landtype, habitat, and species diversity. Extensive fieldwork detected 18 taxa that are listed in either or both Kentucky and Tennessee (*Carex alata, Hieracium longipilum, Hydrastis canadensis, Juglans cinerea, Malus angustifolia, Muhlenbergia glabrifloris, Oenothera linifolia, Panax quinquefolius, Phacelia ranunculacea, Platanthera peramoena, Populus grandidentata, Prenanthes aspera, Prenanthes barbata, Rudbeckia subtomentosa, Scleria ciliata, Silphium laciniatum, Silphium pinnatifidum,* and *Tomanthera auriculata*). Three of these species (*J. cinerea, P. barbata,* and *T. auriculata*) are federal candidates (C2).

ANALYSIS OF CHLOROPHYLL A FLUORESCENCE FROM GERMINATING *EQUISETUM HYEMALE* L. SPORES. *Jefferson G. Lebkuecher and Christopher J. Chabot*, Austin Peay State University, Clarksville, Tennessee.* The spores of *Equisetum* can survive virtually complete desiccation yet cannot endure this quiescent state for more than ca. 2 weeks. To examine the effects of desiccation-duration time on rehydration-induced photosynthetic recovery, isolated spores of *E. hyemale* were desiccated at 2% relative humidity for 24 h, 1 week, and 2 weeks and then rehydrated for 24 h at 200 μmol photons m^{-2} s^{-1}. Previous research from this laboratory demonstrated that, following rehydration, photosynthetic O_2 evolution from spores desiccated 1 week is slowed relative to spores desiccated 24 h. Spores desiccated 2 weeks do not exhibit any sign of rehydration-induced photosynthetic activity. In the present study, the same desiccation-rehydration design is employed to examine the nature of the desiccation duration-induced loss of photosynthetic recovery utilizing chlorophyll a fluorescence. The relative number of photosystem II centers is determined by variable fluorescence yield. Photochemical efficiency of photosystem II centers is determined by variable to maximum fluorescence yield ratio. We found that increasing desiccation duration significantly decreases the number of photosystem II centers as well as the photochemical efficiency of the remaining photosystem II centers following rehydration. The combination of these decreases parallels the desiccation duration-induced losses of whole-spore photosynthetic recovery as determined by the previous O_2-exchange experiments. These results suggest that the extremely short viability of spores of *E. hyemale* is due to progressive loss during the desiccated period of the ability to recover photosystem-II-center concentrations and efficiency upon rehydration. (Poster)

CELL AND MOLECULAR BIOLOGY SECTION
Terrance Johnson, Chair

ENZYME PROFILES OF *FESTUCA ARUNDINACEA* **(SCHREB.) INFECTED WITH** *ACREMONIUM COENOPHIALUM*. *Evelyn V. Prather* and S. K. Ballal, Tennessee Technological University, Cookeville, Tennessee.* Tall fescue, *Festuca arundinacea* (Schreb.), is an important forage and turfgrass in the southeastern United States. It often is infected with the fungal endophyte *Acremonium coenophialum.* The endophyte's mode of entry into the plant is through the seed. There is no known mechanism of the transmittance of the endophyte from plant to plant in nature. When tall fescue is dormant, the endophyte is confined to the apical meristem. Early in the spring and fall, the endophyte appears prominently in the leaf sheaths. Later in the season, the fungus grows into the floral shoots and ultimately into the seed. The endophyte is located intercellularly within the plant and never damages or penetrates the cells. The presence of the endophyte in tall fescue is correlated with the occurrence of fescue toxicosis in livestock. Fescue toxicosis in livestock is characterized in reduced tall-fescue intake leading to lowered weight gain and milk production. Starch-gel electrophoresis was performed to compare banding patterns of the isozyme malate dehydrogenase in the endophyte-free and endophyte-infected tall fescue. This study indicates that there is a difference in the banding patterns of endophyte-free and endophyte-infected tall fescue. Research is in progress to include banding patterns for the isozymes aconitase, hexokinase, isocitrate dehydrogenase, triose isomerase, catalase, esterase, and peroxidase.

HORMONAL REGULATION OF C-SRC AND C-MYC PROTOONCOGENE EXPRESSION IN GOLDFISH (*CARASSIUS AURATUS***).** *Yukiko Taketani* and J. Michael Redding, Tennessee Technological University, Cookeville, Tennessee.* Protooncogenes play major roles in controlling cellular growth and development in animals. Various hormones regulate protooncogene expression. In this study, insulin, testosterone, and estradiol were tested for their ability to regulate C-SRC and C-MYC expression in the goldfish, *Carassius auratus.* Liver, testis, and brain tissue from goldfish were cultured alone or in the presence of the hormones. Protooncogene expression was estimated by immunostaining of proteins extracted from the tissues and prepared as dot-blots on nitrocellulose or after electrophoresis on polyacrylamide gels. Antibodies raised against mammalian C-SRC and C-MYC crossreacted with fish proteins, with strong staining signals in liver and brain but only faint signals in the testis. Insulin consistently increased the intensity of signal in the liver. Testosterone and estradiol also altered signal strength; however, these results were inconsistent, suggesting the possibility of sex-dependent and developmental differences in sensitivity to these steroid hormones.

CHEMISTRY SECTION
Rudy Gostowski, Chair

AN UNDERGRADUATE POLYMER CHEMISTRY LABORATORY COURSE. *Edward R. Covington, Tennessee State University, Nashville, Tennessee.* A one-semester, undergraduate, polymer chemistry, laboratory course is described. The course consists of experiments in polymer identification by infrared spectroscopy, polymer synthesis by free radical, ionic, and step-growth techniques and polymer characterization. Characterization will include experiments in molecular-weight determination by viscometry and osmometry and in determination of physical properties by thermal analysis including differential scanning calorimetry and thermomechanical analysis.

APPLICATION OF SECOND-DERIVATIVE ABSORPTION SPECTROSCOPY FOR THE DETECTION OF HISTONE H1 AND PHENOL IN DNA SAMPLES. *James C. Howard and Hamid R. Haghnegahdar*, Middle Tennessee State University, Murfreesboro, Tennessee.* Using second-derivative spectra of DNA, N-acetyl-L-phenylalanine ethyl ester, poly(L-lysine, L-tyrosine) 4:1 hydrobromide, and phenol as standards, the contents of mixtures of DNA and histone H1 or phenol employing the multicomponent analysis features of a Hewlett-Packard 8452A Diode Array Spectrophotometer were analyzed. A published work used second-derivative spectroscopy for the simultaneous quantification of aromatic amino acids in purified proteins and in protein-DNA mixtures. The protein used for the protein-DNA mixtures in that study, namely α-crystallin, is questionable. In analyzing protein-DNA solutions, it would be logical to choose a protein that binds or interacts with DNA, such as the histones which function to pack the DNA into compact structures. Human DNA, for example, is about 1 m long but is condensed into a cell nucleus for which the diameter is about 10 μm. The very lysine-rich histone H1 contains one tyrosine and one phenylalanine residue per molecule. The amount of these aromatic amino acids in several DNA-histone H1 mixtures was analyzed spectrophotometrically. In all solutions, DNA was determined with <5% error. Tyrosine was detectable at high H1 to DNA molar ratios in residues per base pair, e.g., 21 residues/base pair, whereas the phenylalanine results suffered from large percent errors and standard deviations. Therefore, sensitive detection of aromatic amino acids contaminating DNA samples using second-derivative spectroscopy requires proteins with multiple phenylalanine, tyrosine, or tryptophan residues. This is especially important for phenylalanine residues because they are much less solvent accessible. The common DNA extraction reagent, phenol, was successfully detected in solutions of 0.1 phenol/base pair (molar ratio) or higher.

THE EFFECTS OF IRON AND HUMIC ACID ON HERBICIDE PHOTODEGRADATION. *Eugene A. Kline, Fangling Lin*, Dennis B. George, and G. Kim Stearman, Tennessee Technological University, Cookeville, Tennessee.* Rose-bengal sensitized photodegradation of the herbicide bromacil in pure silica at greater than pH 9 proceeded by singlet oxygen as the major pathway and free radical as the minor mechanistic pathway. Iron ($\leq 2.5\%$ Fe_2O_3) inhibited (63%) the photodegradation process while increased iron ($\leq 6\%$ Fe_2O_3) caused no further degradation. Water solutions of commercially acquired humic acid in small amounts (0.1%) added to the soil had no effect on the photodegradation of bromacil. Additional humic acid decreased the amount of bromacil recovery which had usually been inversely related to the amount of degradation. However, the humic acid was not shown to be the cause of the decreased photodegradation. Adding mixtures of iron (Fe_2O_3) and solutions of humic acid to the soil showed a surprizing increase in bromacil recovery and less degradation. The exact effects of the iron and humic acid on the photodegradation process were not shown. Bromide analysis of the water solutions after degradation often compared well with the extent of photodegradation and showed no bromide degradation from the unrecovered bromacil.

THE CHEMISTRY DOCTOR OF ARTS PROGRAM AT MIDDLE TENNESSEE STATE UNIVERSITY. *Martin V. Stewart, Middle Tennessee State University, Murfreesboro, Tennessee.* The Doctor of Arts (D.A.) is a terminal degree that is designed to prepare classroom teachers for both 2- and 4-year colleges as well as for teaching positions in larger universities. Thus, this degree provides an alternative to the traditional Doctor of Philosophy (Ph.D.), which is geared towards a research emphasis, or the Doctor of Education (Ed.D.), whose emphasis is the training of academic administrators. The Chemistry Doctor of

Arts at Middle Tennessee State University is one of the few doctoral programs in Chemical Education conducted within a chemistry department and is the only such program whose residence requirement can be completed entirely during summers, an aspect that is attractive to potential students who are already working faculty. From its meager beginnings in 1982, it has grown to include nine graduates and 12 current students, several of which are supported by either internal or external fellowships.

MM2 CALCULATIONS OF GROUP-13 ORGANOMETALLIC CHALOGEN OLIGOMERS. *Kathryn M. Rust* and William H. Ilsley, Tennessee Technological University, Cookeville, Tennessee (KMR), and Middle Tennessee State University, Murfreesboro, Tennessee (WHI).* Organometallic chalcogen derivatives of group-13 elements have been studied through molecular modeling techniques. The compounds of interest were $[Me_2Al(\mu\text{-}SMe)]_2$, $\{Me_2Al(\mu\text{-}SSiPh_3)\}_2$, $[Mes_2Al(\mu\text{-}SBz)]_2$, $[Mes_2Al(\mu\text{-}SPh)]_2$, $[Mes_2Al(\mu\text{-}SeMe)]_2$, and $[Ph_2Ga(\mu\text{-}SeMe)]_2$, $[Me_2AlOMe)]_3$, and $[Me_2Al(\mu\text{-}SMe)]_3$. The stability of the anti conformer of the dimer was examined relative to the syn conformer in an effort to establish an understanding of the anti-syn equilibrium. The minimum energies of each conformation were studied using an MM2 calculation. Similar conformational studies were performed on the trimers. The dimer-trimer equilibrium also was examined using MM2 calculations and comparing them to NMR data for the solution species.

UNSUBSTITUTED POLYAROMATIC HYDROCARBONS IN EXTRACTS OF COAL FLY ASH. *Michael D. Applequist and G. Doyle Daves, Jr., The University of Tennessee at Martin, Martin, Tennessee (MDA), and Rensselaer Polytechnic Institute, Troy, New York (GDD).* Extracts of coal fly ash from the solid waste disposal test cell at Montour, Pennsylvania, were analyzed by isotope-dilution mass spectrometry to detect, identify, and quantify trace amounts of selected, unsubstituted polyaromatic hydrocarbons. Isotope-dilution experiments using deuterated analogs of polyaromatic hydrocarbons demonstrated that the concentrations of benzo[a]pyrene and anthracene were <1 ng/g of fly ash. Maximum concentrations of fluorene, fluoranthene, pyrene, and chrysene were estimated to be 3 ng/g of fly ash. Concentrations of phenanthrene were found to range from 6 to 38 ng/g of fly ash with a mean concentration of 14 ng/g of fly ash. No correlation was found between concentrations of phenanthrene and the position, depth, or time of weathering of samples of fly ash taken from the test cell. An isotopic carrier was not required for any of the selected polyaromatic hydrocarbons except benzo[a]pyrene.

