

ABSTRACTS PRESENTED AT THE ANNUAL MEETING
NOVEMBER 19 AND 20, 1976, UNIVERSITY OF TENNESSEE—CHATTANOOGA

GENERAL SESSION*

JOHN M. MALLETT, *Chairman*

Biology in 1776. Carl D. Brown, Memphis State University.
Chemistry in 1776. Stanley Tarbell, Vanderbilt University.
Mathematics in 1776. Al Tirman, East Tennessee State University.
Medicine in 1776. Simon R. Bruesch, University of Tennessee Center for the Health Sciences.
Physics in 1776. Robert T. Lagemann, Vanderbilt University.
* A summary for each presentation is included earlier in this issue beginning with p. 42.

BOTANY SECTION I

Prem S. Kahlon, *Chairman*

The Effects of Two Mammalian Carcinogens on Cinnamon Fern Leaf Development in Sterile Culture. James D. Caponetti, University of Tennessee.

Cinnamon fern leaf primordia can be cultured easily under sterile conditions. They offer a practical system for evaluating the effects of a variety of chemical compounds on the growth and development of a determinate plant organ. There are two well-publicized classes of mammalian carcinogens, namely the nitrosamines and the aflatoxins. In these experiments, the nitrosamine tested was nitrosopyrrolidine, and the aflatoxin was sterigmatocystin. Leaf primordia were exposed to concentrations of 10^{-8} to 10^{-4} M nitrosopyrrolidine and sterigmatocystin. Increasing concentrations of both carcinogens inhibited overall growth of the leaves when compared to controls, but nitrosopyrrolidine did not inhibit the development of the leaflets. Sterigmatocystin at all four concentrations tested increased overall growth of the leaves and the leaflets when compared to controls. Neither carcinogen induced visible tumorous growths on the leaves. Nitrosopyrrolidine induced death at the concentration of 10^{-4} M, which is considered highly toxic to animal tissues, but sterigmatocystin did not.

Pigment Formation in a Salt Marsh Sediment Bacillus Species. Theodore E. Snaazelle, University of Tennessee at Nashville and David W. Cook, Gulf Coast Research Laboratory.

An asporogenous, orange-pigmented mutant of a *Bacillus* species (GCRL #29) was isolated as a regularly appearing mutant in older colonies of a sporogenous, non-pigmented *Bacillus* species (GCRL #28). A complete culture medium which supports pigment production by the GCRL #29 isolate contains the following ingredients (g/liter H₂O): 5g Bacto-peptone, 1g Bacto-yeast extract, 23.9g NaCl, 0.7g KCl, 10.8g MgCl₂ • 6H₂O, 1.6g CaCl₂ • 2H₂O, 4.0g Na₂S₂O₄, 20g Bactoagar. No pigment was produced when the inorganic salts were deleted from the complete medium. Production of pigment was not prevented by the addition of 1×10^{-4} M diphenylamine (carotenoid inhibitor) to the complete medium. Decreasing the Mg ion concentration decreased the intensity of the pigment. When the concentration of KCl was decreased in the complete medium in which KCl (24.6g/liter) had replaced NaCl, the intensity of the pigment decreased and the colony size increased.

Natural Landmarks in Middle Tennessee. Elsie Quarterman, Vanderbilt University.

An inventory of sites of ecological/geological interest on the Interior Low Plateaus is under way, as part of the ongoing Natural Landmarks Program of the National Park Service. Because of the paucity of publications on vegetation of the Highland Rim and the Western Valley, information regarding potential landmark sites in these areas is requested from members wishing to propose sites for inclusion in this inventory. Criteria for selection will be discussed.

A Vegetation Study of Long Pond Slough, Montgomery County,

Tennessee. Frank Dodson, Dyersburg State Community College

Long Pond Slough is a privately-owned natural swamp located on an alluvial terrace of the Cumberland River. The area is floristically significant because: (1) it is one of the few remaining lowland swamps on the northwestern Highland Rim, and (2) the area is rapidly being encroached upon and filled in for agricultural purposes and will lose its unique characteristics. The absence of periodic flooding which occurred before the damming of the Cumberland River in 1966 will undoubtedly lead to changes in the physical and floristic composition of the area.

It was the purpose of this study to quantitatively and qualitatively describe and document the plant communities and flora of the area. The floristic affinities were determined and it was found that the vegetation of the study area falls naturally into five major plant communities. This study resulted in the collection and identification of 202 species representing 160 genera and 75 families.

Problems Constructing a Phylogenetic Tree in the Ranunculaceae. Gene S. Van Horn, University of Tennessee at Chattanooga.

A variety of character states were obtained from genera of the Ranunculaceae and various combinations of the data were used to prepare Wagner Trees. The trees which were produced exhibit serious differences as well as similarities with regard to certain groups of genera which were always found together. None of the trees matched previously published opinions regarding phylogeny in the family. An unusually large number of characters exhibited homoplasy. In order to generate a tree in which a reasonable degree of confidence can be placed, it is apparent that many more characters will have to be included.

Effects of Phenolic Acids and Their Derivatives upon the Growth of Avena Coleoptiles. Frederick T. Wolf, Ronnie H. Tilford and Mitzi L. Martinez, Vanderbilt University.

The elongation of *Avena* coleoptiles in the presence of indoleacetic acid and sucrose is inhibited by cycloheximide, but not by chloramphenicol, and therefore involves cytoplasmic protein synthesis. Coleoptile elongation is rather insensitive to inhibition by cyanide, but is inhibited to a greater extent by azide or 2,4-dinitrophenol.

Trans-cinnamic acid, o-coumaric acid, p-coumaric acid, ferulic acid, quinic acid and coumarin were inhibitory to coleoptile growth in all concentrations tested. Caffeic acid, chlorogenic acid, m-coumaric acid, sinapic acid, quercetin, rutin and umbelliferone were stimulatory to coleoptile growth in the presence of indoleacetic acid and sucrose. Certain of these naturally occurring compounds may therefore be considered as fine controls upon auxin-induced growth.

Aquatic Phycomycetes of Radnor Lake, Nashville, Tennessee. Norman C. Fox and Frederick T. Wolf, Vanderbilt University.

Collections of aquatic phycomycetes were made at Radnor Lake, Nashville, Tennessee, an area chosen because of current local interest. Collections made from July, 1973, through December, 1975, resulted in identification of 13 species of water molds. Those found were *Olpidiopsis saprolegniae* var. *saprolegniae*, *Aphanomyces laevis*, *Aphanomyces* spp., *Dicryuchus monosporus*, *Achlya americana*, *A. proliferoides*, *A. rodrigueziana*, *Achlya* spp., *Saprolegnia ferax*, *S. dieliana*, *S. antispora*, *S. subterranea*, *S. litoralis*, *Saprolegnia* spp., *Pythium prostratum*, *P. irregulare*, and *Pythium* spp. Several of these have not been previously collected in Tennessee.

Information was accumulated on the seasonal periodicity of species. Species with centric or subcentric oospores were characteristic of cooler months, while those characterized by eccentric oospores were present all year, but predominated in summer. These results compare well with the findings of other workers.

BOTANY SECTION II

Wayne Chester, *Chairman*

Effects of Fire on Barrens Vegetation. H. R. DeSelm and E. E. C. Clebsch, University of Tennessee at Knoxville.

In cooperation with the Department of Forestry of the University of Tennessee, Knoxville, we have now had more than a decade of experience with the use of understorey fire in the oak barrens near Tullahoma. The contrasts in aspect and composition of certain floristic elements on annual, periodic and no-burn plots is great. More than 80 percent of the flora responded to the burning treatments; there are perhaps 20 burn response types among the flora. The May Prairie, recently purchased by the Tennessee Department of Conservation, may require burning and/or other treatments to preserve the open grassy aspect and allow certain members of its biota to flourish.

A Species Ordination Procedure Utilizing Distance Related Species Co-occurrence Indices. David E. Fields, Murray State University; Charles T. Kelsey, McGill University; and F. Glenn Goff, Oak Ridge National Laboratory.

The challenging problem of obtaining a species ordination from multiplet species co-occurrence data has been approached in the past through the application of many "indices of joint occurrence." These indices have been almost universally interpreted as expressing the coordinates along, or projection onto, a set of orthogonal axes corresponding to the species of interest. We interpret most of these indices as being more correctly expressions of inter-species distances. The determination of an optional set of n species coordinates in an n - 1 dimensional "environmental space" from a set of inexact distances may be solved numerically. For this application we have developed the NONEUC code and have applied it to several sets of occurrence data.

The Uptake of Lead and Mercury by Cladophora. James A. Campbell and Gladys Mayers, Tennessee State University. (No abstract submitted.)

Seed Germination in Cedar Glade Plants: A Review. Thomas E. Hemmerly, Middle Tennessee State University.

Using results of studies involving thirty-four cedar glade species, a summary was compiled to determine any pattern in the experimental conditions considered optimum for germination. It was found that the seeds of perennials generally require either scarification or an extended stratification period in order to achieve maximum germination. In contrast, seeds of winter annuals never require stratification, high germination percentages being attained at maturity or following periods of from four to twenty-six weeks of dry storage. Seeds of all spring annuals required ten to twenty-eight weeks of stratification.

Perennials and spring annuals require, in most instances, somewhat higher temperatures (commonly 25 C) than do winter annuals, which usually germinate best at 10 or 15 C. Alternating temperatures (most often 10/25 C) provided maximum results only in approximately one-fourth of the species.

Tennessee Rare Plants List: A Status Report. Joseph L. Collins, Tennessee Valley Authority.