REACTION OF CARBON RADICALS WITH NITROXIDE TRAPPING. *Rudy Gostowski, Erin Emrich*, Stephanie Steelman*, and Jeremy Anderson*, Austin Peay State University, Clarksville, Tennessee.* Carbon-centered radicals have been produced by electrochemical oxidation of an in situ formed anion. The incipient radical may participate in bimolecular self-reactions to form a dimer. Decreasing the time frame of the cyclic voltammetry electrochemical experiment by utilizing ultramicroelectrodes and a current-to-voltage converter having a small time constant allows the radical to be reduced back to the anion before it may decay. Addition of a nitroxide trapping agent to the solution facilitates comparison of the self-reaction with the trapping process. Both processes are sensitive to steric bulk in either the carbon radical, the nitroxide, or in both species. (Poster)

PURIFICATION OF CARBOXYLASES (PURK, PURE, AND ADE2) IN *DE VOVO* PURINE BIOSYNTHESIS. *Kimm Grafenreed*, V. Jo. Davisson, Shawn Misialek, and Prem S. Kahlon, Tennessee State University, Nashville, Tennessee.* De novo purine biosynthesis is responsible for the formation of DNA bases adenosine and guanosine. One of the objectives of this reseach was to understand and observe the mechanical differences that exist in the bacterial and fungal de novo purine biosynthetic pathways. Specifically, our focus was directed to the enzymes PurK and PurE (bacterial de novo purine pathway) and ADE2 (fungal de novo purine pathway). These enzymes are associated with the carboxylation of 5-aminoimidazole (AIR) in de novo purine biosynthesis. Escherichia coli and Cryptococcus neoformans were the organisms which served as subjects for this investigation. The evolutionary variations among different organisms in this pathway suggest the possibility of the development of selective medicinal agents. Previous studies show that fungal de novo purine biosynthesis is necessary for the virulence of the organisms. Inactivation of ADE2 prevents the virulence of C. neoformans. By identifying the structure as well as active sites of the enzyme, medicinal inhibitors can be designed with decrease, if not inhibit, fungal virulence. Therefore, the purification of ADE2 as well as PurK and PurE was the primary objective of this research. Each enzyme was purified by slight modification of previously published protocols. Results of this research show that the isolation of PurE, PurK, and ADE2 was not achieved. Additional bands on sodium dodecyl sulfate polyacrylamide-gel electrophoresis indicate the presence of contaminant bands. Investigation of purification procedures utilizing dye ligand as a well as affinity chromatography to remove the contaminants present in each enzyme. (Poster)

ROLE OF K$^+$ FLUX IN ELICITOR-INDUCED OXIDATIVE BURSTS. *Zarius Drummond*, Philip S. Low, and Prem S. Kahlon, Tennessee State University, Nashville, Tennessee.* The focus of this project was to establish methods for detecting potassium fluxes and studying their involvement in a variety of elicitor-induced oxidative bursts. When the potassium electrode reaches equilibrium, an elicitor is introduced into the cell media. The elicitors that were utilized in this experiment were harpin, *Verticillium dahliae* extract, and polygalaturonic acid. Valinomycin was used as a positive control for a potassium efflux. Harpin and polygalaturonic acid showed no appreciable increase on an average external potassium concentration by 11 mM, while valinomycin maintained an average maximum increase of 16 mM. Through the use of inhibitor studies, it was found that staurosporine inhibits the oxidative burst of V. dahliae but does not inhibit the potassium efflux, implying that protein kinases were not required for a potassium efflux. This experiment along with data showing that valinomycin does not induce an oxidative burst suggest that potassium fluxes are not involved in the oxidative burst, but, perhaps, soybean cells utilize a potassium flux for initiating other defense responses. (Poster)

NMR AND NQR STUDIES OF THE FLUXIONAL BEHAVIOR OF PENTACHLOROCYCLOPENTADIENYL MERCURY(II) DERIVATIVES OF THE TYPE C_5Cl_5HgR. *Haiping Lu*, Kevin Benner, and William H. Ilsley, Middle Tennessee State University, Murfreesboro, Tennessee.* The fluxional behavior of pentachlorocyclopentadienyl mercury(II) derivatives of the type $RHgC_5Cl_5$ have been studied. Their methods of preparation and NMR and NQR data will be presented. In particular, data for the 2,4,6-tri-t-butylphenyl and the 2,4,6-tri-methylphenyl derivatives will be presented. This data will show that both derivatives are fluxional in solution and that the 2,4,6-tri-t-butylphenyl derivative is fluxional in the solid state but that the 2,4,6-tri-methylphenyl derivative is not. (Poster)

COMPUTER SCIENCE SECTION
Gregory Schaper, Chair

AN APPROACH FOR RESCHEDULING IN HETERARCHICALLY-CONTROLLED FLEXIBLE MANUFACTURING SYSTEMS. *Ashraf Saad and Adel Salama, Austin Peay State University, Clarksville, Tennessee.* This is an extension of our previous work on heterarchical scheduling for small to medium batch size, flexible manufacturing systems. The approach is based on our decentralized-control architecture where machines and products in the manufacturing system are represented by autonomous agents that interact via a bidding scheme, based on the contract net protocol, in order to achieve production planning and scheduling. The performance of the originally proposed approach has been evaluated via modeling and simulation of a job shop. The bidding scheme has been contrasted to dispatching rules that are typically used in such manufacturing systems. It was proven to yield better performance for the manufacturing system under consideration when production reservation is utilized and when it is augmented by dispatching rules. Our current work enhances production reservation to incorporate rescheduling at the machines during the initial scheduling phase. In addition to the original production-reservation schedule, a machine quotes back to a part the best possible times to finish its processing when rescheduling of existing parts reservations (i.e., reserved capacity) is considered. In order to achieve that, each machine negotiates with the parts in its reservation list in order to allocate capacity for the new incoming part. The parts in turn can agree to be rescheduled within their operational windows, that are based on their remaining operations slack times, and still be guaranteed deliveries by their due dates. Hence, this approach enables the system of being more dynamic in accomodating new orders for production, therefore, increasing the productivity of the manufacturing system under consideration. Another important advantage is achieving such an increase while striving to guarantee its existing production commitments, therefore, avoiding any penalties for late products deliveries.

COMPUTER CRIME: A PERSPECTIVE. *John W. Ramsey* and Jerry Sayers, East Tennessee State University, Johnson City, Tennessee.* The purposes of this paper are twofold. The first purpose is to identify and define several of the various forms of computer crime and illicit activities involving the use of computing equipment. While a specific delineation of all types and potential types of computer crime is beyond the scope of this work, general outlines sufficient to acquaint the reader with computer crime in some of its various incarnations are provided. The second purpose is to present an overview of institutional (criminal justice and computer trade) and general public responses to computer crime and an overview of the differential levels of importance attached to each of the discussed categories. The results of the research indicated a primary focus in the computer trade publications on "hacking" and "hackers," in law enforcement on white-collar criminal applications, and in the general public on privacy. A conclusion that can be drawn from this is that each discipline is focused upon that aspect of computer crime that it (institutionally) believes itself best able to comprehend and react to. Considering the known figures associated with computer crime, it seems likely that these beliefs on the parts of both institutions may be poorly founded. Acknowledgment of the need for cooperation between law enforcement and computer trade to more effectively combat computer crime is present throughout the research. However, such cooperation and sharing of resources is shown to be essential on other levels as well: rational identification of the actual scope of the problems; formulation of public policy to effectively and efficiently resolve those problems; education of the general public about the problems.

ENGINEERING AND ENGINEERING TECHNOLOGY SECTION
Chen Chin-Zue, Chair

THE DEVELOPMENT OF AN ENVIRONMENTALLY ISOLATED SEAFOOD MANUFACTURING SYSTEM. *J. Richard Booth, Tennessee Technological University, Cookeville, Tennessee.* The United States currently imports over half the shrimp consumed in this country. The resulting trade deficit exceeding \$2 billion in 1993 is expected to increase by 8% annually. The technology used in some exporting nations generates serious environmental damage and uncertain productivity. These factors decrease the value of the perceived economic opportunity. Since 1970, the United States Department of Commerce, through the Sea Grant Program, has supported the development of aquaculture technology appropriate to the United States. During this time, much progress has been made; however, there is no process which can produce a stable, economically viable shrimp product without risk of environmental damage in the United States. There are semi-intensive commercial shrimp facilities along the southeastern margin of the United States. However, their productivity is unstable because of disease and environmental conditions. A few research systems have demonstrated stable high productivity in ultra-intensive, environmentally isolated systems, but these currently are not economically viable.

DYNAMIC ANALYSIS OF SOFTARM ROBOT USING THE VECTOR-NETWORK METHODS. *Adel Salama and Ashraf Saad, Austin Peay State University, Clarksville, Tennessee.* The Vector-Network method is a comprehensive mathematical model to systematically formulate the nonlinear equation of motion for dynamic three-dimensional constrained multi-body systems. The Vector-Network method combines the theoretical concepts of graph theory with the concepts of Vector mechanics in a consistent manner. The result is a methodological approach for the formulation of dynamic equations. The method can serve as a basis for self-formulating computer programs which simulates six degrees of freedom robot (Softarm), given only the system's description and initial excitation as input. The computer program is capable of automatically creating and solving the differential equations of motion.

CHARACTERIZATION OF THE MECHANICAL PROPERTIES OF PORCINE AORTA. *Gladius Lewis, The University of Memphis, Memphis, Tennessee.* Various mechanical porperties of arteries play a key role in the genesis and progression of cardiovascular disease (and, hence, in managing it). For these tissues, the pig has been shown to be a suitable model. The focus of the present work is the experimental determination of the passive rheological and rupture properties of healthy procine aorta. Specifically, this comprised stress-relaxation tests on specimens cut in either the tangential or the axial direction and tear tests on specimens cut in the tangential direction. The results from the relaxation tests were used to estimate the "theoretical" tear energy. The results of the tear tests were used to obtain the "experimental" tear energy. The mean results for theoretical and experimental tear energy for the tangetially-cut specimens were, respectively, 0.62 and 0.85 kg/mm, whereas theoretical tear energy for the axially-cut specimens was 4.87 kg/mm.

DEVELOPMENT OF SIGNAL ANALYSIS METHODS TO IMPROVE CONDENSER EFFICIENCY OF A STEAM PLANT. *Heui Seong Lim*, A. G. Civera, and Michael L. Daley, The University of Memphis, Memphis, Tennessee (HSL, MLD), and Tennessee Valley Authority, Tennessee.* A critical factor in the efficient operation of a steam plant is condenser performance. The goal of this research is to use digitally acquired signals of temperature, flow, and back pressure to

develop analytical techniques to detect the occurrence of subtle mechanisms which degrade condenser efficiency. As a first step toward this goal, a method of checking the accuracy of estimated flow signals has been developed. Specifically, three estimated flow signals derived from differential pressure measures are available for analysis: two inlet flows; a single total outlet flow. The two estimates of inlet flow are used to construct a theoretical total outlet flow signal. The theoretical and estimated total outlet flow signals are compared. If any one of the three estimates of flow is incorrect, correlation analysis will reveal either a bias error or a low correlation between the theoretical and measured total outlet flow signals.

MODEL OF THE DYNAMICS INTRACRANIAL PRESSURE WAVES. *Jin Ye*, Eryu Wang*, and Michael L. Daley, The University of Memphis, Memphis, Tennessee.* Intracranial pressure waves are observed in patients with intracranial hypertension from head injury. In order to investigate the nature of cerebral blood flow during intracranial pressure waves, an electrical circuit model of cerebral blood flow has been developed. This model is based on the hypotheses that changes in vascular tone create changes in cerebral arterial pressure and corresponding changes in cerebral blood volume. Furthermore, the rapid changes in cerebral blood volume are directly reflected as intracranial pressure waves. With the aid of a second-order model, circuit-model plateau waves were simulated by changing capillary pressure in time-varying manner to obtain an intracranial pressure recording which approximately matches clinical recordings. The time-varying change of capillary pressure is assumed to result from a combination of changes of arterial pressure and the resistance of the arterial vasculature.

CENTER FOR MANUFACTURING RESEARCH AT TENNESSEE TECHNOLOGICAL UNIVERSITY. *Ted S. Lundy, Tennessee Technological University, Cookeville, Tennessee.* The Center for Manufacturing Research (CMR) at Tennessee Technological University was proposed during 1983 by Joseph T. Scardina, Professor of Mechanical Engineering, to be one of the Centers of Excellence within the university system of the State of Tennessee. His successful proposal emphasized its mission "...to advance scientific and engineering knowledge in manufacturing and to support the instructional program in those areas related to manufacturing." This mission continues as the guiding light for the Center although operation details have evolved continuously with time. The importance of manufacturing within the United States will be emphasized with specific statements about its importance within Tennessee. The presentation includes a brief overview of the types of research, development, demonstration, and technology transfer activities accomplished by the Center during its nearly 12-year history.