A member of the Tennessee Committee for Rare Plants will discuss the outcome of the Tennessee Rare Plants Workshop held November 18, 1976. Included will be a summary of the Committee's formation and the future plans for the resultant species list. Also, the need for field work to improve the list will be discussed.

Regeneration and Survival Dynamics in a Naturally Created Forest Opening. James N. Skeen, Fernbank Science Center.

Woody seedlings and saplings inhabiting the most recently exposed one-third of a 375 m² clearing in a mature Piedmont forest were censused and marked prior to the fourth growing season. Eighteen species were encountered with six species accounting for 91% of the individuals present. A subsequent inventory two years later revealed 19 species accounting for 88% of the individuals present and allowed determination of total survival and survival by species, colonization/regeneration of particular species, and shifts in relative density of the prominent species. Seedling and sapling densities encountered at the outset (4.4 individuals/m²) and at the study's end (3.4 individuals/m²) were high compared to values previously reported by other

workers, probably as a result of the high energy availability in the clearing. Shifts in the prominent species' relative densities over the timespan will be noted, reasons for the shifts will be mentioned, and the likely directions of future compositional changes or successional patterns will be discussed.

CHEMISTRY SECTION

Thomas A. Furtch, *Chairman*

Chemical Processing of Isotopic Mercury. H. H. Caudill, H. R. Gwinn and J. O. Younghanse, Oak Ridge National Laboratory.

The Electromagnetic Isotope Separations Program at the Oak Ridge National Laboratory has been involved in the separation, recovery, and chemical purification of the stable isotopes of mercury since 1947. The initial interest was in the more abundant isotopes of this element, which were needed for basic physical research. Recently the major emphasis has shifted to the least abundant isotope, mercury-196, which is used to produce the radio-pharmaceutical, mercury-197. The evolution of customer demand and the various methods of collecting the volatile mercury isotopes will be discussed. Procedures are described for the safe chemical processing of milligram quantities of the mercury isotopes with minimum losses. (Research sponsored by the Energy Research and Development Administration under contract with the Union Carbide Corporation.)

Cyclic Voltammetry of the Methylmercury Cation. J. Edward Doody, Christian Brothers College; Richard A. Durst, Frederick E. Brinckman and Kenneth L. Jewett, National Bureau of Standards.

Methylmercury compounds are currently of interest because of their high toxicity and potential environmental impact on waterways. The mechanism of the reduction of the methylmercury compounds to mercury and methane has been the subject of study for many years, but is not yet completely understood.

The electrochemical phenomena observed while studying the reaction mechanisms appears to be inconsistent, judging from literature reports. We have used cyclic voltammetry in this investigation to examine the variables which may have caused the apparent lack of agreement. We have found that the varied phenomena are due to the sensitivity of the reduction processes to changes in pH, ionic strength, depolarizer concentration and anion effects, as well as the rate of scan. These cause electrochemical irregularities as prewaves, peak splitting and new reduction peaks appearing during the reverse anodic scan.

Possible reaction mechanisms are presented and the feasibility of using electrochemical techniques in the analysis of methylmercury compounds for environmental concentrations is discussed.

The Effect of Hydrogen Ion Concentration on the Reactivity of Several Common Chelating Agents. Rita K. Hessley, Tennessee Technological University.

The anodic oxidation of methylsuccinic acid (MIDA), N,N'-ethylenediaminediacetic acid (SEDMA), and N,N'-ethylenediaminediacetic acid (UEDDA) was carried out by rapid scan polarography on a shiny platinum anode. Using the peak potential, E_p (vs. SCE), as a measure of the ease of oxidation, the reactivity of the three aminopolycarboxylic acids was compared. Aqueous solutions of varying pH were prepared for each compound. In water solutions the order of reactivity is MIDA (pH=5.3, E_p=0.350v) > UEDDA (pH=5.5, 0.460v) = SEDDA (pH=5.4, 0.460v). Only one oxidation peak is observed. In basic solutions, two reaction peaks are observed. In the first, the order of reactivity is MIDA (pH=11, 0.200v) = UEDDA (pH=12.5, 0.195v) > SEDDA (pH=12, 0.265v). The second MIDA solution of pH=2, where the zwitterion species predominates, and at pH=9 for UEDDA, in which a comparable neutral species can be postulated, the reactivity is significantly enhanced: MIDA: 0.165v (SCE); UEDDA: 0.155v (SCE). No similar reactive species was observed for the symmetrical compound.

A Study of the Purification of Chlorspan Using Affinity Chromatography. Thurston E. Banks, Tennessee Technological University.

Clostripain is a proteolytic enzyme obtained from culture filtrates of the *Clostridium histolyticum*. It has a high specificity for arginine, even more so than Trypsin, and as such has great potential as a tool in protein structural studies. Purification by taking advantage of a specific enzyme interaction (affinity chromatography) was undertaken to increase yields and activity levels in less time than are currently obtained by classical methods. Preparation of the affinity resin, resin capacity, purification procedure and resulting improvement in specific activity are discussed.

Circular Dichroism of Quinine Esters. Thomas G. Waddell, University of Tennessee at Chattanooga.

Despite more than one hundred years of structural studies, experimental evidence of a preferred solution conformation of the *Cinchona* alkaloid quinine remains inconclusive. The technique of circular dichroism (CD) has been applied to this problem with limited success, in that deduced quinone (C-8 ketone) and quinone-O-p-chlorobenzoate solution conformations are probably perturbed from their native state. In the present study, a series of quinine esters has been prepared (acetate, propionate, butyrate, valerate, hexanoate) and the CD spectra carefully examined in the region of $n \rightarrow \pi^*$ ester carbonyl absorption (225 nm). The more positive (θ) values at 225 nm in the CD spectra of the esters were seen to be due to dissymmetric perturbations of quinone absorptions and/or conformational changes in the molecule, and not due solely to a positive ester carbonyl Cotton effect.

Oxidation of Mesitylaldehyde Oxime by Cerium Ammonium Nitrate. Robert T. Swindell and Mary L. Harding, Tennessee Technological University.

The oxidation of mesitylaldehyde oxime by cerium ammonium nitrate has been investigated. The principal product of oxidation is the N,N'-dioxide. This reaction is thus similar to oxidation of other aromatic oximes studied in the past.

It was also shown that increasing the acidity of the reaction medium reduces the yield of N,N'-dioxide product to zero at high acid concentrations.

The Effect of Scavengers in the Alpha Radiolysis of Hydrogen Sulfide. Rubye P. Torrey, Tennessee State University.

The alpha radiolysis of hydrogen sulfide in the gaseous state has been studied in the presence of certain electron scavengers. The rise in the ion yield-field strength curve was suppressed by twenty-eight percent in the presence of sulfur hexafluoride, and completely suppressed in the presence of a sulfur hexafluoride-nitrous oxide mixture. The ion yield was also completely suppressed in the presence of small amounts of helium. Ethylene had no effect on the ion yield.

The production of hydrogen appears to be due to the excitation of hydrogen sulfide molecules and their subsequent dissociation to hydrosulfide radicals and hydrogen atoms with varying amounts of energy. The hydrogen atoms with sufficient energy abstract hydrogen from hydrogen sulfide molecules to form hydrogen molecules. The hydrogen sulfide excitation is by electron impact brought about by delta rays, or by electrons accelerated by the field. Our experimental evidence is compatible with this explanation.

The Statistical Mechanics of Floc Foam Flotation. John W. Wilson and David J. Wilson, Vanderbilt University.

Adsorption isotherms are calculated for floc foam flotation within the framework of a Gouy-Chapman model which includes both the electrical attractions of the floc particles to the surface and their electrical repulsions for each other. The air-water surface potential is calculated by means of a model which permits hemi-micelle formation on the surface by a model which the free energy of interaction of the floc surface with the air-water interface and the floc-floc free energy of interaction are calculated and used to obtain the free energy of interaction for the system, from which adsorption partition function for the air-water interface are calculated. The dependence of the adsorption isotherms on temperature, ionic strength, surfactant concentration, floc zeta potential, and floc particle size is investigated.

Direct Fluorination—Synthetic Alternative or Laboratory Curiosity. James L. Adcock, University of Tennessee at Knoxville.

Reactions of Elemental Fluorine with organic compounds

conjure up visions of violent, uncontrolled combustion and extensive fragmentation of all hydrocarbon structures subjected to this most reactive element. These ideas persist despite application of advances in fluorine control technology and utilization of low temperature fluorination techniques. Developments by Margrave and Lagow at Rice University and by Adcock, Maraschin, and Lagow at MIT have resulted in successful fluorination of organic compounds in high yields. These techniques utilize low temperature and initial high dilution of fluorine to control the rate of the fluorination reaction.

Compounds with open structures are easily fluorinated in excellent yields at room temperature using initially high but decreasing dilution of fluorine. For volatile liquids or solids, similar fluorine control but lower temperatures and employment of a gradient reactor are required to achieve high yields. These techniques are successful in fluorination of polymers, hydrocarbons and functional hydrocarbons including ethers, esters, and acid fluorides. Techniques for the fluorination of other functional groups are being developed presently.

The Decomposition of Ni(CO)₄ by SF₆. Thomas A. Furtch and Joe C. Haney, Tennessee Technological University.

When sulfur tetrafluoride is allowed to warm from -196°C in a sealed container with nickel tetracarbonyl, degradation of the Ni(CO)₄ occurs with the formation of NiF₂, Ni, CO and COS. Although the number of infrared active bonds in the carbonyl stretching region increases, there were none which could be assigned to SF₆-metal carbonyl complex formation, and none could be separated from the reaction mixture.

GEOLOGY-GEOGRAPHY SECTION

Richard E. Bergenback, Chairman

Karst Depressions in a Time Context. Phillip R. Kemmerly, Austin Peay State University.

A longitudinal study of dolines (sinkholes) in Montgomery County indicated measurable growth in doline long axis and mean width over a thirty-five year period. Areal growth rates are dependent upon a number of factors including surficial geology (0.01 level). Areal growth rates, based on doline long axis (dL/dt) and mean width (dW/dt) magnitudes assuming ellipticity, ranged from 40-100 m²/century.

Estimates of doline age, computed from representative samples, are compatible with the Darks Mills mastodon site of similar geomorphic setting.

Earth Resistivity Surveys of the Tiptonville Dome East Scarp, Lake County, Tennessee. Thomas M. Haselton, Parrish N. Erwin, Jr., Vicki L. Castro and Richard G. Stearns, Vanderbilt University.

Earth resistivity profiling and soundings were combined to study the Tiptonville dome east scarp. Profiling and grid contouring have shown large differences in map pattern and value with higher, more irregular values on the west (up) side and lower, smoother values on the east (down) side.

Soundings have shown near-surface resistive layers on the high side and near-surface conductive layers on the low side. These are consistent with the resistive layer (sand) being uplifted on the high side and/or being more deeply buried on the low side. They are also consistent with the fault following the west edge of a clay plug, with the resistive high side being natural levee material.

Keltner Landslide, a Model for New Madrid Earthquake "Fissures." Richard G. Stearns, Parrish N. Erwin, Jr. and Thomas M. Haselton, Vanderbilt University.

The uphill portion of the Keltner Slide is a graben of collapsed ground like the 1811 "fissures." Folded, faulted and broken clay beds characterize the toe in the stream. It squeezed a stream, causing a lake and a pond in the "fissure." Liquefaction of clay during the slide is demonstrated by a mudflow.

We believe 1811 slides can be recognized by: (1) grabens (faults under "fissures"), (2) stream trends (controlled by "fissure" erosion), (3) pond deposit in the "fissures," (4) deformed and broken beds of clay in streams, and (5) remnants of mudflows in streams. The grabens under "fissures" and dipping clay beds at the toe are apt to persist longest, and stream

alignment may show trends of the old fissures. Depressions, mudflows and pond deposits are apt to be destroyed.

The Lenox "fault" in Dyer County may be an 1811 landslide, as it has a compressed toe, graben, and aligned drainage. **Lineations in the Mississippi Floodplain Area in Northwestern Tennessee.** Richard G. Stearns, Vicki L. Castro and Phillip A. Steidl, Vanderbilt University.

As a guide to possible faults, 66 lineations were mapped, from 3 sets of aerial photos, and topographic maps. Most topographic lineations are escarpments; many of these are the loess bluffs. Most striking photo lineations on the alluvial plain follow changes in soils. Northwest and Northeast trends of all lineations were most evident.

Texture of both soil and subsoil from soil maps was combined with flood data, topographic forms of natural levees and alluvial fans to give an interpretation of soil age relationships. Of 35 photo lineations, 25 occur in the oldest alluvium not subject to flooding or burial. Of 10 lineations in recently buried areas, the majority are found near Reelfoot Lake. A number of lineations in the older alluvium could be non-tectonic or, if tectonic, are strongly influenced by location of stronger clay plugs of old channels.

Two Hundred Years of Water Management in the United States: Trends and Prospects. Thomas H. Orton, Roane State Community College.

By 1876 there were less than 600 urban water supplies in the United States. Expanding industrial and urban growth has placed continuous pressure on those institutions providing the resource for the 40,000 communities on municipal water supply today.

Outdated federal and passive state policies have left the primary responsibility for municipal water in the hands of local government. Community response traditionally has emphasized large storage reservoirs and interbasin transfers. Recent opposition to such developments has been based on economic, political, and ecologic considerations.

Other options, including price controls, reuse of wastewater, and inter-municipal cooperation, have not been fully utilized. Inter-municipal cooperation, or regional water supply, is examined as a potential non-technical management strategy. Although regionalism is more common in the populous and industrial northeast, there are also social and political factors responsible for the variation in the pattern of use.

Geological Communication in The Journal of the Tennessee Academy of Science, 1926-1975. James X. Corgan and Lynn D. Lyle, Austin Peay State University.

The first 50 volumes of the *Journal of the Tennessee Academy of Science* were examined for evidence of trends in geological communication. In 1926-29 the infant *Journal* averaged one geological paper per year. In 1930-37 the average rose to 2.5.

A Geology Section was established in 1937 and publication of abstracts of talks began in 1938. Through the end of World War II about nine abstracts and three papers appeared annually. Similar averages continued through 1971-75. Development of a Junior Academy program and of a strong Collegiate Division did little to increase the average number of geologic publications. Detailed analysis of all abstracts and papers failed to show significant trends in the subject matter presented or in the variety of techniques used to gather data. In its first 50 years, the *Journal* has played a remarkably stable role in geologic communication.

Aerial Photographic Interpretation of the Benthic Communities Living on Bruce Shoals, Biscayne Bay, Florida. Ruby Nowlin, University of Tennessee at Chattanooga.

Water penetration aerial photographs, a type of film not yet on the market, were used as an aid in reconnaissance mapping of benthic communities on a shoal in a tidal belt in Biscayne Bay, south of Key Biscayne, Florida, which is locally known as the Safety Valve area.

There are distinct color changes in the photographs, which may be related to bottom dwelling organisms. Sediment samples were taken to ascertain organisms responsible for color changes in the photographs.

The distribution of benthic communities in the Safety Valve area has not been mapped previously. We attempted to map

one shoal in this area and were able to develop a general key that can be used to map other shoals in the Safety Valve area by using water penetration aerial photographs.

Subsurface Back-Barrier Facies in the Whitwell Shale, Northwestern Herbert Domain Quadrangle, Cumberland County, Tennessee. Randall Wilson and Richard E. Bergenback, Hensley-Schmidt Consulting Engineers.

Coreholes have penetrated the subsurface Pennsylvanian Whitwell Shale in the northwestern portion of the Herbert Domain Quadrangle in Cumberland County, Tennessee.

Five facies, interpreted as tidal flat deposits, have been recognized in the Whitwell Shale:

Facies	Interpretation
1. Coal-bearing gray to black shale	Upper tidal flat
2. Gray to black shale with bands of siderite.	
3. Gray to black shale with flasher beds.	Mid-tidal flat
4. Sandstone, siltstone, shale complex; rippled flaser-bedded, horizontal and vertical burrows (bioturbated).	Lower tidal flat
5. Sandstone siltstone complex; horizontal and vertical burrows, completely churned.	

Lower Pennsylvanian Exposures along the W Road on Signal Mountain, Tennessee. Greg Warren and Richard E. Bergenback, University of Tennessee at Chattanooga.

Roadcut exposures of the Pennsylvanian Raccoon Mountain formation and Warren Point Sandstone, located along the W road on the southeast side of Signal Mountain (Chattanooga 71 1/2' Quadrangle) were examined for bedforms presented in the Hobday (1969) model of a regional Pennsylvanian clastic wedge. This model contains deltaic beach, barrier bar, lagoonal (bay), tidal delta, and tidal flat paleoenvironments.

Hobday model bedforms recognized in the Warren Point Sandstone include: (1) type B, (2) type C, and (3) type F beds. Type B beds may represent filled-in large scale ripple troughs formed by longshore currents or on top of tidal deltas. Type C beds, horizontally disposed rippled beds averaging about 2 1/2 inches in thickness occurring in solitary sets, may represent intertidal sand flats. Type F beds may represent tidal channel infillings.

Flaser bedding and a coal deposit in the underlying Raccoon Mountain Shale suggest tidal flat and marsh paleoenvironments.

Milici (1972) has utilized the Hobday model and established a localized model of early Pennsylvanian sedimentation in southeastern Tennessee. Data from W road exposures suggest that tidal flat, tidal channel, and tidal delta deposits were extant in this area during deposition of Lower Pennsylvanian rocks.

Roadcut Exposures of the Mississippian Pennington Tidal Flat Complex Along Interstate 24, Hamilton County, Tennessee. Randy Boyd, Terry Carroll and Richard Bergenback, University of Tennessee at Chattanooga.

Portions of the Mississippian Pennington Formation are exposed in roadcuts along Interstate 24 east of the Hamilton-Marion County line. The overlying Pennington-Pennsylvanian systemic boundary and the lower Pennington-Bangor formation contact are not exposed here.

These Pennington shales and limestones were examined for deposit morphology, small and large scale sedimentary structures as well as texture and composition.

Bergenback et al. (1972) and Horne et al. (1971) have considered the Pennington Formation as a tidal flat complex. Four major paleoenvironments have been recognized:

1. Red and green shale—high/low intertidal flat
2. Dolomitized calcilitite—tidal pools on tidal flat
3. Calcareous lenses—tidal channels with cut and fill structures on tidal flat
4. Massive crossbedded calcarenite—offshore barrier bars

Right Lateral Fault and Associated Karst Features, Northeast Rutherford County, Tennessee. Burton W. Bordine, Middle Tennessee State University.