EFFECTIVENESS OF REFLECTIVE ROOF COATINGS. *David W. Yarbrough, Tennessee Technological University, Cookeville, Tennessee.* The use of exterior coatings with solar reflectances > 0.8, radiation control coatings, reduces building solar gain and air-conditioning load. An energy balance on a roof surface is used to predict the effect of solar reflectance on the roof's temperature. The roof surface temperature, T_{SUR}, then is used to define an effectiveness, E, for the surface coating: $E = (1 - (T_{SUR} - T_{AIR})/(T_{BLACK} - T_{AIR})) \times 100$. E-values have been measured for a number of roofing materials and coatings. Radiation control coatings with effectiveness >90% have been observed. Solar reflectance data, measured E-values, calculated E-values, and selected building simulator results will be discussed.

A COMPARATIVE STUDY FOR THE OPTIMIZATION OF PARAMETERS OF A SPECTROMETER. *John S. Camilleri* and Satish M. Mahajan, Tennessee Technological University, Cookeville, Tennessee.* Integration time and wavelength interval are the two most important

parameters of an emission spectrometer. Increase in integration time and decrease in wavelength interval may yield higher signal intensities although not necessarily higher signal:noise ratio. Such an effort may improve accuracy of the system, however, at the cost of time. In a rapid analysis technique, every attempt is made to minimize integration time and increase the wavelength interval while accuracy is not compromised. Experiments were conducted on three different samples with integration time ranging from 0.01 to 1.00 sec and wavelength interval ranging from 0.1 to 0.5 A. Repeated scans and comparison of relative intensity patterns indicate that scanning time could easily be reduced from 32 to 20 min corresponding to ca. 40% improvement in scan time with no change in accuracy of the technique.

POTENTIAL APPLICATIONS OF COMPUTATIONAL FLUID DYNAMICS IN OTHER FLUID ENGINEERING PROBLEMS. *J. D. Mo, The University of Memphis, Memphis, Tennessee.* Computational fluid dynamics, as one of the three branches of modern fluid mechanics, was initially started from aeronautical and aerospace applications and has been well established for several decades in the analysis and design of fluid and thermal systems. Currently, activities of computational fluid dynamics experience its trough in terms of job opportunity, which resulted partially from the economics and partially from misleading of medium. Actually, computational fluid dynamics still has its brightness today and will certainly be a star in the next century simply because there is great potential of application of computational fluid dynamics in high technology and in other engineering problems as well. This presentation provides an engineering application of the proof of the concept of trace-gas concentration, which well demonstrates the advantage of computational fluid dynamics in new mechanical product development over the conventional procedure of trial and error.

DEMONSTRATION OF AUDIO FEEDBACK SPOON FOR NEUROLOGICALLY IMPAIRED CHILD. *Cassandra Nash*, Harry B. Nichols*, and Michael L. Daley, State Technical Institute of Memphis, Memphis, Tennessee (CN, HBN), and The University of Memphis, Memphis, Tennessee (MLD).* Neurologically impaired children may fail to acquire adequate self-feeding skills during developmnet. Such inadequate self-feeding skills also can lead to nutritional deficiencies and insufficiencies in their physical and social growth. With the purpose to assist in the learning of adequate self-feeding skills for these children, an audio feedback spoon had been developed. The spoon assembly operates a remote-controlled, electronic relay circuit connected to an audio cassette player. The device is intended to give the child a chance to learn how to correctly hold a spoon in a horizontal position as he or she tries to take it to the mouth. When the spoon is tilted beyond the "spill angle," a remote-control relay unit will stop the playing of music on a tape player. The feedback circuitry activates an alarm when the spoon is incorrectly positioned and plays music as a reward when the spoon is held correctly. Two prototypes of the feedback spoon have been assembled, an analog version using a sinusoidal waveform to frequency modulate a carrier signal in the 100 MHz FM radio band and a digital version employing amplitude modulation of a 300 MHz radio carrier signal. Both versions are currently undergoing tests to determine which version is more effective. (Poster)

EXPERIMENTAL EVALUATION OF FIRST- AND SECOND-ORDER DIGITAL FEEDBACK CONTROL SYSTEMS. *Rajkumar Kailasam*, Cedric Golliday*, J. Michael Northern, and Michael L. Daley, The University of Memphis, Memphis, Tennessee (RK, MLD), and State Technical Institute of Memphis, Memphis, Tennessee (CG, JMN).* The range of stability of an Allen Bradley PLC 5 programmable controller used in a unity feedback control system with first- and second-order processes was investigated. The first- and second-order processes

were simulated with RC and RLC circuits. To obtain low natural frequencies of oscillation in the second-order process, inductances in the order of 1,000 H were obtained with an operational gyrator circuit. Theoretical simulation of the step response for each experimental condition was obtained. Comparison of theoretical and experimental results were found to be in good agreement. The Allen Bradley PLC 5 was determined to be a stable controller for a wide range of values of gain, damping factor, and natural frequencies. (Poster)

DYNAMICS OF CEREBRAL VENOUS DRAINAGE AND IN-TRACRANIAL PRESSURE. *Jin Zhang, Charles Leffler, James T. Robertson, Henrietta Bada, and Michael L. Daley, The University of Memphis, Memphis, Tennessee (JZ, MLD), and The University of Tennessee-Memphis, Memphis, Tennessee (CL, JTR, HB).* From previous experimental measures and theoretical simulations of arterial and intracranial pressures for conditions of normal cerebral tone and massive vasodilation, the following hypothesis has been developed. During intact cerebral vascular tone, the low frequency variation in the baseline of intracranial pressure is produced by a corresponding change of cerebral venous blood volume caused by restricted venous flow during positive pressure inhalation. During loss of vascular tone, unrestricted venous flow occurs during positive pressure inhalation. With the use of a cranial window in a laboratory model, the following parameters of a posterior parietal vein at a site near its connection to the sagittal sinus were made: diameter with a video micrometer; relative flow with laser doppler velocimetry; estimated flow determined from differential image analysis of the movement of clusters of blood cells. Preliminary results indicate that measurable change in the diameter of the vein does not occur during ventilation and that, because of the cyclic movement of the vein during ventilation, artifactual results are obtained with laser doppler velocimetry. However, preliminary results obtained from estimated flow measures derived from frame-by-frame video analysis of the movement of clusters of venous blood cells paritally support the hypothesis. Specifically, cerebral venous flow is restricted during the positive pressure inhalation in a manner consistent with the correspond-ing increase of intracranial pressure. Further study should determine the influence of massive dilation on the dynamics of cerebral venous drainage. (Poster)

VARIATION OF SPECTRAL POWER OF ARTERIAL PRESSURE SIGNAL WITH CHANGE IN VASCULAR TONE. *Jie Ren, Massroor Pourcyrous, Charles Leffler, and Michael L. Daley, The University of Memphis, Memphis, Tennessee (JR, MLD), and The University of Tennessee-Memphis, Memphis, Tennessee (MP, CL).* During positive pressure ventilation, the cardiovascular tree within and adjacent to the thorax is mechanically modulated at the frequency of ventilation. The objective of this analytical study was to determine the influence of positive pressure ventilation on the arterial pressure obtained during normocapnia, prolonged asphyxia, and deep hypercapnia. Arterial pressure signal data were made available from laboratory experiments designed for other purposes to produce these three conditions. Epochs of 2.5 min in which the arterial pressure signal was stationary were used in this analysis. The normalized power spectral density function for frequency between 0.0 and 1.0 HZ was computed for each epoch. The power in the signal at the frequency of ventilation was determined. Prolonged asphyxia ($n = 4$) and deep hypercapnia ($n = 8$) produced a reduction in power relative to the control values determined from the epochs of signal data obtained during normocapnia. The results of this analysis suggest that the loss of vascular tone produced by prolonged asphyxia or deep hypercapnia dampens the effect of the mechanical modulation due to ventilation on the cardiovascular tree. (Poster)

ETHICS IN SCIENCE AND TECHNOLOGY SECTION
Rubye Prigmore-Torrey, Chair

WHISTLEBLOWING = CAREER SUICIDE. *David K. Hackett, P.E. Center for Government Accountability, Knoxville, Tennessee.* Despite high-minded ethics policies, the establishment of ethics offices, and elaborate policies for the protection of whistleblowers, real practice has changed little. Corporate and bureaucratic practice is still focused on killing the messenger, whether reform or cover-up results from his efforts. Despite possible good intentions, the time-honored, sophomoric tradition of ostracizing the "ratfink" is still in effect in the public and private sectors. Despite any management claims to the contrary, loyalty to the "brotherhood," whatever its transgressions, supercedes any other ethic. This leaves the question of whether whistleblowing is ever advisable. What is socially necessary to the integrity of our economic and political culture comes at extremely high personal cost. Can we afford to continue tolerating traditions that result in progressive erosion of the social fabric?

CODE DOESN'T COUNT PROFESSIONAL RESPONSIBILITY. *Donald Gotterbarn, East Tennessee State University, Johnson City, Tennessee.* In this paper, I argue that, given the new developments in computing, merely being a highly skilled computer technician is not enough to be a competent professional. Computer practitioners need to understand and be committed to a higher order standard of service to society. The establishment of public standards by certification and licensing of computer practitioners will aid in increasing this awareness. I present one model of licensing which will help accomplish the establishment and maintenance of standards which includes a commit-ment to the application of technical skills guided by moral values.

INTEGRATING ETHICAL ISSUES ACROSS THE COMPUTER SCIENCE CURRICULUM. *Robert R. Riser, East Tennessee State University, Johnson City, Tennessee.* Efforts to include ethical, social, and professional issues in the computer science curriculum have gained increasing attention over the past several years. The Computer Science Accreditation Commission (CSAC) requires that "the social and ethical implications of computing" be included in an accredited program. This presentation will describe some of the efforts of the Department of Computer and Information Sciences at East Tennessee State University to integrate ethical, social, and professional issues into the existing computer science curriculum. The most desirable approach is the integration of ethical, social, and professional issues into the major, rather than relying on a single "stand-alone" course. This demonstrates to students and faculty that this material is a fundamental component of the major and discourages the perception that these issues are less important or that they can be neatly separated from the technical content of the major. Two specific areas of the computer science curriculum are considered: the required first year "CS-1" and "CS-2" courses; the upper division "project-oriented" course (e.g., Software Engineering, Systems Analysis and Design, a capstone course) in which students work in teams, undertake a complete project from requirements analysis through implementation, and work with "real" customers and users. Examples of specific assignments and exercises will be provided to illustrate that ethical, social, and professional issues can be integrated into existing curriculum without negative impact on the technical content.

CALLING ALL SCIENTISTS AND ENGINEERS: WHAT IS YOUR ETHICS QUOTIENT (E.Q.)? *Rubye Prigmore-Torrey, Tennessee Technological University, Cookeville, Tennessee.* Ethics may be defined as the principle of conduct that governs an individual or a group. Hence, individuals and groups may have an ethics quotient. Consider

the role of scientists and the role of engineers in the ethical arena. Scientists generally push back the frontiers of knowledge, i.e., they participate in discovery without looking for a reason. Engineers generally participate in discovery with a reason, i.e., they are usually looking for a solution to a problem. In scientific research, it is not uncommon for more than one research team to be working on the same problem during the same time but in different laboratories. The rude awakening of this event occurs when a presentation is made in an open forum or it is published in a journal. Most cases of unethical behavior that are reported deal with fabrication or misrepresentation of facts, cases where the investigators have attempted to "fix" the data. In all cases involving this behavior, one might ask what is the ethics quotient of these scientists and engineers. If ethics quotient is ratio of intellectual integrity to intellectual fame (E.Q. = I^2/IF), how ethical are you?

INFLUENCE OF TECHNOLOGY ON CREATIVITY AND OBJECTIVITY. *Michael L. Daley, The University of Memphis, Memphis, Tennessee.*

Motivated by curiosity, the human spirit has followed many paths into the frontier of the unknown. Initial advancements were slow and solely based on sensory observations and reflective thought. Empowered with an enlightened understanding of aspects of nature, the innovative spirit developed technologies which extended the reaches of sensory observation, and the pace of advancement quickened. More recently, the successful growth of science into areas of abstract concepts outside the realm of sensory experience, such as electricity, the DNA molecule, and the speed of electronic computation, has led to an interdependence of science and the instruments used to investigate nature. It may be argued that aspects of recent technology tend to isolate sensory observations from the physical phenomena of study. As a result, the ability of the investigator to integrate sensory observation and reflective thought is reduced. This presentation will further discuss the proposed argument with particular reference to its implications on the creativity and objectivity of the human spirit.