A northeast trending, right lateral fault located northeast of Murfreesboro has produced a zone for groundwater migration which has subsequently formed numerous karst features. The fault is well evidenced by 12 meters of vertical exposure and approximately 100 meters of lateral extent at the Hoover Quarry, four kilometers from Murfreesboro. At this location,

quarrying operations have exposed the Murfreesboro, Pierce, Ridley, and Lebanon Limestones, through which the fault has cut.

The total lateral extent is unknown, but it is traceable for approximately five kilometers. Direct evidence at the quarry includes brecciated zones, grooves, and striations; the direction of movement is well documented by solution features (caves, sinks and depressions) and by the alteration of a stream course. All of these features are aligned parallel to the strike of the fault. Additionally, an increase in plant density is noticeable where rooting has taken place into the soil-filled fracture.

MATHEMATICS SECTION

Donald C. Ramsey, *Chairman*

Two Theorems on Obtuse Pythagorean Triples. Marilyn McIntosh, Tennessee Technological University.

A triple (x,y,z) is called an obtuse Pythagorean triple if $x, y,$ and z are all positive integers and $x^2 + xy + y^2 = z^2$. The triple (x,y,z) is called a primitive obtuse Pythagorean triple when the greatest common divisor of $x, y,$ and z is one. The following two theorems were proved as the solution to the problem proposed by Edward Kramer in the December, 1975 issue of the *American Mathematical Monthly*, p. 1010. Theorem 1: Every positive integer except 1, 2, 4, and 8 can appear as the smallest member of an obtuse Pythagorean triple. Theorem 2: The only positive integers which can appear in primitive obtuse Pythagorean triples are odd integers greater than one or in pairs divisible by eight.

Mathematics on a Billiard Table. Jim R. Ridenhour, Austin Peay State University.

The path of a ball on a billiard table has some interesting properties and several papers have appeared on the subject. In the usual situation, it is assumed that the dimensions of the table are positive integers and the ball is shot from the lower left-hand corner of the table at an angle of 45° to the sides. The ball travels indefinitely until it strikes a corner, in which case it stops. It is possible to show that there is always a terminal corner. Moreover, depending upon the dimensions of the table, one can predict where the terminal corner is, the distance traveled by the ball, and the number of times the ball strikes the sides of the table.

However, when the ball is shot from some initial point other than the lower left-hand corner, there may be no terminal corner. We consider this more general situation and by use of a theorem concerning the solution of diophantine equations, predict, among other things, when a terminal corner exists. This result is then used to determine when a shot on a pool table is a scratch shot, assuming that the collision between the cue ball and the other ball is completely elastic.

The Asymptotic Behavior of the Convolution Product of Real Valued Sequences. David Leland Wolfe, Bryan College.

The convolution product of real-valued sequences $\{a_n\}$ and $\{b_n\}$ is a new sequence $\{c_n\}$ defined by

$$c_n = \sum_{j=0}^n a_j b_{n-j} \quad (n = 0, 1, 2, \dots)$$

The purpose of this paper is to describe the asymptotic behavior of $\{c_n\}$ under various hypotheses on $\{a_n\}$ and $\{b_n\}$.

It is shown, for example, that if $\sum_{j=0}^{\infty} a_j x^j$ has radius of

convergence R and if $\{b_n\}$ is a positive sequence satisfying

$$\lim_{n \rightarrow \infty} \frac{b_{n+1}}{b_n} = \lambda,$$

where $0 < \lambda < R$, then

$$\lim_{n \rightarrow \infty} \frac{c_n}{b_n} = \sum_{j=0}^{\infty} a_j \lambda^j.$$

The main result gives an estimate of the rate of convergence of $\{c_n/b_n\}$ when, in addition to the above hypothesis, one has an estimate on the rate of convergence of $\{b_{n+1}/b_n\}$.

Simulating Rainfall on a Digital Computer. Leland L. Long, Clemson University.

Hypervelocity impact damage by raindrops introduces material failure limitations on certain types of aircraft. This paper presents an interdisciplinary approach to this problem, wherein an equation is derived which predicts the amount of nosecone material actually eroded during flight through a given rainstorm. Further study demonstrates the feasibility of a digital computer simulation of the nosecone flight through a rainstorm where rainfall rate, aircraft velocity, and distance travelled are the external parameters affecting the simulation results.

A User-Oriented Linear Programming Interpreter. Roger E. Lessman, Tennessee Technological University.

A programming language is described for the presentation of linear optimization models for solution. Features are shown which allow the problem solver to construct his models and to modify those models by interacting with the interpreter in a time-sharing mode. The advantages of a primal-dual linear programming algorithm are presented as they relate to an interactive application.

Some Identities Between Univariate and Multivariate Normal Distributions. Surgounda A. Patil, Tennessee Technological University.

Six identities between univariate and multivariate normal integrals are considered. The first three identities express the integrals involving distribution functions which are expressed in terms of the distribution functions. These are used in finding the minimum variance unbiased estimators of distribution functions in univariate and multivariate distribution functions. The second set of three identities expresses the identities between bivariate normal distributions for particular arguments. These are used in finding the bias and mean square error of the estimator of the mean μ in the presence of an outlier.

Distortion Properties of Functions of Positive Real Part and Some Related Classes of Analytic Functions. Charles A. Brown, University of Tennessee at Chattanooga.

In this paper we study the influence of the second coefficient in the power series representation of a function, defined in the unit circle E , upon the behavior of the function. In particular, we investigate the class of functions of positive real part as well as some generalizations of this class introduced by T. H. MacGregor. We obtain distortion theorems and coefficient theorems.

MEDICAL SCIENCES SECTION

James W. Wilson, *Chairman*

Epithelial Cysts of the Jaws. J. P. McGinnis, Jr., University of Tennessee Center for the Health Sciences.

The cystic lesions of the jaws are routinely reviewed by the oral pathologist. General pathologists see fewer of these lesions and tend to be less specific in their diagnostic terms.

Developmental odontogenic cysts may be classified by their microscopic and clinical features. Proper treatment and post-operative care are dependent upon a correct classification. The odontogenic keratocysts feature a high rate of recurrence; while benign and malignant neoplasms have been reported in the epithelial lining of dentigerous cysts, odontogenic keratocysts, calcifying odontogenic cysts, and radicular cysts.

The non-odontogenic developmental cysts arise from epithelial remnants of embryologic processes, and simple surgical removal is considered adequate treatment.

The commonly encountered radicular cyst is an inflammatory lesion associated with a nonvital tooth, and may be treated by either extraction of the pulpless tooth or endodontic therapy.

Mutagenicity Screening of Pesticides, Nitrocarbamates, and Hallucinogens Using Salmonella typhimurium Mutants. R. Dean Blevins and Morris Lee, East Tennessee State University.

This investigation was designed to determine the mutagenic

activity of five organochlorine pesticides, five carbamate pesticides and their nitroso derivatives, and two hallucinogens on strains TA 98, TA 100, TA 1535, TA 1537, and TA 1538 of *Salmonella typhimurium* (effects of compounds on human cellular DNA was also monitored).

Neither the organochlorine pesticides nor the carbamate pesticides caused any significant increase in the number of revertant colonies in any of the strains used. All of the nitroso derivatives of the carbamate pesticides greatly increased the number of colonies on plates inoculated with strains TA 100 and TA 1535. The hallucinogens significantly decreased the number of colonies counted in all strains below the control values.

All pesticides tested are non-mutagenic in this screening procedure. The nitroso derivatives of the carbamate pesticides, however, are potent mutagens. The hallucinogens tested appear to prevent mutation to some degree.

Evidence Favoring Diverse Pathogenetic Mechanisms in the Sudden Infant Death Syndrome. J. M. Mason, J. T. Francisco, J. W. Wilson and J. S. Bell, University of Tennessee Center for the Health Sciences.

Blood was obtained by percutaneous aortic puncture from victims of sudden infant death syndrome (SIDS) within one hour after their arrival at the Medical Examiner's facility at Shelby County (Memphis) Tennessee. The internal body temperature was measured, using a thermistor encased in a hypodermic probe. This probe was placed adjacent to the arterial needle and inserted at the same site. Because pO_2 levels fall with time after death and with the lowering of the body temperature, about six hours being the longest one can wait and successfully differentiate between cardiac and respiratory terminal events, only pO_2 values obtained on blood with temperatures over $21^\circ C$ were evaluated. A frequency of distribution histogram showing pO_2 values from 26 SIDS cases was bimodal, or possible trimodal, with peaks at 6, 30 and 48 mm Hg and minima at 16 and 40 mm Hg. Three cases in which pneumonia was the cause of death had a mean pO_2 value of 8.3 mm Hg; the only uncomplicated case of congenital heart disease measured 29 mm Hg. Other control cases—including a death by dehydration, one with biliary atresia and a case of Down's Syndrome—had pO_2 values over 50 mm Hg. These data suggest that there are at least two, possibly three, types of SIDS which may have radically different origins and pathogenesis. (Supported by a grant from the National Institute of Child Health and Human Development—USPHS Grant Number HD-07511.)

Biological Effects of Low Frequency Electromagnetic Radiation. Jacques Srouji, University of Tennessee at Nashville.

This paper represents a specialized subset of a much broader multidisciplinary pilot study and is directly concerned with procedures to measure the effects of extremely low frequency fields (ELF) on selected aspects of human performance—specifically, cognitive and psychomotor performance. It is based on data obtained from research to determine whether man can safely be exposed to electric and magnetic fields in the ELF region of the spectrum below 100 Hz.

Studies were prompted by the proposed installation of a communications system for naval use which would produce an ELF field (45 to 75 Hz) of low intensity (magnetic field strength of 0.02 mT; electric field strength of 0.06 v/m). Earlier anecdotal evidence—not performed at the exact frequencies and intensities of those peculiar to the communication system under consideration—had noted some evidence which attributes a rather ambiguously defined neurasthenic syndrome (general weakness, fatigue, laziness, etc.) to organisms experiencing a prolonged exposure to ELF. While these earlier symptoms evolved primarily from crude clinical observations based upon heterogeneous samples, they were valuable as a basis for selecting a set of tests to examine variables.

Four tests were used to measure performance before, during, and after a 24-hour exposure to a low intensity magnetic field of $10^{-4} Wb/m^2$ at 45Hz. The tests used were the Response Analysis Tester (RATER), the simplified electronic tracking apparatus (SETA), the Wilkinson Adding Task, and the Minnesota Rate of Manipulation Test (ROM). The results were analyzed at three levels: (1) a gross analysis by test type com-

paring the performance measures obtained before, during, and after ELF exposure; (2) a micro analysis of the session-by-session performance changes for each test; (3) a test session by session analysis of performance for each subject.

In view of the large number of statistical analyses drawn from a somewhat limited amount of data, the few significant performance decrements must be interpreted with extreme caution. However, none of the tests revealed significant performance decrements under the gross analytical conditions.

In Vitro Inhibition of Wound Healing by Concanavalin A. W. A. Simpson, Jr. and J. M. Mason, University of Tennessee Center for the Health Sciences.

Concanavalin A (Con A), a plant lectin widely used in the study of cell surface changes in malignant cells, inhibits wound healing of vero cells in vitro. Confluent sheets of vero cells were wounded with a microspatula and the percent healing was monitored. The wound healing effects of Con A were completely inhibited by methyl mannose. Con A inhibits wound healing at concentrations as low as 10 mg/ml and shows maximum inhibition between 30 and 100 mg/ml. Treatment of vero cells by Con A after the wounding operation is more effective in inhibiting cell migration into the wound bed than Con A treatment before wounding. These experiments preclude a mechanism of simple adhesion between the migrating cells and Con A attached to the wound bed. Wounds treated with dimeric Con A healed no slower than wounds treated with tetrameric. (Supported by a grant from the National Institute of Child Health and Human Development—USPHS Grant Number HD-07511 and ACS Institutional Research Grant IN-85-K-7, University of Tennessee.)

World Health Organization Study of Tetanus Prophylaxis in Trauma. B. R. Jennings, J. M. Mason and A. A. Fedinec, University of Tennessee Center for the Health Sciences

A project is to be undertaken to determine the effectiveness of using Tetanus Antitoxin titrations to determine the course of therapy for the prevention of tetanus in patients who have sustained traumatic injury. This project is being conducted by four laboratories in different countries under the auspices of the World Health Organization. Serum will be collected at the time of admission to the emergency room and the serum antitoxin level measured by passive tanned erythrocyte agglutination. The titer will then be reported to the physician in order to determine if antitoxin or toxoid therapy will be instituted. These laboratories are currently standardizing the agglutination test in order to have reasonably consistent reports from each laboratory.

The Growth and Fecal Microflora of Rats Fed "Natural" and Purified, "Fat-Free" Diets. John M. Witherington and Glenn E. Peterson, Memphis State University.

During recent years evidence has accumulated that dietary fat and the resulting nature of the intestinal microflora may be related in human populations with varying degrees of proneness to colonic cancer. Most of the relevant microbiological and biochemical studies have been with feces from non-cancerous individuals living "normal" existences.

The studies reported herein consist of interim data about the fecal microflora and growth of laboratory rats being used for the study of the microbiology, biochemistry and pathology of the intestinal tracts when the animals are fed diets with presumably different carcinogenic potentials.

In summary, it has been noted that rats fed conventional laboratory chow have significantly more fecal microbes than those fed several variations of purified, "fat-free" diets. Of the microbial types comprising the fecal flora, the lactobacilli and those which could use cholesterol as a sole source of organic carbon showed the greatest and most consistent variations between groups of rats fed the various diets. The comparative growth data of the rats will also be discussed.

Role of the Interstitial Mast Cell in Human Lungs. James W. Wilson, University of Tennessee Center for the Health Sciences.

Histamine, along with all but one of the presently recognized mediators of anaphylaxis, is stored in the granules of the mast cell or basophil where it is bound as an ion-exchange resin to the anionic polymers which form the bulk of the mass of each granule. In the lung, these interstitial mast cells apparently degranulate by fusion of the perigranular membrane surrounding

the mediator-containing granules, with an invaginating cell membrane. The mast cell contains, in addition to performed histamine, serotonin (5-hydroxytryptamine), heparin, and eosinophil chemotactic factor (ECF-A). The release of ECF-A parallels that of histamine. Whether the intravascular eosinophils have the potential to migrate from that compartment into the interstitial space is unknown. Electron microscopic observations do not support such migratory activity. Lung biopsies from 200 patients on cardiopulmonary bypass showed significant degranulation when pre- and post-pump biopsies were compared. Degranulation was rarely found to be complete in any of the post-pump tissues. Likewise, it is known that this reaction is self limiting and depletion of all of the stored mediator is difficult to accomplish. All of these mediators can be individually assayed and have been found to be elevated in blood samples taken from pulmonary blood following cardiopulmonary bypass procedures. These mediators may represent a homeostatic mechanism for the preservation of the pulmonary vascular network and the parenchyma of the lung, following prolonged periods of stimulatory damage to the lung, rather than the basic mediator of pathologic cellular alterations which have been documented following bypass procedures. It is quite likely that the lung has its own unique system for anticoagulation and fibrinolysis, which is completely separate and independent of that described in the peritoneal cavity. (Supported in part by the Upjohn Company, Kalamazoo, Michigan.)

Doxapram Hydrochloride, A Potent Pharmacologic Ventilatory Drug Which Acts on the Brain Stem. James W. Wilson, University of Tennessee Center for the Health Sciences.

The effect of doxapram hydrochloride on the cardiovascular system was observed in 10 dogs during a two-hour period of hypotension induced by slow venous bleeding to a mean pressure of 30 mm Hg. The drug (Doxapram) was given as a pharmacologic stimulant to offset the apnea of shock and produce better ventilation. Improvement in the cardiac status was evidenced by a sharp rise in the cardiac output. The systemic arterial pressure also increased, while systemic vascular resistance remained essentially unchanged. This pressor response was greater in hypotensive dogs than in the normotensive controls. Cardiac work was also sharply increased and central venous pressure changes were insignificant. This suggested a marked improvement in cardiac function. The venous admixture was calculated and these data suggested a concomitant decrease in the pulmonary shunt seen in shock animals. Even though oxygen consumption did not rise significantly, a comparable increase in oxygen availability was found. These significant data suggest the improvement of flow and ventilation-perfusion (V/Q) ratios. No convulsions could be induced when the drug dose was doubled three times. This finding suggests that the drug acts on medullary respiratory centers without adverse cortical stimulation as a side effect. Electron microscopic examination of the pulmonary vascular tree and the parenchymal architecture revealed minimal cellular disruption, which has been reported as a consequence of shock. The typical cellular changes that have been described in the lung following shock and hypotension were not demonstrable by either light or electron microscopy. The kidney and the bowel did not show the characteristic lesions of shock. All ten of the dogs were resuscitated and allowed to regain consciousness before they were sacrificed and studied. These findings point toward a drug which can be successfully administered in shock as a respiratory stimulant, as long as no cardiac impairment of functional reserves is present in the animals. (Supported in part by the A. H. Robins Company, Richmond, Virginia.)

An Assessment of the Oral Hygiene Status of Selected Families in Six Tennessee Counties. O. L. Adams, Tennessee State University; W. J. Seibert and H. A. Moses, Meharry Medical College. Approximately 128 families with 648 family members (495 blacks and 153 whites) representing six West Tennessee counties (Crockett, Dyer, Hardeman, Henderson, Lauderdale and Tipton) participated in this study.

The oral assessment was made using the lingual ascorbic acid test, the fifteen minute caries conductiveness test and the simplified

oral hygiene index. Serum ascorbic acid determinations were made for comparison.

The results of the dental evaluation showed that vitamin C status was satisfactory or marginal for most subjects of all ages. About 27 percent of 648 subjects in all counties were of marginal to poor vitamin C status and the others were satisfactory. These data correlated positively with vitamin C levels found in the serum. Only one percent of these subjects had low to deficient levels of serum vitamin C. The caries conductiveness assessment gave a picture of the immediate dental hygiene needs as compared to the long-term picture described by the oral hygiene index.

Out of 648 subjects tested, 209 were highly or extremely susceptible to caries and oral hygiene status of 582 was fair to poor. This was true for all age levels.

It seems quite evident that oral hygiene (cleanlines) is grossly neglected and an intensive program of health (dental education) and health care services is needed.

PHYSICS-ASTRONOMY SECTION

Marvin Tidwell, *Chairman*

Laser-Driven Fusion—A Prognosis. Jacque Strouji, University of Tennessee at Nashville.

Laser-driven fusion, in contrast with the longer-studied and more familiar magnetically-confined fusion (CTR), depends on the laser-initiated release of explosively-generated fusion energy from an inertially confined fusion pellet. Analyses show that this process can be produced at an interesting level of efficiency only if the pellet is very highly compressed into an optimum condition for ignition and subsequent explosive burning. Although the desired conditions are well-known, major uncertainties presently exist in many features of the physical phenomena of laser-interaction, energy transfer, and compression. And, present experimental results are far short of a demonstration of scientific feasibility, the compressions achieved being too low by a factor of 100 to 1000. Implosion velocities have been achieved which would be sufficient to produce ignition in large pellets. These velocities have, however, been associated with strong irreversible shock heating, and thus are of little relevance to the conditions of quasi-adiabatic heating essential for high-gain pellets.