GEOLOGY SECTION
Phillip R. Kemmerly, Chair

APPLICATION OF THE CONCEPTS OF SEQUENCE STRATIGRAPHY TO A DEEP (1,221 FEET; 372.4 M) CORE OF A PENNSYLVANIAN SUCCESSION SITUATED NEAR THE EASTERN MARGIN OF THE CUMBERLAND PLATEAU, WEST OF THE TOWN OF GRAYSVILLE, TENNESSEE. *Richard E. Bergenback, The University of Tennessee at Chattanooga, Chattanooga, Tennessee.*

A deep core was spudded in at elevation 576.1 m (1,890 feet) on the Cumberland Plateau in search of subsurface deep-mineable coal seams. This core penetrated the Pennsylvanian Crab Orchard Mountains and Gizzard Groups and bottomed in the Mississippian Pennington Formation at 372.4 m (1,221 feet). Sedimentary structures in this core that are recognized in quartz arenite sandstone stratigraphic units include troughs, in-channel bars, and various types of scour infillings. Shale-rich formations show rippled shale with small-scale sand lenses, horizontal burrows, siderite bands, and coal seams. Detailed examination of the core log revealed what may be interpreted as four fining-upward cycles with basal scours (unconformities) in the sandstone formations: Warren Point Sandstone-Signal Point Shale; Sewanee Sandstone-Whitwell Shale; Newton Sandstone-Vandever Lower Shale; Vandever Needleseye-Vandever Upper Shale Sandstone. Sandstone stratigraphic units represent high-gradient, braided stream siliciclastics associated with eustatic lowstands. Shale-rich stratigraphic units are considered as mudflat and swamp deposits related to a eustatic highstand. These rocks are proximal to their source area and are more influenced by isostasy than eustasy.

GEOGRAPHIC INFORMATION SYSTEM OF HAZARDOUS MATERIALS GENERATED IN MONTGOMERY COUNTY, TENNESSEE. *Frank E. Wisniewski*, Austin Peay State University, Clarksville, Tennessee.*

Despite the widespread use of geographic information system (GIS) over the years, there has been a limited application for statewide modeling of pollutant loadings such as nitrogen, phosphorus, sediment, and toxic substances, to name a few. In this study, a GIS base screening model was used to rank the hazardous sites within Montgomery Co., Tennessee, for nonpoint and point pollution and also toxic release. The goal of this project is to identify any relationships between the population composition and that of the toxic chemicals found coming out of each particular hazardous site. The GIS database being used consist of watershed boundaries, topography, soils, precipitation, toxic release inventory, race, and income. These layers will be used to produce maps that will provide a focus to the relative magnitude of these releases and their potential human and ecological health significance. Taken together, the maps generated by this study can provide a risk assessment that can help certain pockets of urban households that are effected from such pollutant loadings.

VARIATIONS IN THE SPATIAL-TEMPORAL FORMS OF BARRIER ISLANDS UNDER DIFFERENT EQUILIBRIUM CONDITIONS. *James M. McCluskey, Austin Peay State University, Clarksville, Tennessee.*

The process-response variables associated with the landscape envelope in barrier island systems vary in space and time under different equilibrium conditions. A positive relationship exists between geographic area and duration of time required to produce substantial change. Third-order relief features, such as barrier island chains and lagoons, are shaped in the cyclic time frame by processes operative over thousands of years under conditions of dynamic or dynamic metastable equilibrium. Fourth-order relief features, like inlets, primary dune fields, marshes, or overwash fans, are formed in the graded time frame by processes operative over tens to hundreds of years under conditions of steady-state equilibrium. Fifth-order relief features, such as ocean beaches, foredune ramps, and blowouts, are formed during the steady time frame by processes operative for fraction of years to years. The nature of the spatial and temporal structure of barrier islands systems is bi-directional. Changes in the set of third-order process-response variables can produce changes in a downward direction in fourth- and fifth-order process-response variables. Changes in the fifth-order set of process-response variables can initiate change in an upward direction in the fourth- and third-order set of process-response variables. The occurrence of random, catastrophic events can significantly alter relaxation paths and thresholds across the entire landscape envelope. This conceptual model is based on a sediment budget calculated for Fire Island, New York. Volumes of various depositional sedimentary lenses were calculated through coring, first-order surveys, air photos, and historic charts. Relative time frames were established using C^{14} dates.

CRETACEOUS-TERTIARY TSUNAMITES IN THE MISSISSIPPI EMBAYMENT. *Gary L. Patterson*, David N. Lumsden, Charles G. Stone, and Ernest E. Glick, The University of Memphis, Memphis, Tennessee (GLP, DNL), and Arkansas Geological Commission, Arkansas (CGS, EEG).*

There is evidence that the 200-km diameter Chicxulub structure in the subsurface of the Yucatan Peninsula was created by a massive meteor impact at the Cretaceous-Tertiary transition. If this interpretation is correct, a tsunami of incredible size would have swept out of the Gulf of Mexico into the Mississippi Embayment, disrupting sediments throughout the embayment coastline. Preliminary examination of outcrops in central Arkansas suggests that Cretaceous-Tertiary tsunami deposits indeed exist in the area. Additional investigations in northwestern Mississippi and western Tennessee was less supportive of the hypothesis.

LOOKING FOR GEOMORPHIC EVIDENCE OF GROUND DE-FORMATION IN THE EAST TENNESSEE SEISMIC ZONE: A PRELIMINARY ATTEMPT USING TOPOGRAPHIC, STREAM-PATTERN, AND STREAM-GRADIENT-INDEX ANALYSES. *Hugh H. Mills, Daniel L. North*, and Jennifer C. Wellman, Tennessee Technological University, Cookeville, Tennessee.* The East Tennessee Seismic Zone shows the second highest level of microseismicity in the eastern United States; yet, no major earthquake has occurred in this zone in historical time. To complement the ongoing seismological research, an effort is being made to find geomorphic evidence of ground deformation. To help narrow the area to be searched in the field, digital map data is being analyzed to look for areas that may show evidence of late Cenozoic uplift or subsidence. Instrumentally located epicenters in the East Tennessee Seismic Zone tend to lie close to and east of the New York-Alabama aeromagnetic lineament. Stream patterns from 1:100,000-scale maps, however, show no discernible trend parallel to this linea-ment. Topographic data from 1:250,000-scale maps have been analyzed by computer to detect anomalous topography in the Valley and Ridge province that cannot be readily explained by differences in lithology and structure. This attempt has been supplemented by gradient-index analysis of all streams longer than 5 km in this province. Unusually high topography and steep stream courses occur in the vicinity of the lower reach of the Little Tennessee River and where the Tennessee River cuts abruptly across the Valley and Ridge, suggestive of differential uplift. These areas also show particularly high rates of microseismicity.

THREE GENERATIONS OF "OLD NATCHEZ TRACE" IN LEWIS COUNTY, TENNESSEE. *Richard G. Stearns, Vanderbilt University, Nashville, Tennessee.* The Natchez Trace was a pre-1830 return route to Nashville from Natchez on the Mississippi River. First, it was a Chickasaw Indian footpath; about 1806, it was improved to a wagon road; about 1830, steam boats made the trace obsolete for upstream travel. Parts were abandoned, but parts continued as local roads. The Meriwether Lewis Historic property is a favorable place to look at the trace, because, north of the monument, the trace has not been even a local thoroughfare since before 1902. The Highland Rim here has an infertile cherty soil that resists erosion and has not been farmed; so, a worn path or road would be preserved when abandoned. Three trace types can be discerned: 1) old trace path that is 0.9 to 1.8 m wide and any flattened bottom <0.9 m wide; 2) old trace road that is ca. 3.4 m and lacks ruts, with the deepest flattened part 1.8 to 2.1 m wide and commonly slightly concave; 3) truck road that was used as a 20th-century timber road and is ca. 4.0 m wide with a prominent pair of ruts that are 2.4 m wide. Trace types are documented by photographs and cross profiles. Depth of wear is controlled by gradient and geology. The old trace road is preserved from overprinting where it was abandoned as too narrow and deep; the old trace path is preserved where the route was straightened. The old trace path could be the pre-1806 Chickasaw Indian path, and the old trace road could be the 1806-1830 wagon road.

DIAGENESIS AND FLUID-FLOW HISTORY IN THE OLIGO-CENE CREEDE FORMATION, COLORADO. *Daniel Larsen, The University of Memphis, Memphis, Tennessee.* The Oligocene Creede Formation is a well-preserved, caldera lake sequence within the 26.8-Ma Creede caldera in southwestern colorado. The predominantly tuffaceous and calcareous lacustrine and alluvial deposits were subject to an initial phase of burial diagenesis followed by localized low-temperature hydrothermal events. Burial diagenesis resulted in basin-wide dissolution of volcanic glass and precipitation of smectite and clinoptilolite. The distribution of late-stage authigenic silicate minerals (cristobalite, illite, potassium feldspar, quartz, analcime, and chlorite) suggests that coarse-grained deposits around the margin of the basin and faults that offset Creede Formation beds acted as conduits for movement

of hydrothermal fluids into the basin. The results indicate the impor-tance of sedimentary facies and structure for controlling hydrothermal fluid movement, even in shallow sedimentary basin settings.

PALEOAUTECOLOGY OF *SPHAERIRYNCHIA LINDENENSIS*: LIFE HISTORY AND THE COMPACTING WEDGE ADAPTATION TO SUBSTRATE STABILITY. *Elizabeth Bruce, Dwayne Webb, Gloria Mansfield, Lisa Adamo, and Michael A. Gibson, The University of Tennessee at Martin, Martin, Tennessee.* The brachiopod *Sphaerirynchia* has been interpreted to have been a pedunculate form that inhabited lower energy, marine environments because of its globular shape and lack of a functional adult pedicle. We investigated specimens from the Lower Devonian Ross Formation which is known to have been a storm-dominated environment based upon outside evidence. We suggest that the brachiopod retained stability by forming a cohesive bond between the rapidly expanding wedge shape of the shell during growth and the dewatering muddy substrate. This adaptation allowed the globular-shaped shell to retain stability in a periodically disturbed environment without a functional adult pedicle or excessive thickening of the umbo region of the shell. (Poster)

STREAM WATER QUALITY AND HYDROGEOLOGY ASSOCI-ATED WITH A LANDFILL SITE ALONG THE HIGHLAND RIM, MIDDLE TENNESSEE. *J. J. Farmer*, E. F. Hollyday, Thomas D. Byle, and F. C. Bailey, Middle Tennessee State University, Murfreesboro, Tennessee (JJF, FCB), and United States Geological Survey, Nashville, Tennessee (EFH, TDB).* The objective of this study was to determine the effects of runoff and seepage coming from an active sanitary landfill in Middle Tennessee on the surface water quality and ecology of the surrounding streams. Hydrogeologically, the facility is directly on top of cherty residuum from Mississippian-age Fort Payne Formation. The area is dissected by numerous streams flowing off the Highland Rim. Several tributaries and springs from the landfill area empty into these streams. In order to determine regional patterns in water quality, data and water samples were collected at 176 sites on nine streams, including a seep and a spring at the toe of the landfill. The samples were analyzed to determine conductivity, alkalinity, pH, and levels of dissolved oxygen, chloride, and nitrate. Preliminary results indicate a general pattern of increasing conductivity from a stream's headwaters to its confluence with a larger stream. Three exceptions to this pattern are apparent. One stream flanking the landfill on the south has an elevated conductivity at its source. A second stream flanking the landfill on the north shows significant rises in conductivity below the confluence with tributaries and springs coming off the landfill. A third stream that is completely within the Highland Rim has low conductivity throughout. A cursory survey of the benthic invertebrates in the streams also was conducted. Streams adjacent to the landfill show a low diversity and abundance of benthic macroinvertebrates as compared to reference sites. Gas chromatography with flame-ionization detection was used to determine the presence of organic molecules. This analysis indicated the presence of ca. 37 unidentified organic compounds in a small seep adjacent to the landfill. Additional hydrogeologic, ecologic, and ecotoxicologic studies are planned to better determine the effect of the water from the landfill on the surrounding ecological communities. (Poster)

HEALTH AND MEDICAL SCIENCES SECTION
John M. Zamora, Chair

GENOMIC IMPRINTING: A FAMILIAL PATTERN. *Harris O. Yates, James L. Netterville, and David Robertson, David Lipscomb University, Nashville, Tennessee (HOY), and Vanderbilt University,*

Nashville, Tennessee (JLN, DR). A familial pattern of paragangliomic inheritance is presented. Twelve members of a family involving 28 paragangliomas including carotid bodies, vagales, and jugulares in various combinations are considered. Also noted is the presumed metastasis of one of the tumors to the lung. An autosomal dominant inheritance pattern is apparent. Phenotypic expression is consistent with genomic imprinting.

THERAPY OF *PNEUMOCYSTIS CARINII* PNEUMONIA IN SCID MICE WITH INTERLEUKIN-13. *A. L. Farone, R. Molina, and J. D. Brain, Middle Tennessee State University, Murfreesboro, Tennessee (ALF), and Harvard School of Public Health, Boston, Massachusetts (RM, JDB).* Pneumocystis carinii infection in immunocompromised hosts is a significant cause of morbidity and mortality. the extracellular and cell-associated accumulation of *P. carinii* in the lungs is a hallmark of *P. carinii* pneumonia. The alveolar macrophage represents the first line of host defense against inhaled pathogens in the respiratory tract. Studies from our group have shown that the mannose receptor on the alveolar macrophages is important for phagocytosis of this organism. A recently described cytokine, interleukin-13, has been shown to be a potent upregulator of mannose-reception expression. We sought to test the hypothesis that intratracheally instilled human recombinant interleukin-13 would enhance the clearance of *P. carinii* in a SCID-mouse model. In this *P. carinii*-pneumonia model, C.B-17 SCID animals are infected by co-housing with infected animals for 8 weeks. This establishes a lung burden of 10^6 organisms prior to interleukin-13 therapy. For the initial experiment, animals received one intratracheal instillation of interleukin-13 (50 ng or 350 ng/0.1 ml in phosphate buffered saline) or phosphate buffered saline alone. Organisms were enumerated by direct microscopic counting of stained lung homogenates. Results from this experiment indicated that 350 ng of interleukin-13 was more effective in reducing the burden of organisms than 50 ng compared to the control animals. These results suggest a dose-dependent clearance effect. We then sought to determine the utility of multiple doses of interleukin-13 by administering three intratracheal instillations of interleukin-13 (350 ng/0.1 ml phosphate buffered saline) or phosphate buffered saline alone on days 0, 2, and 4. Lung homogenates from these animals again demonstrated that interleukin-13 was an effective therapy for *P. carinii*-pneumonia with interleukin-13 animals ($n = 4$) showing an approximate 10-fold decrease in the lung burden of organisms compared to control animals ($n = 3$). These results support the hypothesis that interleukin-13 is therapeutic for *P. carinii*-pneumonia. Studies are in progress to further analyze the role of interleukin-13 and alveolar macrophage mannose receptors in vivo.

DETECTION OF HUMAN ENTERIC VIRUSES IN WATER SAMPLES VIA POLYMERASE CHAIN REACTION. *Tracy Spaeth* and Stephen M. Wright, Middle Tennessee State University, Murfreesboro, Tennessee.* Worldwide, over one million children die annually due to gastrointestinal illness. The majority of infectious agents responsible for gastrointestinal disease are viruses. Transmission of these viruses is fecal-oral, often through inadequately treated water. Currently, federal law does not mandate for the detection of viruses in wastewater or effluent. There is little information on the presence of human enteric viruses in wastewater in Middle Tennessee. This investigation has examined raw sewage and effluent from three water treatment plants in Middle Tennessee for the presence of several human enteric viruses (adenovirus, hepatitis A virus, poliovirus, and rotavirus). Following filtration and concentration of water samples, the presence of viral nucleic acid was evaluated by the polymerase chain reaction. We report the presence of human enteric virus nucleic acid in wastewater.

PRODUCTION OF THE VASOCONSTRICTOR PEPTIDE ENDOTHELIN BY CULTURED ENDOTHELIAL CELLS FOLLOWING STIMULATION WITH CAFFEINE OR NICOTINE. *William Lee* and Stephen M. Wright, Middle Tennessee State University,* Murfreesboro, Tennessee.* Hypertension afflicts ca. 10% of the adult population in the United States. Hypertension is the leading cause of strokes, cardiovascular failure, and kidney failure. The pathophysiology of hypertension in association with biologically active compounds is not well understood. Endothelin is a recently described, potent vasoconstrictor peptide produced by vascular endothelial cells. Endothelin secretion is reported to occur following exposure to thrombin and angiotensin II, two biologically active agents associated with the regulation of vascular tone. The role of endothelin in hypertensive disease remains unclear. Vasoconstrictive properties have been attributed to nicotine and caffeine. There is no information on the effects of nicotine or caffeine on cultured human endothelial cells. This report evaluates endothelin production by endothelial cells following exposure to nicotine or caffeine.

HISTORY OF SCIENCE SECTION
James X. Corgan, Chair

KEPLER'S VICARIOUS THEORY. *Kevin Ryan, Christian Brothers University, Memphis, Tennessee.* All astronomers before Kepler believed that the planets moved in circular orbits; Kepler changed most minds to the idea that planets move in elliptical orbits. His Vicarious Theory is a transitional step from the circle to the ellipse. The Vicarious Theory is ancient in that it is circular, has a linear eccentricity, and an equant point; it is modern in that it uses the real Sun as a reference point, is Copernican, and uses careful visual observations. Paradoxically, Kepler's Vicarious Theory is fundamentally incorrect but gave correct results.

SERENDIPITY ON MARS HILL: V. M. SLIPHER AND THE RADIAL VELOCITIES OF SPIRAL NEBULAE. *George E. Webb, Tennessee Technological University, Cookeville, Tennessee.* The discovery of large radial velocities of spiral nebulae was one of the major developments in cosmology in the early 20th century. This discovery ultimately led to the identification of spiral nebulae as external galaxies and to the concept of an expanding universe. The origins of the work that resulted in this discovery, however, were actually tangential to nebular astronomy. Initiated as part of the Lowell Observatory's continuing program in planetary astronomy, the investigation of spiral nebulae was designed by Percival Lowell to support his theories concerning extraterrestrial life. V. M. Slipher's research in this area would soon lead to unanticipated and far more significant results.

HOMER'S ASTRONOMY: A COMPUTER PLANETARIUM STUDY OF THE STARS AND CONSTELLATIONS NAMED IN THE ILIAD AND THE ODYSSEY. *Philip Jack Lorenz, Jr., The University of the South, Sewanee, Tennessee.* In the *Iliad* and the *Odyssey* (mostly in the description of Achilles' shield and the sailing directions of Calypso to Odysseus), Homer named the following star groupings: Pleiades; Hyades; Orion; Orion's Dog (Sirius or Canis Major); Great Bear; the Wagon (the seven starred Big Dipper asterism); the Wagoner (Arcturus or Boötes). Attention centers on Ursa Major, the Great Bear, which "looks ever toward Orion and alone dips not into the waters of the deep." A computer planetarium program was used to determine if Ursa Major was indeed circumpolar for Homer's time frame and geography. His curious selection of stars and constellations was investigated, and some answers found in a contemporary (8th century B.C.) farmer's almanac, the *Works and Days*, by Hesiod.

A HISTORY OF BIOLOGY COURSE WITH A TRAVEL COMPO-NENT. *C. Steven Murphree and Robert T. Grammer, Belmont University, Nashville, Tennessee.* From 10 July to 10 August 1995, students and faculty participated in a Belmont Studies Abroad Program course which emphasized the study of biology from a historical perspective. The first 10 days of the course included on-campus lectures, daily assignments, research papers, and a written exam. The travel component of the course consisted of 7 days in London and Cambridge, England, and 4 days in St. Petersburg, Russia. Pre-arranged lectures and tours of sites of biological interest (e.g., the Linnean Society) and cultural experiences (e.g., the Hermitage Art Museum) were included. While abroad, students made journal entries which were later submitted with photographs during the final week of class. A journal and copies of course materials will be made available.

SIR FRANCIS BACON: NEW GOALS FOR OLD IDOLS. *Laurina Isabella Lyle, Austin Peay State University, Clarksville, Tennessee.* In 1620, Sir Francis Bacon published in part the *Instauratio Magna.* Although the multivolume work was never completed, the volume *Novum Organum or True Suggestions for the Interpretation of Nature* holds particular significance in the history of the development of the scientific method. Through a series of aphorisms, Bacon defines the usage of inductive logic to examine the natural world. His application circumscribes and instructs the observer on how to recognize certain biases (idols) that impede impartiality. A comparison of Bacon's application with current rhetorical styles is given with specific attention to lay interpretation of science.

EARLY NATURALISTS IN KENTUCKY AND TENNESSEE. *Philip M. Mathis, Middle Tennessee State University, Murfreesboro, Tennessee.* Andre Michaux, Francois Andre Michaux, Dr. Samuel Brown, Charles L. Mitchill, John James Audubon, Alexander Wilson, Thomas Nuttall, Dr. Charles W. Short, and Constantine S. Rafinesque were among the noteworthy naturalists who visited, collected, and researched in Kentucky and Tennessee during the period from 1793 to 1825. They met important political leaders and explorers, discovered new plant and animal species, recorded geological data, founded new scientific societies and journals, contributed important collections to the world's herbaria and museums, and observed now-extinct forms of bird life.

ONE-HUNDRED FIFTIETH ANNIVERSARY OF "THE TENNES-SEAN," A SPURIOUS GIANT FOSSIL MAN. *James X. Corgan, Austin Peay State University, Clarksville, Tennessee.* In 1845, newspapers in several states announced the discovery of an immense human fossil in Williamson Co., Tennessee. Called "The Tennessean," this 18-foot giant was authenticated by medical experts. The discoverer sold shares, created an exhibit, and lobbied the legislature, which soon exempted displays of fossils from State taxes. A November showing in Nashville was short-lived. A December exhibit in New Orleans closed after snide remarks in newspapers. Further history is unknown. The Tennessean resembles The Cardiff Giant, a New York fraud of 1869. Found by well-diggers and certified by physicians, the Cardiff Giant was totally fradulent, a statue. The Tennessean was almost authentic. The bones were real, the bones of a mastodon. It lacked all parts that precluded a human look.

MATHEMATICS SECTION
Jay Boland, Chair

GREEN'S FUNCTION SOLUTIONS OF THE EQUATION OF PO-TENTIAL ON MULTI-CONNECTED REGIONS. *Scott McDaniel and Steve Hughes, Middle Tennessee State University, Murfreesboro,* *Tennessee.* Green's functions provide an excellent way to obtain solutions of boundary value problems for partial differential equations, especially for regions of complicated configurations. The present study deals with the development of computational algorithms for mixed boundary value problems of the equation of potential. We present the Green's functions approach which is based on Green's functions constructed in advance for regions that are as a rule simpler than those in the formulated problem. Several numerical examples are presented.

GREEN'S FUNCTIONS ON SURFACES OF REVOLUTION. *Scotty M. Tucker*, Middle Tennessee State University, Murfreesboro, Tennessee.* The present study touches upon a nontrivial subject in applied mathematical physics. Construction of Green's functions is not a trivial routine, even for cases where the original problem has a simple formulation. Therefore, a formulation which involves curvilinear coordinates, such as geographical coordinates on surfaces of revolution, presents a rather complicated process of derivation. This problem is solved by a version of the method of separation of variables. Several particular results are shown for spherical and cylindrical surfaces.

ECCENTRICITY SEQUENCES OF GRAPHS; PRELIMINARY RESULTS. *P. O. Torbett*, J. W. Boland, and L. M. Lawson, East Tennessee State University, Johnson City, Tennessee.* The eccentricity of a given vertex, v, of a graph, G, is the distance from v to a vertex in G farthest from v. The eccentricity sequence of a graph is a list of the eccentricities of the vertices of G in nondecreasing order. The eccentricity sequences for several classes of graphs are determined. In addition, we examine the characteristics of edges whose addition to some graph G does not alter the eccentricity sequence of G.

MICROBIOLOGY SECTION
Anthony Newsome, Chair

TRACKING OF THE POPULATION GROWTH OF THE *ISCORYSIS GALBANA* SPECIES OF PHYTOPLANKTON THROUGH FLOW CYTOMETRY. *Omari K. Jones*, Tennessee State University, Nashville, Tennessee.* The rate of population growth and reproduction is very different among all living things. There also is a diversity in the methods of tracking the population growth and cell growth rates for a given species. In the case of phytoplankton, for example, someone can take the painstaking process of counting cells through a microscope over a long period of time. I chose to take advantage of modern technology and use a flow cytometer to take systematic measurements of population growth and cell growth rates within a species. Measurements were made with the flow cytometer once every hour over a 24-h period.

DEVELOPMENT OF MEDIUM SELECTIVE FOR *LEGIONELLA*-LIKE BACTERIA. *Lemuel Daubenspeck* and Anthony Newsome, Middle Tennessee State University, Murfreesboro, Tennessee. Legionella pneumophila* is a facultative intracellular parasite and can use common free-living amoebae as a host cell. *Sarcobium lyticum* is described as an obligate intracellular parasite of free-living amoebae and is remarkably similar to *Legionella* bacteria based on 16s rRNA sequences. *Sarcobium* recently has been cultured in artificial media in the absence of an amoeba host cell for the first time. The present studies are directed at developing a medium selective for *S. lyticum* which could be useful in culturing the bacteria directly from environmental samples. Diffusion disks were used to compare antibiotic susceptibility between *L. pneumophila* and *S. lyticum.* Both were equally susceptible to amoxicillin-sulbaciam, ticarcillin-clavulinic acid, cefoxitin, and erythromycin. *Legionella* showed more resistance than *S. lyticum* to cefaclor, cefamandole, and amoxicillin-clavulinic acid. *Sarcobium lyticum* showed more resistance

to ceftazidime. Neither *S. lyticum* nor *L. pneumophila* were highly susceptible to colistin. Artificial medium capable sustaining growth of *S. lyticum* was supplemented with cephalothin, colistin, vancomycin, and cycloheximide. Polymyxin-B, anisomycin, and cefamandole also were evaluated for use in selective media. The addition of bromeresol purple and bromothymol blue was helpful for differentiation between *S. lyticum* and *L. pneumophila* based on colony color.