This paper, an assessment of the engineering and scientific feasibility of laser-driven fusion, is largely based on studies and site visits carried out in the period from February, 1975 to May, 1976. The studies in reactor design considered in this report have assumed high pellet gain and have not included assessments of pellets of classified design which have higher gain and altered output spectra.

It seems that the only laser technology which presently can be extrapolated with some confidence to reactor scale is CO₂. However, the problems of laser-pellet interaction (with unclassified targets) at the CO₂ wavelength of 10.6 microns are very severe, so that feasibility appears to depend on the success of other pellet designs. No other laser technology has been sufficiently developed to give even a low confidence level of expansion to reactor scale, pulse rate, and efficiency. The iodine and HF lasers, for example, are interesting but far from a level of understanding and performance allowing projection to reactor application. A major effort in laser research is clearly needed, particularly if the attractive features of CO₂ cannot be utilized because of unfavorable pellet physics.

Energy Environment Simulation. John Czirr, Austin Peay State University.

Energy shortages are real, and all of us are directly involved in both the causes and the effects. The Energy-Environment Simulator vividly displays the relationship between the demands man places on the energy system and the eventual depletion of our fossil fuel resources.

The Energy-Environment Simulator, an electronic model of the energy supply-demand system including environmental effects, is a realistic decision-making game based on current information about energy supplies and energy demands.

SCIENCE AND MATHEMATICS TEACHERS SECTION

Bernard W. Benson, *Chairman*

Teaching Photography as a Chemistry Unit. Mildred B. Perry, Clarksville High School.

For the past six years, I have included a unit on photography in my plans for chemistry classes. Topics covered include cameras, film and paper, solutions, film developing and print making. Students find the unit very interesting and are highly motivated. It has proven to be an excellent way to teach applications of chemistry.

A Recommended Procedure to Effect Change in the Science Curriculum. Charles W. Gee, Milligan College and William N. Pafford, East Tennessee State University.

The past decade has seen many excellent science programs adopted by school systems, but in many cases the adoption has not resulted in an improved science curriculum. In order to ensure the successful implementation of new science programs, it is necessary that a specific plan be developed and followed. One possible procedure involves the following steps: (1) develop among teachers an awareness of the need for change; (2) make teachers aware of available options; (3) select an option based on input from as many individual teachers as possible; (4) locate teacher-leaders and educate them thoroughly in the selected program option; (5) implement the program by training all teachers with teacher-leaders serving as group leaders and consultants; and (6) constantly evaluate and revise the program.

Implementation of BSCS Collegiate Minicourses in a General Biology Laboratory. Jean K. Tuech and Dianne C. Pope, Christian Brothers College.

BSCS collegiate minicourses were pioneered at Purdue University as a student-oriented, audiotutorial alternative to traditional lecture presentation of introductory college biology. Each minicourse covers limited subject matter and requires manipulations and observations by students as they listen to cassette tapes.

The minicourses have been adopted for the laboratory portion of a general biology course for science majors at Christian Brothers College. This program differs from Purdue's, since regular lectures are retained; selected laboratory work is converted to a self-paced program using published BSCS collegiate materials. This was done because the minicourses offer guided inquiry approach, self-pacing, self-correction, and further inquiry according to interest and ability.

Minicourses were coordinated with lecture topics as "core" (fundamental) or "excursion" (enrichment). Completion of minicourses plus experimentation, reading, etc., were assigned point values for grading purposes. Requirements for minimum numbers of core minicourses and the point spread for determining each final grade were posted.

A Laboratory Exercise on Photoaxis in Terrestrial Isopods. J. R. Freeman and P. B. Perfetti, University of Tennessee at Chattanooga.

A laboratory exercise testing phototaxis in terrestrial isopods was devised. Petri dishes which had one half of their tops and bottoms painted black were used to house each test run of animals. Comparisons were made on the numbers of animals in the black halves with the numbers in the clear halves after timed exposures to darkness and illumination. By the use of different levels of statistical analyses, this exercise could be adapted to students in junior high, high school or college.

A Review of Empirical Studies Pertaining to Teaching and Learning the "Nature of Science." Philip M. Mathis, Middle Tennessee State University.

Fourteen empirical studies pertaining to teaching and learning the nature of science have been examined and analyzed. Results of these studies support the following conclusions:

1. Both prospective and experienced teachers of science have an inadequate understanding of the nature of science.
2. Little, if any, relationship exists between science teachers' understanding of the nature of science and the quantity or quality of their academic course work in science.
3. No relationship exists between science teachers' understanding of the nature of science and length of teaching experience in science.

4. Appropriately designed institutes, science courses, or science education courses are capable of producing significant growth in teacher and/or student understanding of the nature of science.
5. Both past and concurrent involvement in science courses appear to influence the degree to which students may profit from experiences designed to improve their understanding of the nature of science.

Undergraduate Research in the Small College. Betty W. Giesemann, Bryan College.

A program of undergraduate research in biology and chemistry has been carried on for the past five years at Bryan College. The program has had some very favorable results and some disappointments, but generally has been a gratifying experience for the students and participating faculty members. The areas of research have consisted of biological research, a four-hour course, independent studies in chemistry or biochemistry, and a short research program during the second semester in organic chemistry.

Some of the problems identified with the program have been in the following areas: choice of area of investigation, type of student and preparation, number of hours of credit awarded, scheduling of discussion of progress, and communication. Some of the rewarding aspects of the program have been: development of responsibility in individual students, increased enthusiasm for the major discipline, group learning and teamwork among students and faculty, communication and learning from others at annual meetings, and an increased awareness of the role that the experimental method plays in advancing knowledge in the sciences.

Discovery Learning and Inquiry Strategies: A Historical Perspective. Carlton H. Siedman, Austin Peay State University.

Any attempt to identify and explain the origins of inquiry and/or discovery oriented instructional strategies in American schools seems to necessitate taking a close look at two general phenomena: one, the nature and perception of science as a discipline as it was interpreted by early American science practitioners; and, two, a general perusal of the historical development of schools and their curricular programs and ideals.

Science in early America, up to the mid-1800's, had several characteristics which probably would preclude the use of inquiry strategies as generally defined. Among these were: a reliance on the Baconian perspective of practicing science which "disdains" hypothesizing and theorizing, a dominance of theology in directing scientific thinking toward a divinely "guaranteed" uniformity in nature, and the general absence of "pedagogy" as a respected discipline.

Teaching for Learning. II. Hear Thyself Talk. Rubye P. Torrey, Tennessee State University.

Since the renaissance in inorganic chemistry about twenty-five years ago, there has been an exponential rate of growth in both academic and industrial inorganic research as evidenced by the number of published articles in journals and the number of texts appearing on the market. The teaching of inorganic chemistry has become an arduous task in many instances.

At Tennessee State University, the idea of Round-Table-Talks has been introduced as a pedagogical technique. The "Talks" are tape-recorded, after which the students listen to the tape(s) and write a critical analysis of themselves and/or of their peers.

The purposes for using this technique are: (1) to introduce students to the literature of inorganic chemistry, (2) to give students experience in making oral presentations of chemical knowledge, and (3) to give students experience in making critical analyses of themselves and of their peers.

ZOOLOGY SECTION I

Michael L. Kennedy, *Chairman*

*Geographic Variation in *Orchopeus leucopus*.* Ollar S. Fuller and Michael L. Kennedy, Memphis State University.

Geographic variation was assessed in the flea, *Orchopeus leucopus*, using univariate and multivariate statistical techniques on scaled data. Eleven male and 14 female morphological characters were used in the analyses. Males were sampled from 18 localities and females from 22 localities. Animals from the

western, midwestern, and parts of the eastern United States group differently than those in the northern and northeastern United States. *O. leucopus* found on *Sigmodon* cluster differently than those from other host genera. Evapotranspiration and morphology were found to be significantly correlated with morphological variation.

Intraspecific Variation in the Hispid Cotton Rat, *Sigmodon hispidus*. Michael C. Wooten and Michael L. Kennedy, Memphis State University.

Intraspecific variation was examined in 246 hispid cotton rats, *Sigmodon hispidus*. These specimens represent 22 localities from Tennessee, Arkansas, Mississippi, Texas, Louisiana, Missouri, and Oklahoma. Multivariate analyses of 20 morphological characters were used during this investigation. Cotton rats were found to show interlocality heterogeneity. However, results of the morphological analyses show cotton rats from the areas studied to be very similar.

Co relation of Environmental Factors with the Geographic Variation of the Dwarf Crayfish, *Cambarus puer*. Carlene L. Chambers, James F. Payne and Michael L. Kennedy, Memphis State University.

Eleven environmental variables were analyzed with respect to geographic variation in the dwarf crayfish, *Cambarus puer*, described earlier (Chambers et al., 1976). Variables analyzed included mean January temperature, mean July temperature, mean annual temperature, precipitation, heating degree day, cooling degree day, latitude, longitude, altitude, evapotranspiration, and river drainages. Evapotranspiration and longitude were significantly correlated with morphologic variation in *C. puer*. Net primary productivity appeared to influence body size in these animals.

Description of the Adult Male of *Allonarcys comstocki* (Smith) and Re-examination of Phyletic Relationships within the Pteronarcidae (Plecoptera). C. H. Nelson, University of Tennessee at Chattanooga.