PHYSICS AND ASTRONOMY SECTION
James C. White, Chair

SPUTTERING AND MIGRATION OF SURFACE CONTAMINANTS FROM SILICON SURFACES DURING NITROGEN BOMBARD-MENT. *Martha Riherd Weller*, Victor J. Montemayor, Diane Pedersen, and Robert A. Weller, Middle Tennessee State University, Murfreesboro, Tennessee (MRW, VJM), and Vanderbilt University, Nashville, Tennessee (DP, RAW).* We have deposited low levels of transition metal atoms onto silicon surfaces and investigated the behavior of these deposits under bombardment by 270 keV N^+ ions. Areal coverages of gold, iron, copper, molybdenum, and tungsten were less than one monolayer. Samples were analyzed using 270 keV He^+ time-of-flight backscattering before and after irradiation with 6 mC of 270 keV N^+ at current levels in the hundreds of nanoamps. The yield of sputtered metallic atoms ranged from 1.0×10^{-3}/incident nitrogen ion to 3.3×10^{-3}/incident ion. Lowest yields occurred for species which migrated into the silicon during bombardment. In all cases, yields were much smaller than those predicted based on stochiometric sputtering of the surface. We will discuss implications of these results for limitations on the sensitivity of medium-energy, heavy-ion backscattering for the analysis of trace species on surfaces.

PREDICTING CHEMICAL TRANSPORT AND HUMAN HEALTH RISK IN BRAZIL. *David E. Fields and Ana Maria L. Gordon, Oak Ridge National Laboratory, Oak Ridge, Tennessee (DEF), and Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil (AMLG).* The International Atomic Energy Agency (IAEA) has supported work at the Instituto de Pesquisas Energeticas e Nucleares (IPEN) research facility in Sao Paulo, Brazil, that has improved monitoring and health physics capabilities at this nuclear research facility. Specific areas of emphasis were acquiring equipment for monitoring meteorological variables; using the acquired data to develop databases for environmental assessment; developing estimates of radionuclide transport, human exposure, and health risk; interpreting these results in view of probable model uncertainties; and assessing models in view of their capabilities, data requirements, and correspondence with the needs of IPEN. This work resulted in the development and installation of the only meteorological system at the University of Sao Paulo that collects a complete set of wind and atmospheric stability data. IPEN is located on the University of Sao Paulo campus and includes two research reactors (IEA-R1 and MB-01), a radioisotope processing and packaging building, and a radiopharmaceutical shipping building, all of which potentially contribute to the liquid and gaseous source terms. One of the reactors is being upgraded to operate a higher power and on a continuous rather than part-time operation. Other facilities, such as the decontamination laboratory and a center for the nuclear fuel processing, normally emit only liquid effluents. This work demonstrates the benefits that accrue to second- and third-world countries from modest investments by the international community.

COMPARISON OF MIE MODEL AND HENYEY-GREENSTEIN MODEL OF PHASE FUNCTIONS FOR LIGHT SCATTERING IN OCEANIC WATERS. *Miguel D. Hayes, Tennessee State University, Nashville, Tennessee.* The phase function is defined as the scattered irradiance to the incident irradiance. It is usually written as a function of the scattering angle. The phase function was measured by T. J. Petzold at one wavelength in three types of ocean water in 1972. No other measurement is found in the literature. Therefore, it is convenient to have an analytical method to approximate the shape of a phase function. The Henyey-Greenstein phase function will be compared to the Mie calculation phase function. It is important to note that Greenstein function is not wavelength dependent but does depend on the average of all scattering cosine directions. The Mie model phase function will be determined using the size parameter of the particles calculated by the Galai instrument and by the wavelength of the incident beam. The particle (organisms) size distribution were determined from water samples taken from Cattle Point Bay located in San Juan Channel. Although these volume scattering phase functions are calculated differently, they show general agreement between scattering angles from about 10° to 150° with each other and the phase function measured by Petzold.

RECORDING LISSAJOUS FIGURES PHOTOGRAPHICALLY: A TRIBUTE TO ROBERT T. LAGEMANN. *Richard J. Raridon, Oak Ridge, Tennessee.* Lissajous figures are created whenever two simple harmonic motions are present at right angles to each other in some medium. They are probably most commonly seen on an oscilloscope screen. However, they also can be created graphically by plotting the output from two equations of X and Y motion, or photographically by using a swinging light source. I observed Lissajous patterns that Professor Robert T. Lagemann had produced when I was a graduate student at Vanderbilt in the mid 1950s, and I have produced my own several times since. A Y-shaped pendulum with a light source in the bob is allowed to swing in a dark room such that a pin-point of light exposes a sheet of photographic enlarging paper. The pendulum has two periods, based on its total length, and the length from the junction of the "Y" to the bob. By adjusting these lengths to obtain ratios of periods that are near integral, e.g., 3:2 or 4:3, beautiful patterns will result when the paper is developed. Several examples will be shown. (Poster)

A BVRI CCD PHOTOMETRIC STUDY OF OPEN CLUSTERS IC 361 AND NGC 6802. *Rica D. Sirbaugh, Kristen A. Lewis, and Eileen D. Friel, Maria Mitchell Observatory, Tennessee, and Middle Tennessee State University, Murfreesboro, Tennessee (RDS), Maria Mitchell Observatory, Tennessee, and Ohio Wesleyan University, Ohio (KAL), and Maria Mitchell Observatory, Tennessee (EDF).* We present a CCD photometric survey of two relatively unstudied open clusters, IC 361 and NGC 6802, on the BVRI system. Color-magnitude diagrams of both clusters reveal fairly populous red giant clumps and well-defined main sequences, extending about four to five magnitudes below the main sequence turnoff to V$\sim$ = 21. Comparison with evolutionary models allows us to estimate cluster properties such as metallicity, reddening, age, and distance. Using VandenBerg's theoretical isochrones, we find a best fit to the color-magnitude diagram sequences for IC 361 with parameters [Fe/H] = -0.23, E(B - V) = 0.66, true distance modulus (m - M) = 11.98, and an age of 1.25-1.50 Gyears. Likewise, for NGC 6802, we find a best fit with [Fe/H] = -0.45, true distance modulus (m - M) = 10.78, and age of 1.0 Gyear. The reddening for NGC 6802 is calculated to be E(B - V) = 0.94, but the width of the main sequence relative to expected observational errors suggests the influence of differential reddening to the cluster. Our revised ages for these clusters make them attractive targets for in-depth studies of stellar evolution and the structure and chemical evolution of the Galactic disk. (Poster)

NEUTRON TOTAL CROSS SECTION FOR THE N + 54 Fe REACTION. *R. Weinberg*, B. Seals*, and R. F. Carlton, Middle Tennessee State University, Murfreesboro, Tennessee.* Neutron total cross sections, measured at the Oak Ridge Electron Linear Accelerator facility, have been analyzed in the R-matrix formalism by least squares fitting over the neutron energy range, $E(keV) = 3D [100, 1100]$. A total of 370 resonances have been identified, of which 64 are due to s-wave interaction. J-values have been deduced for other large resonances on the basis of peak cross sections and resonance-resonance interference. Values for smaller resonances have been deduced in a companion study. The techniques and methodologies for determining these J-values from the total cross section data will be shown. From the analysis, for s-waves, we have determined the neutron strength function, S, the level spacing, D, and the external R-functions. Over this energy range, we find $(6.4 \pm 1.2) \times 10^{-4}$ and 17.7 ± 1.2 keV for S and D, respectively. These results are in agreement with earlier results, with reduced uncertainties. We also will present the external R-function for this partial wave, which determines the resonance-potential-scattering interference due to resonances outside the analyzed energy region. (Poster)

SPIN AND PARITY ASSIGNMENTS FROM N + 54 Fe ELASTIC SCATTERING CROSS SECTIONS. *B. Seals*, R. Weinberg*, and R. F. Carlton, Middle Tennessee State University, Murfreesboro, Tennessee.* Differential elastic scattering cross sections have been measured at the 200-m flight path of the Oak Ridge Electron Linear Accelerator facility up to a neutron energy of 1.5 MeV. Data are obtained simultaneously at angles of $39 = B0$, $55 = B0$, $90 = B0$, $120 = B0$, $140 = B0$, and $160 = B0$. These data have been used to determine the spin and parity of small resonances by comparing the differential elastic scattering data with theoretical calculations using an R-matrix code based on the Blatt-Biedenharn formalism. Resonance energies and widths have been taken from the companion study. The present study involved trying, for each resonance, various spin and parity assignments for the well-defined resonances with $1 > 0$ and selecting the values giving the best representation of the data. Results will be presented showing the type resonances and the features of the data which make these determinations possible. The spin and parity assignments have been made for the neutron energy region $E(keV) = 3D [100, 1000]$. We will indicate the number of definite and favored assignments for the partial wave interactions s1/2, p1/2, p3/2, d3/2, and d5/2. (Poster)

PHYSIOLOGY AND BIOCHEMISTRY SECTION

EFFECTS OF ESTRADIOL ON FOOD INTAKE AND BODY WEIGHT IN THE PRAIRIE VOLE. *Renita Hite* and Bruce S. Cushing, Middle Tennessee State University, Murfreesboro, Tennessee.* Objectives for this experiment were to determine the relationship between serum dose concentrations of estradiol and associated changes in food intake and body weight and, if food intake and body weight are affected, to determine if these effects occur at the same serum concentrations of estradiol that are known to affect activity and sexual behavior. In other species of rodents, estradiol has been shown to cause a decrease in food intake and body weight and an increase in activity in females. Based upon the fact that female prairie voles show an atypical response to estradiol, i.e., increasing levels can decrease activity, we predicted that no body weight change would occur and that food intake changes would occur only at high serum concentrations of estradiol, where prairie voles display a more typical response, i.e., increase activity. Forty females were assigned to one of four treatment groups; control (50 μl peanut oil) and injected with 0.05, 0.10, or 0.50 μl of estradiol benzoate suspended in 50 μl of peanut oil. After a baseline mean was establised, subcutaneous injections were given daily for 7 days, after

which postinjection data were recorded. Results show no significant change in body weight in any of the treatment groups. Significant changes in food intake showed a bimodal response with intake decreasing in the groups receiving 0.05 and 0.50 μl but not in the control group or the 0.10 μl treatment group. The significance of these findings also will be discussed.

EFFECT OF 24-H PREFERENTIAL THORACIC VOLUME EXPANSION ON CARDIORENAL FUNCTION IN THE CONSCIOUS RAT. *Glenn B. McCombs*, Cobern E. Ott, and Brian A. Jackson, Middle Tennessee State University, Murfreesboro, Tennessee (GBM), and University of Kentucky, Lexington, Kentucky (CEO, BAJ).* The temporal effects of preferential thoracic volume expansion on body fluid homeostasis were studied in conscious rats using a new hindlimb supported head-down tilt model designed to simulate the effects of microgravity. Compared to rats maintained at $0°$ tilt (controls), a $40°$ head-down tilt caused an immediate increase in central venous pressure from 1.4 ± 0.3 to 2.7 ± 0.3 mmHg which peaked after 8 h ($\Delta - 135\%$, $P < 0.05$). Mean arterial pressure and heart rate were not significantly affected by a $40°$ head-down tilt. Compared to controls, cumulative urinary sodium excretion was significantly increased within 6 h of the head-down tilt and remained increased at 24 h (198.8 ± 40.3 versus 72.8 ± 18.4 μEq; $P < 0.01$). Head-down tilt also significantly increased glomerular filtration rate measured after 6 ($P < 0.05$) and 24 h ($P < 0.01$). In contrast, fractional proximal reabsorption (assessed by lithium clearance) was unchanged over the 24-h period of head-down tilt, indicative of an appropriate proximal tubule response to the increased filtered load of sodium. Nevertheless, distal sodium delivery was still significantly increased at 6 and 24 h of head-down tilt ($\Delta + 172\%$, $P < 0.05$; $\Delta + 189\%$, $P < 0.01$). Head-down tilt had no significant effect on plasma catecholamine or atrial natriuretic peptide concentration (measured as urinary excretion), nor on plasma renin, although activity did tend to increase after 24 h of tilt ($\Delta + 177 \pm 75\%$). Conversely, plasma aldosterone concentration was significantly increased after 24 h of tilt compared to the tilt control values (72.8 ± 24.0 versus 32.4 ± 8.7 ng/dl; $P < 0.05$), probably as a result of the cumulative loss of sodium during head-down tilt. In summary, the present studies indicate that thoracic volume expansion induced by head-down tilt significantly increases sodium excretion, primarily as a result of an increase in glomerular filtration rate. The mechanism(s) underlying the increase in glomerular filtration rate remains to be determined.

MELATONIN ACCELERATES METAMORPHOSIS IN *XENOPUS LAEVIS*. *Matthew F. Rose, Memphis University School, Memphis, Tennessee.* Delayed metamorphosis with large body size has been observed in tadpoles of *Woodhousei fowleri* reared in continuous dark. To evaluate the mechanism by which continuous dark delayed metamorphosis, light-cycle exposure was controlled and T4, melatonin, or drugs altering prolactin concentrations were given to tadpoles of *Xenopus laevis*. The hypothesis was that exogenous melatonin would increase growth rate and delay metamorphosis and that elevation of prolactin concentrations would have effects similar to melatonin exposure. Tadpoles of *X. laevis* were randomized to three light conditions: 12L:12D; continuous dark; continuous light; subgroups in each light condition treated with T4, melatonin, bromocriptine, haloperidol, or no drug. Each subgroup included 12 tadpoles. Drugs were administered in the water either continuously or daily 0700 to 1900 h. Measurements of total length, length of leg, and stage of metamorphosis were obtained at regular intervals. Continuous dark resulted in delayed metamorphosis in controls, while continuous light did not. In contrast to the hypothesis, melatonin impaired growth rate and accelerated metamorphosis. T4 accelerated metamorphosis as expected, countering delaying effects of continuous dark. In continuous dark, T4, melatonin, and haloperidol

each led to increased size of tadpoles in contrast to that in 12L:12D or continuous light. Intermittent haloperidol promoted growth rate and metamorphosis, while bromocriptine slowed growth rate and delayed metamorphosis. Delayed metamorphosis in continuous dark may be caused by altered T4 production but is not caused by increased melatonin production. Melatonin and haloperidol accelerated metamorphosis. Melatonin acceleration of metamorphosis may be a direct effect or may be exerted by increasing the concentration of prolactin. Because tadpole metamorphosis and human embryonic development may involve similar physiological mechanisms, melatonin may be involved in regulation of human limb development. (Poster)

SCIENCE AND MATHEMATICS TEACHING SECTION
Sarah Barlow, Chair

LUCKY LEARNING: A TABLE OF RANDOM DIGITS FOR ONLY A PENNY. *Dennis P. Walsh, Middle Tennessee State University, Murfreesboro, Tennessee.* Randomization is an indispensable tool in proper decision-making, especially in the area of statistical inference. Nonrandom selection methods often lead to biased decisions or unfounded conclusions. I present a simple method that allows students (working alone or in groups) to generate their own table of random digits, which can be used subsequently in class projects involving randomization. Based on coin-flipping, the method also lends itself to further investigation of the concepts of average, variation, bias, independence, and efficiency. A follow-up exercise entails the generation of a random permutation of digits.

THE TENNESSEE JUNIOR ACADEMY OF SCIENCE: A VEHICLE TO ACCELERATE PRE-COLLEGE STUDENTS IN SCIENCE. *Jack Rhoton, East Tennessee State University, Johnson City, Tennessee.* The Tennessee Junior Academy of Science is designed to further the cause of science education in Tennessee high schools by providing an annual program of scientific atmosphere and stimulation for capable students. It is comparable to scientific meetings of adult scientists. The Junior Academy supplements other efforts in the encouragement of able students of science by providing one avenue of stimulation and expression. The primary activity of the Tennessee Junior Academy of Science is the annual meeting held in April each year. Top young scientists throughout the state, present papers and exchange research ideas. This session will focus on the activities of the Junior Academy and discuss procedures for student participation.

IMPLEMENTATION OF NINTH-GRADE LESSON PLAN ON FLUID AND CURRENT FLOW. *Deborah Hochstein and Michael L. Daley, The University of Memphis, Memphis, Tennessee.* Opportunities for ninth-grade students to integrate mathematical skills, understanding of physical concepts, and interpreting graphs are needed. The objective of this study was to provide students the opportunity to measure and analyze the behavior of electrical current and fluid flow. One experiment demonstrates Ohm's law for a direct-current flow resistive circuit, and the other demonstrates laminar and turbulent flow. The study involved 361 students, composing 15 physical science class sections, 5 regular class sections, and 10 honors sections. A diagnostic test on graphing and a pre-test on Ohm's law were administered. Post-tests were administered on Ohm's law, analogues between electrical circuits and fluid circuits, and interpretation of graphs. All sections showed improvement in post-test evaluations. Furthermore, even though the honors sections scored significantly higher than the regular class sections, the average increase between pre- and post-test scores was approximately equal. Implementation of the lesson plan was enthusiastically received by teachers and students.

A VISUAL PERSPECTIVE OF THE BINOMIAL AND MULTINOMIAL THEOREMS. *Scotty M. Tucker*, Middle Tennessee State University, Murfreesboro, Tennessee.* Pascal's Triangle is a well-known visual aid (and pedagogical tool) in the generation of binomial coefficients. A similar visual method is presented for the generation of trinomial coefficients. For specified n, our method entails generation of a triangle from which trinomial coefficients are read. Suggestions for higher dimension expansions also are discussed.

PLANT PHYSIOLOGY AND BIOMETRY: A DUAL COURSE INTEGRATION. *John D. DuBois and Philip M. Mathis, Middle Tennessee State University, Murfreesboro, Tennessee.* The objective of this project has been to improve students' abilities in scientific research, organization, presentation, and writing. For the past 6 years, Plant Physiology students have been required to perform a classical mineral nutrition-deficiencies experiment, lasting 6-8 weeks. This experiment uses two species of plants (lima bean and tomato), 10 different mineral deficiencies, one control (no deficiency), and three plants per treatment and control. At the conclusion of data collection, the students convey their methods and data orally and in writing to students in the Biometry course in a formal presentation. The Biometry students then conduct the necessary statistical analyses over a period of 2-3 weeks and report back to the Plant Physiology students, orally and in writing. The Plant Physiology students use the statistical computations in their final class reports. From this exercise, Plant Physiology students learn skills in communicating with statisticians, oral presentation, and scientific writing. Biometry students learn skills in communicating with research scientists, practical applications of biostatistics, and oral presentation. (Poster)

ZOOLOGY AND ENTOMOLOGY SECTION
John Koons, Chair

TEMPORAL VARIATION IN THE RIFFLE FISH COMMUNITY STRUCTURE OF A TENNESSEE STREAM. *Dennis Mullen, Middle Tennessee State University, Murfreesboro, Tennessee.* Patterns of temporal variation in stream riffle fish communities were examined by sampling a first-order and a third-order site every 4-8 weeks for 2 years. Samples were obtained by electrofishing, and species richness and Shannon's diversity were calculated for each site on each date. Discharge, average depth, average width, and average velocity were determined for each site on each date. At the first-order site, species richness exhibited little temporal variation (two to three species were collected on most dates) while diversity varied from 0.28 to 0.74. The variation in diversity was due to changes in the relative abundances of the three species and was not related to variation in the physical parameters. At the third-order site, richness (range of five to 14 species) and diversity (range of 0.34-0.80) exhibited strong temporal variation. Species richness and diversity were significantly negatively correlated with discharge, average depth, and average velocity. At high water levels, the community consisted mostly of small benthic-oriented fishes, while, at low water levels, water-column-oriented fishes were added to the community. The different patterns exhibited by the two sites probably result from differences in the physical environments at low discharge levels. At low discharge, the water level of the first-order site was too low for all but the smallest benthic fishes. At high discharge, the water velocity at both sites was too high for most fish species.

SPATIAL VARIATION IN THE RIFFLE FISH COMMUNITY STRUCTURE OF A TENNESSEE STREAM SYSTEM. *David Moore* and Dennis Mullen, Middle Tennessee State University, Murfreesboro, Tennessee.* Fourteen riffles along the East Fork of the

Stones River were sampled, by electrofishing, to examine patterns of spatial variation in species richness, Shannon diversity, average depth, average width, discharge, average velocity, and temperature. Species richness and Shannon diversity were positively correlated ($n < 0.05$) with stream order, average depth, average width, and discharge. The increase in diversity with increasing stream order was due largely to the addition of species at each order, with little replacement of species. Twenty-four species from seven families were collected. Five, 10, 9, 18, and 16 species were collected from first- through fifth-order sites, respectively. *Cottus carolinae* dominated first-order sites, *Etheostoma flabellare* dominated second- through fourth-order sites, and *Etheostoma rufilineatum* dominated the fifth-order site. Small insectivores and generalists, such as darters, sculpins, and cyprinids, were common in all orders, but larger insectivores and piscivores, such as sunfish, bass, and suckers, were collected from higher (four to five) riffle orders. The most important factors shaping the riffle fish community structure were average width and average depth.

APPLICATION OF AN INDEX AN BIOTIC INTEGRITY ON SPRING CREEK, TENNESSEE. *Alexis P. Ware*, Tennessee Technological University, Cookeville, Tennessee.* The index of biotic integrity, a measure of fish community structure, was used to assess the stream quality of Spring Creek, Tennessee. The third-order, warmwater stream has many land-use practices in its watershed, including agriculture, road construction, and residential development. These anthropogenic activities have effects on the overall quality of Spring Creek. Index-of-biotic-integrity analysis produced a total of 23 fish species from three longitudinally distributed sampling sites, with declining scores from the upper to the lower site. A consistent response to decreasing habitat quality caused a changed species composition. There was a reduction of expected species and piscivores with a general increase in tolerant species at the lower site. There also was an increase in proportion of individuals with anomalies. Physiochemical parameters and total coliform counts yielded difference at storm events for dissolved oxygen and pH and seasonal variability for alkalinity, temperature, and dissolved oxygen. A modified index of biotic integrity appeared to reflect changes in fish community structure associated with land-use practices within Spring Creek.

HYPOTHESES FOR THE MAINTENANCE OF SEXUAL REPRODUCTION: WHEN WILL DATA MEET THEORY? *R. Stephen Howard, Middle Tennessee State University, Murfreesboro, Tennessee.* Sexual reproduction is less efficient than parthenogenesis because of the cost associated with the production of males or reduction in genetic contribution due to meiosis and syngamy. In spite of this apparent handicap, the overwhelming majority of eukaryotes reproduce sexually. In recent years, evolutionary biologists have put forward several hypotheses to explain the ubiquity of sex. One possibility is that sex is maintained because it is adaptive as a defense against parasitism. Results from experiments suggest that the basic assumptions of this model are valid, but a direct test of the idea has not been conducted. A competing hypothesis holds that sex is selected because it purges the genome of recurring deleterious mutations, leading to a substantial reduction in the equilibrium mutation load of recombining populations. Unlike the host-parasite model, the critical assumptions of the mutation-accumulation model remain untested. In particular, little is known about mutation rates and the nature of selection against deleterious mutations. Here, I review the state of evidence bearing on each of these hypotheses and suggest avenues of experimentation that may be helpful in resolving the paradox of sexual reproduction.

NOTE ON TENNESSEE'S RARE STONEFLY *HELOPICUS RICKERI* STARK (INSECTA: PLECOPTERA: PERLODIDAE). *Charles H. Nelson, The University of Tennessee at Chattanooga, Chattanooga, Tennessee.* In 1984, Stark described *Helopicus rickeri* from a single male specimen. The generic placement, however, of this distinctive species was speculative, and Stark concluded that any resolution of this question would have to await the finding of the female and nymph. The recent collection of these life-history stages as well as that of the egg has permitted the opportunity of reviewing the generic assignment of this species. *Helopicus rickeri* is transferred to *Hydroperla*, new combination. The adult female, nymph, and egg of this species are described and illustrated for the first time. Cladistic analysis of the species in *Hydroperla* indicates that *H. rickeri* and *H. crosbyi* (Needham and Claassen) form a monophyletic group within the genus.

DIEL ACTIVITY AND BEHAVIOR OF THE EASTERN MOLE, *SCALOPUS AQUATICUS*. *Michael J. Harvey, Tennessee Technological University, Cookeville, Tennessee.* Diel activity of eastern moles (*Scalopus aquaticus* was monitored for a total of 100 days by recording time spent in and out of the nest. Moles were active at all hours of the day and night, with two primary periods of activity, one from 0800 to 1600 h and one from 2300 to 0400 h. Periods spent in the nest ranged from a few minutes to 6 h 25 min and averaged 3 h 9 min. Periods out of the nest averaged 5 h 26 min.