The adult male of *Allonarcys comstocki* (Smith) is described for the first time. The adult specimen was reared by D. C. Tarter and M. L. Little from a last instar nymph collected in Seneca Creek, Pendleton County, West Virginia. Characters serving to distinguish the male of this species from other members of this genus are discussed. Identification of the male of *A. comstocki* means that the adult male and female of every described species within the family Pteronarcidae is at last known. Hence, a re-examination of phyletic relationships within this family is undertaken. Numerical phenetic measures of relationship include the UPGMA and WPGMA. Quantitative cladistic methods include those of Farris (1970) involving the construction of a Wagner Network.

Distribution and Ecology of Bats in the State of Colima, Mexico. Michael J. Harvey and Michael L. Kennedy, Memphis State University; Troy L. Best, Eastern New Mexico University.

During periodic visits to the state of Colima, Mexico, from 1972 to 1976, 726 bats, representing 25 species, 19 genera, and 8 families, were collected. More than 1000 additional bats were captured, examined, and released. All specimens were captured by the use of mist nets and Tuttle bat traps. Habitats sampled ranged in elevation from sea level to over 5000 ft and included tropical deciduous forest, mountainous thorn forest, tropical lowland forest, and mangrove swamp. Families represented were: Emballonuridae, Noctilionidae, Mormoopidae, Phyllostomatidae, Desmodontidae, Natalidae, Vesperilionidae, and Molossidae.

Survey of the Suctorina from Streams and Ponds in Rutherford County. Judy A. Cooper and Ralph Sharp, Middle Tennessee State University.

Survey of the Suctorina from Streams and Ponds in Rutherford County. Judy A. Cooper and Ralph Sharp, Middle Tennessee State University.

Suctorina identified were collected from six species of turtles and from slide traps placed at four stations along the West Fork of the Stones River, Rutherford County, Tennessee. Suctorina from turtles were found attached to algal filaments, epizooic peritrich stalks, or attached directly to the carapace and plastron. Suctorina attached to slides in a trap left at collecting sites for 3-4 days. Eight species of suctorians were collected from the turtles and ten species were collected from the slide traps. With

one exception, species of suctorians found attached to turtles differed from those found attached to slides.

A Preliminary Survey of the Soil Protozoa from a Cedar Glade in Rutherford County, Tennessee. Elaine Martin and Ralph Sharp, Middle Tennessee State University.

Soil samples from gravel, grass, shrub, shrub-cedar and cedar-hardwood communities in a cedar glade southwest of Murfreesboro, Tennessee were examined for protozoa. Samples were collected in June and October of 1974. They were examined weekly for five months and then periodically through June of 1976. No significant differences were found in species composition from the different communities.

A wide range of species was observed among the naked amoebae, flagellates, ciliates and testacea; but representatives of the genus *Colpoda*, typically the most common soil ciliates, were conspicuously rare. All morphotypes of testacea were represented, but the "Arcella" types were rare and the crypto-stome types were inactive.

Activity Patterns of the Troglitic Grotto Salamander, *Typhlotriton spelaeus*. William H. Weathered, Jr., and Michael J. Harvey, Memphis State University.

Activity patterns of the troglitic grotto salamander, *Typhlotriton spelaeus*, were studied from 24 May through 27 August 1973 at the Ozark Underground Laboratory, Taney County, Missouri. Thirty-two salamanders were marked for individual identification. Activity data were gathered during 213 two-hour observation periods scheduled to give equal coverage for all hours of the 24-hour cycle. Over 75 percent of all observed activity occurred between 0500 and 2100, during the epigeal daylight hours. Activity was greatest between 0800 and 1700; minimum activity was recorded between 2200 and 0400.

Observations of a Baldpate Hornet's Nest. Mildred B. Perry, Clarksville High School. (Duplicated abstract provided was illegible.)

An Anomaly in the Reproduction of the Tardigrade *Macrobrotus areolatus*. Diane R. Nelson, East Tennessee State University.

Tardigrades from the moss *Leucodon* were maintained for ten days in a Petri dish in which the water was oxygenated daily. Several large *Macrobrotus* adults with developing eggs in the ovary were seen moving actively after the sample was soaked in tap water. After ten days, numerous free eggs and large adults of *M. areolatus* were found and mounted in Hoyer's. In the genus *Macrobrotus*, eggs are usually deposited outside the exoskeleton and develop projections or ornamentations after deposition. In only a few species, smooth eggs are deposited within the exoskeleton.

One tardigrade with a single spiny egg in the exoskeleton was observed as it molted. The tardigrade escaped from the exoskeleton, leaving the egg inside, and then ceased active movement as it clung to the exoskeleton. The egg, exoskeleton, and adult were then mounted in Hoyer's and identified as *M. areolatus* although the adult lacked mouthparts. Other exoskeletons containing spiny *M. areolatus* eggs were also located.

ZOOLOGY SECTION II

Charles J. Biggers, Chairman

Electrophoretic Hemoglobin Patterns of Four Species of *Peromyscus*. Phyllis K. Price, Melvin L. Beck and Michael L. Kennedy, Memphis State University.

Polyacrylamide gel electrophoresis was used to examine hemoglobin patterns of *Peromyscus maniculatus*, *P. leucopus*, *P. gossypinus*, and *P. attwateri* collected from Oklahoma, Arkansas, or Tennessee. Three common hemoglobin patterns were revealed in *P. maniculatus* from Tennessee; Oklahoma *P. maniculatus* were monomorphic, *P. leucopus* and *P. gossypinus* exhibited variable hemoglobin bands. All *Peromyscus* examined tended to express banding patterns reported for these species in other areas.

Chromosomal Study of *Liomys irroratus* and *Liomys pictus*. Jon C. Stanford, Melvin L. Beck and Michael L. Kennedy, Memphis State University.

Somatic metaphase chromosomes were analyzed from bone marrow cells of *Liomys irroratus* and *L. pictus* collected in Colima, Mexico. A diploid number of 60 and a fundamental

number of 62 was found for *L. irroratus*, whereas *L. pictus* had a diploid number of 48 and a fundamental number of 66. The sex determining mechanism of both species was of the typical XX/X type. *L. irroratus* possessed a large submetacentric X-chromosome, but the X-chromosome of *L. pictus* was metacentric. Both species possessed a medium-sized submetacentric Y-chromosome. No intralocality and/or interlocality chromosomal polymorphism was observed in either species.

A Karyotypic Study of *Bufo woodhousei fowleri*. James T. Mahan and Melvin L. Beck, Memphis State University.

Bufo woodhousei fowleri possesses a diploid number of 22 and a fundamental number of 44. The karyotype is composed of metacentric and submetacentric elements, with six pairs of relatively large and five pairs of relatively small chromosomes. A large secondary constriction is found near the centromere of the largest pair of chromosomes. This secondary constriction was shown by silver staining to be the nucleolar organizer region. Constitutive heterochromatin was localized in the mitotic chromosomes by the C-banding procedure. Heterochromatic segments were found in the centromeric regions of all chromosomes. In addition, the nucleolar organizer region was found to be heterochromatic.

Chromosomal Study of *Microtus pinetorum*. Norman L. Donati, Melvin L. Beck and Phyllis K. Price, Memphis State University.

Somatic metaphase chromosomes were analyzed from bone marrow cells of *Microtus pinetorum* taken in western Tennessee. This species was found to possess a diploid and a fundamental number of 62 which included 29 pairs of large to small acrocentric chromosomes, one pair of small metacentric chromosomes, a large submetacentric X-chromosome, and a medium-sized Y-chromosome. No chromosomal polymorphism was found in any of the specimens examined.

Localization of Constitutive Heterochromatin in the Neuroblast Chromosomes of *Drosophila virilis* and *Drosophila hydei*. Melvin L. Beck, Memphis State University.

The neuroblast chromosomes of *Drosophila virilis* and *Drosophila hydei* were stained for constitutive heterochromatin utilizing C-banding techniques. In *D. virilis* the proximal halves of the autosomes, with the exception of the dot chromosomes, were found to be heterochromatic. The tiny dot chromosomes showed no detectable heterochromatic regions but instead stained lightly like the euchromatic regions of the other autosomes. The proximal region of the X-chromosome was heterochromatic but was divided into three darkly-stained regions and two small lighter-stained areas in less condensed X-chromosomes. The Y-chromosome stained darkly and appeared to be almost entirely heterochromatic.

The autosomes of *D. hydei* possessed very little heterochromatin. In this species most of the heterochromatin is localized in the sex chromosomes. One arm of the X-chromosome was heterochromatic while the Y-chromosome appeared to be entirely heterochromatic.

Effect of Temperature and Salinity on Muscle Chloride and Water Distribution in Channel Catfish, *Ictalurus punctatus*. Kenneth B. Davis and Cheryl A. Goudie, Memphis State University.

Chloride regulation and intra-extracellular water distribution was compared in muscle tissue of channel catfish acclimated to 0, 7.5, and 11 g/l sodium chloride at 10° and 22°C. Plasma and muscle chloride concentrations increased in fish held in water hyperchloremic to the chloride concentration of fresh water acclimated fish. Water content in muscle tissue was only slightly decreased in fish held in a hyperchloremic medium; however, extracellular water volume, estimated by the chloride space method, increased sharply. These effects were more dramatic in fish acclimated at 22° than at 10°C. Cellular dehydration appears to be more pronounced at high temperatures, since total tissue water changed slightly while extracellular water volume increased markedly. Little difference in plasma or muscle chloride concentrations occurred in fish held in salt water concentrations isochloremic with plasma from fresh water acclimated fish held at either 22° or 10°C.