LIPIDS AS A POSSIBLE FACTOR IN THE NORTHWARD MIGRATION OF FIRE ANTS INTO TENNESSEE. *Linda A. Wilson and Alice Meldrum*, Middle Tennessee State University, Murfreesboro, Tennessee.* Red imported fire ants came into this country in 1918 (*Solenopsis invicta*) and in the 1930s (*Solenopsis richteri*). At the present time, *S. invicta* and *S. richteri* and their hybrid may be vigorous enough to survive in colder areas than the two species can tolerate. It has been suggested that lipid content may play a factor in cold tolerance and, therefore, in the northward migration into Tennessee. The current study is to establish variations of lipid content in field populations of fire ants. A comparison will be made of the lipids during the four seasons and among the three groups. In addition, *S. invicta* from Florida and Tennessee will be compared in lipid content. Using a spectrophotometric method that was modified from one developed for determining lipids in mosquitoes, the lipid content of several mounds of *S. invicta*, *S. richteri*, and the hybrid were determined. Preliminary results indicate that, in winter and summer, *S. invicta* has more lipids than *S. richteri*. In autumn and spring, *S. richteri* has more lipids than *S. invicta*. In comparing the two species and the hybrid (in Tennessee), it was found that the hybrid had the highest lipid content.

RUB AND SCRAPE ACTIVITY OF WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*) IN WESTERN TENNESSEE. *John R. Ouellette*, R. David Frederick*, and Nathan M. Myers*, The University of Memphis, Memphis, Tennessee.* From September 1994 to November 1995, a study was conducted to determine several parameters for rubs and scrapes made by white-tailed deer (*Odocoileus virginianus*). These parameters were to associate specific vegetation types, scent-post physical characteristics, survivorship of trees rubbed, and temporal frequency as related to breeding for rubs and scrapes on the study site. Over the course of the study, >390 rubs and >95 scrapes were identified and studied. The placement and physical characteristics of rubs and scrapes were similar to that described in the literature. There was a strong association between frequency of trees used for rubs and those tree species with aromatic characteristics. There did not appear to be any association between tree species and scrapes. The survivorship of trees rubbed in the previous year seemed to be moderately low. There were two peaks in the number of sign posts before the peak in breeding activity

for 1994. The first peak occurred 28 days; the second occurred 13 days before the peak in breeding activity.

DEMOGRAPHIC CHARACTERISTICS OF THE BEAVER (*CASTOR CANADENSIS*) AT OLD HICKORY LAKE IN MIDDLE TENNESSEE. *Marjorie E. Grogan*, Juliann L. Waits*, and Michelle J. Richard*, The University of Memphis, Memphis, Tennessee.* Demographic characteristics of beaver (*Castor canadensis*) were obtained from animals taken in Wilson, Sumner, and Davidson counties in middle Tennessee from 1993 to 1995. One hundred sixty-two specimens (52 males and 110 females) were examined. Data obtained were measurements of total length, length of tail, length of hindfoot, length of ear, weight, and age. Animals were placed into one of four age classes using cementum-weight parameters. Results are discussed.

A SYSTEMATIC ANALYSIS OF MORPHOLOGICAL RELATIONSHIPS AMONG THREE SUBSPECIES OF BLACK BEARS. *Juliann L. Waits* and Michael L. Kennedy, The University of Memphis, Memphis, Tennessee.* The use of photogrammetry to examine the systematic relationships of three subspecies of black bears (*Ursus americanus americanus*, black bear; *U. a. luteolus*, Louisiana black bear; *U. a. floridanus*) was conducted using a digital image analysis system. Images of skulls (29 male and 35 female characters) were obtained from two-dimensional photographs taken with a 35-mm camera. Measurements from photographs were compared to actual skull measurements taken with digital calipers to the nearest 0.01 mm using correlation analysis. Data obtained from both procedures were subjected to discriminant function analysis. Results indicated a high correlation between measurements taken from photographs and those taken from skulls, and subspecific taxa were discriminated at a high level using both sets of data.

DAILY ACTIVITY PATTERNS OF THE CAVE SALAMANDER, *EURYCEA LUCIFUGA*, IN A TENNESSEE AND KENTUCKY CAVE. *C. M. White and A. Floyd Scott, Austin Peay State University, Clarksville, Tennessee.* The cave salamander, *Eurycea lucifuga*, is a streamside salamander found in regions of karst topography in the eastern United States. Although anecdotal accounts describe this species as being most abundant in cave entrances at sunset, no quantitative data exist to back this up. The objective of this study was to help clarify this and other questions concerning diel activity of the cave salamander by conducting (seasonally) 24-h surveys in the twilight zones of two caves, one (Dunbar Cave) in Montgomery Co., Tennessee, and the other (Great Onyx Cave) in Edmondson Co., Kentucky. Surveys were conducted seasonally, once each in November 1994 and February, May, and June 1995, all at mid-month during a 2-day period. Data were recorded at 2-h intervals and included the number of cave salamanders encountered, internal and external air temperatures, relative humidity, and light intensity at the cave entrance. The number of observed individuals peaked at sunrise and sunset in what appeared to be a response to changes in light intensity. Although cave temperatures and relative humidities could not be significantly correlated with hourly changes in the size of the visible population, it is believed they are important factors influencing where cave salamanders can exist.

USE OF LOBLOLLY PINE PLANTATIONS BY SHREWS. *Van O. Colebank* and Bruce S. Cushing, Middle Tennessee State University, Murfreesboro, Tennessee.* The Arnold Air Force Base located in southcentral Tennessee is used extensively for the cultivation of loblolly pine for pulpwood and sawtimber. This study examined the impact of pine plantations on the distribution of species of shrews. Two hundred sixteen pitfall traps were set for 11 months in 10 different areas, each containing at least two habitats, one of which was a loblolly pine plantation. A total of 243 shrews was captured during this period. Shrews captured included the southeastern shrew (*Sorex longirostris*), the masked shrew (*Sorex cinereus*), the least shrew (*Cryptotis parva*), the southern short-tailed shrew (*Blarina carolinensis*), and one pygmy shrew (*Sorex hoyi*). Old-field habitats showed the highest numbers of shrews, except for least shrews, while mature pine forests (30-45 years) had the lowest number of shrews. Young pine forests (1-10 years) were utilized primarily by least shrews. The results indicate that there is a difference in habitat utilization and distribution between habitats and between species of shrews.

DAILY AND SEASONAL CHANGES IN EASTERN BLUEBIRD BODY MASS. *David T. Pitts, The University of Tennessee at Martin, Martin, Tennessee.* Eastern bluebirds (*Sialia sialis*) are nonmigratory in Tennessee. Low ambient temperatures restrict the availability of animal foods such as insects and spiders during winter. Fleshy berries and fruits may not be readily available due to either weather or dominant competitors. Optimal body mass theory predicts an increase in body weight immediately prior to periods of time when food supplies are likely to be limited. Lowest mean monthly temperatures and highest snowfall totals in northwestern Tennessee occur in January and February. Body weight of bluebirds begins to increase in December, peaks in January and February, and then declines prior to the nesting season. Individual bluebirds typically increase their body weight by 15-25%, mostly in the form of fat. During January and February, bluebirds are at their lowest weight in early morning and then gain weight during the daylight hours in preparation for nighttime fasting. The amount of daily and seasonal weight gain apparently reflects a trade-off between the increased probability of surviving harsh weather and the decreased probability of escaping predators as a result of decreased agility.

SEX RATIO ESTIMATION: EFFECT OF TEMPORAL SCALE. *Troy A. Ladine* and Michael L. Kennedy, The University of Memphis, Memphis, Tennessee.* The effect of temporal scale on the estimation of sex ratio was assessed during a 3-year mark-recapture study of co-occurring populations of Virginia opossums (*Didelphis virginiana*) and raccoons (*Procyon lotor*). Variance around the mean of mark-recapture (1-9 months and annually) and simulation data (1-10 months) generally decreased as temporal scale increased. However, there were observed spikes for all data between scales corresponding to 5-7 months. Spikes were greater with smaller samples sizes. The sex ratios were found to be stochastic and chaotic. The stochasticity in the demography of the sex ratios can make comparative studies appear to be different even though the populations are similar. Thus, it appears that sex-ratio demographics should be determined using multiple samples and reported as a mean and variance.

LARVAL MAYFLIES (EPHEMEROPTERA) OF THE EAST FORK OF THE STONES RIVER IN RUTHERFORD AND CANNON COUNTIES, TENNESSEE. *Lewis S. Long, Aquatic Resources Center, Franklin, Tennessee.* The diversity of the mayfly (Ephemeroptera) larvae of the East Fork of the Stones River drainage is described. The East Fork Stones begins in Cannon Co., Tennessee, and flows 85.8 km across Rutherford Co., Tennessee, before entering J. Percy Priest Reservoir. A total of 16 stations were visited between June 1993 and August 1995. Thirty species, 21 genera, and 10 families of Ephemeroptera are recorded for the East Fork Stones. Three tentative state records are reported along with 50 county records. The families Heptagoniidae and Ephemerellidae were the most diverse, each with seven species. Previous collection records also are discussed. This study represents the first known attempt to establish baseline data from which future studies on the mayfly fauna of the entire Stones River drainage can be made. (Poster)

MOVEMENT OF THE SLIDER (*TRACHEMYS SCRIPTA ELEGANS*) AT BLACK FOX WETLANDS IN MIDDLE TENNESSEE. *John Lamb*, Middle Tennessee State University, Murfreesboro, Tennessee.* Movement and site fidelity of the slider (*Trachemys scripta elegans*) were examined in Black Fox Wetland in Middle Tennessee from mid-June through October. Black Fox Wetland is an area in Rutherford Co. which was originally an impoundment of Fox Camp Spring for use as a stock pond. Now, however, like many formerly rural areas in this county, it has become surrounded, for the most part, by houses and may be referred to as an urban wetland. Along with the original impoundment, the wetland was further divided in the mid 1980s by the construction of Rutherford Boulevard. To the north of the wetland, Todd Lake is formed by a dam. A study of the demographics of the turtle community in this area found *T. scripta* to be 50% of the total with a predicted 800 individuals of this species. Also found were *Chelydra serpentina* (377 individuals), *Kinosternon subrubrum* (104), *Sternotherus odoratus* (155), and *Apalone spinifera* (6). Radio-transmitters were attached to the carapace of a total of eight individuals (four males; four females) by wire which was threaded through four holes in the lateral marginal scutes (two anterior and two posterior). The eight sliders were initially captured at various sites within the area between Rutherford Boulevard and the earthen dam. Individuals showed varied site fidelity with three entering Todd Lake and one crossing Rutherford Boulevard into the southern portion of the wetland. Movement across man-made barriers was associated with heavy rains in all but one instance. distances traveled differed from 0 to 95 m/h. No terrestrial movement was observed with the possible exception of the short distance across the dam and Rutherford Boulevard. However, this movement could have been through a culvert under Rutherford Boulevard and over a spillway on the dam. (Poster)

IDENTIFICATION AND DISTRIBUTION OF THE GRAY TREEFROG COMPLEX (*HYLA CHRYSOSCELIS/HYLA VERSICOLOR*) IN THE CENTRAL BASIN OF MIDDLE TENNES- SEE. *Gary R. Pritts*, Middle Tennessee State University, Murfreesboro, Tennessee.* The distribution of the gray treefrogs complex (*Hyla chrysoscelis/Hyla versicolor*) within Tennessee is poorly understood. The purpose of this study was to identify to species populations of gray treefrogs located within the Central Basin of Middle Tennessee and, thereby, to determine the distribution of this species complex. Populations of gray treefrogs were located by driving at night along backroads and listening for calling males during the 1994-1995 breeding season. Twenty larvae were taken from each of the 20 sites spread across 18 counties. The species of each population was determined from analysis of chromosome squash preparations made from epithelial tissue taken from the tail-tips of 10 tadpoles. Tadpoles not used for the chromosome squash preparations were allowed to complete metamorphosis in the laboratory to verify that the tadpoles collected were larvae of gray treefrogs. All populations of gray treefrogs sampled in this study were *H. chrysoscelis* (2n = 24). No *H. versicolor* (4n = 48) or triploid hybrid (3n = 36) was found. This study supports the work of other researchers who indicate that the range of *H. chrysoscelis* includes the Central Basin of Middle Tennesssee. The findings of this study indicate that *H. versicolor* is not present within the Central Basin of Middle Tennessee; however, because so many populations of gray treefrogs were not sampled, the status of *H. versicolor* in this area is uncertain. (Poster)