The Effect of Environmental Calcium on the Regulation of Plasma Sodium and Chloride in Channel Catfish. Darrell Criswell, Virginia M. Norton and Kenneth B. Davis, Memphis State University.

Environmental calcium concentration has been implicated in affecting internal ion regulation in fish. Unfed channel catfish were exposed to deionized, aged tap water (calcium 1 mg%) and calcium enriched tap water (250 mg%) for three weeks and then sampled. Plasma chloride levels were significantly lower in fish in deionized (98.0 ± 7.9 mEq/l) and aged tap water (96.3 ± 3.8 mEq/l) than fish held in calcium enriched tap water (117.8 ± 1.3 mEq/l). Plasma sodium of fish held in aged tap water (117.1 ± 4.7 mEq/l) was significantly lower when compared with fish in deionized (135.8 ± 1.4 mEq/l) and calcium enriched tap water (131.3 ± 1.3 mEq/l). Mortality of catfish exposed to an aculemic solution of 12 g/l NaCl was 87.5% after 48 hours, while there were negligible mortalities in groups with calcium added to the salt water.

Ammonia Production by Unfed and Fed Channel Catfish in a Recirculating Raceway. F. Lynn Walker and Bill A. Simco, Memphis State University.

Channel catfish were cultured for 140 days in a recirculating raceway system. Ammonia production by fish maintained for four days without feeding remained constant over a 24 hour period at a rate of 0.051 mg NH₃/Kg fish per minute. At feeding rates of 0.7, 0.7, and 1.4 percent body weight, the ammonia produced over a 24 hour period was 0.0225, 0.0211, and 0.0211 Kg NH₃/Kg food, respectively. Ammonia production peaked 6 hours after feeding at each level; but as feeding levels increased, the percent production in the next 18 hours increased. Biological filters responded quickly to increased ammonia levels and the rate of nitrification increased with increased ammonia levels up to a concentration of 4 ppm. The maximum ammonia breakdown by the filter was 0.115 Kg NH₃ per day. Production of ammonia above this level exceeded the capacity of the filters and resulted in temporarily elevated ammonia concentrations in the system. The capacity of the biological filter thus limited the amount of food that could be used and thus limited the daily fish production in the system.

Fishes of the Rio Armeria, Colima, Mexico. Malinda E. Crane and Bill A. Simco, Memphis State University; Michael Stevenson, Tulane University.

Fish were collected from the Rio Armeria in Colima, Mexico, during January of 1975 and 1976. The stream varies from a narrow, rocky-bottom stream near its origin to a broad, sandy-bottom stream more than 100 feet across near where it empties into the Pacific Ocean. Drag seines, cast nets and an experimental gill net were used in collections from 11 localities. Fish representing the following 14 families were collected: Syngnathidae, Characidae, Clupeidae, Catostomidae, Goodeidae, Poeciliidae, Mugilidae, Atherinidae, Bothidae, Cichlidae, Gerridae, Carangidae, Gobiidae, and Eleotridae.

Polymorphism and Convergent Evolution in Endemic Ground-Dwelling Nasute Antillean Termites. Virginia Ann Spaeth, University of Tennessee at Nashville.

This study is based on twelve species of termites (Termitidae), endemic to Puerto Rico, Hispaniola, and Cuba. They live in endemic damp, rotten wood in contact with the ground, or go several feet into dirt beneath the ground. This is contrast to species of *Nasutitermes* which build conspicuous nests or mounds.

Scanning electron microscopy of the molar plate of imago mandibles separates these endemics into two phyletic lines. One line has species with only monomorphic soldiers, and is most closely related to *Nasutitermes*. The second line has dimorphic closely related to monomorphic species, and is most closely related to the *Diversitermes-Velocitermes-Otitermes* line from South America and Panama, with trimorphic and dimorphic soldiers. This line is not found in the rest of Central America, Jamaica, or islands of Lesser Antilles. Until I discovered six new imago castes, the monomorphic soldiers of each line were classified together due to superficial resemblance.

COLLEGIATE DIVISION

Richard Raridon, Chairman

Geology, Geography, and the Fall of Fort Henry. Clark K. Causey, Austin Peay State University.

For the Confederacy, Fort Henry in Stewart County, Tennessee, was the first line of defense on the Tennessee River. The fort

was an earthwork structure that capped a small rise in the bank that coincided with a bend in the river. While the fort commanded a large area of water surface, the site proved disadvantageous. The fort was lower than nearby hills outside the floodplain and the site was subject to flooding. When Fort Henry fell, poor site selection was generally blamed. In the 1970's, one can objectively appraise the role most geologic and geographic factors played in the brief military history of Fort Henry. All major tactical difficulties could have been foreseen.

An Attempt to Induce Transuterine Migration in Rats—A Preliminary Report. Mark Edwards, Meg Green, Rick Dooley, M. J. Levine, Floyd Denney and R. Garth, University of Tennessee at Chattanooga.

Transuterine migration of preimplantation blastocysts in mammals with duplex uteri is rare, but has been reported. The purpose of this study is to determine whether or not transuterine migration occurs in unilaterally ovariectomized rats treated with hormones to stimulate ovulation.

Thirty-day old unilaterally ovariectomized rats, treated with PMS and MCG, were mated and then laparotomized eight days post-coitum to identify nidation sites.

Radioactivity Associated with Different Tissues after Chronic Administration of Radioactive Butylated Hydroxytoluene in Mice. R. Dees, H. Franks, P. Mauldin, P. Harmeson, A. Dean, J. Dees, L. Beach, and J. P. Daugherty, Lee College and Oak Ridge National Laboratory.

In an attempt to understand the apparent protective effects of butylated hydroxytoluene (BHT) against the action of toxic, mutagenic, and carcinogenic stimuli, we have undertaken a study of the metabolism of this common food antioxidant. Radioactive BHT (^{14}C) was administered to groups of three 8-week-old male BALB/c mice by oral intubation (every other day for 21 days). The amount of radioactivity associated with the various tissues was determined as a function of time after the last administration of BHT (8, 24, 48, and 96 hrs). Generally, the largest amount of radioactivity was observed at 8 hrs, after which it slowly decreased through the 96 hr time interval. The relative amount of radioactivity in brain, testes, muscle, adipose, spleen, small intestine, squamous stomach, large intestine, kidney, and liver was 1, 2, 2, 3, 3, 7, 8, 8, 9, and 33 respectively. There is no apparent accumulation of radioactivity in any of the tissues studied. (Research supported by a NSF-SOS Grant (No. 76-07898) to Lee College.)

Distribution of Radioactivity in the Acid Soluble and Acid Insoluble Components of Nuclear and Cytoplasmic Fractions of Various Tissues of the Mouse after a Single Administration of (^{14}C) Butylated Hydroxytoluene. J. Dees, D. Dees, H. Franks, P. Mauldin, P. Harmeson, A. Dean, L. Beach and J. P. Daugherty, Lee College and Oak Ridge National Laboratory.

The distribution of radioactivity derived from ^{14}C -labeled butylated hydroxytoluene (BHT) has been investigated in 8-week-old male BALB/c mice. The radioactivity was followed at timed intervals ($\frac{1}{2}$ to 120 hrs) after intragastric administration of BHT. The tissues were separated into nuclear and cytoplasmic fractions, and these were divided into acid soluble and acid insoluble fractions. The squamous stomach incorporated the largest amount of radioactivity and reached a maximum at one hr after administration. The relative amounts of radioactivity in the different fractions were as follows: nuclear, acid soluble (1), cytoplasmic, acid soluble (1), nuclear, acid insoluble (10), and cytoplasmic, acid insoluble (1). The radioactivity derived from BHT is distributed differently in the various tissues examined, but appears to accumulate in the acid insoluble components of the nuclear fractions of tissues susceptible to the modifying action of BHT. (Research supported by a NSF-SOS Grant (No. 76-07898) to Lee College.)

New Vertebrate Fossil Sites, 1975-76. Joe F. Penick, Lynn Keeton and James X. Corgan, Austin Peay State University.

Through the assistance of the Cumberland Museum in Nashville, the Biology Department of Middle Tennessee State University, the Geology Department of the University of Tennessee at Nashville, and our colleagues at Austin Peay State University, we learned of five vertebrate fossil discoveries made in Tennessee during the academic year 1975-76. We tried to relocate each discovery and to assess the probable significance of the find. A site

at Selmer, McNairy County, yields a varied marine vertebrate fauna from the Coon Creek (Cretaceous). A locality near Tracy City, in Grundy County, yielded one shark tooth, for which the age seems questionable. We anticipate further efforts to relocate this site. All other sites are apparently Pleistocene. They include a mastodon tooth (camel?) from Edwin Warner Park, Nashville; an artiodactyl tooth from Antioch, Davidson County; and a horse tooth from Trace Creek on Kentucky Lake in Humphreys County. The horse is apparently *Equus complicatus*. Each of the Pleistocene sites yields a single species. *Leadership in the Tennessee Academy of Science, 1912-1975.* James X. Corgan and Sharon L. Riley, Austin Peay State University.

The first 50 volumes of the *Journal of the Tennessee Academy of Science*, and earlier Academy serials, are a unique source of data on the leadership of Tennessee's scientific community during most of the 20th century. In the present study, obituaries, articles on new officers, and similar biographical reports were analyzed. Each person discussed in a formal biography was classified as an Academy leader or a non-leader. Each was assigned to one of four economic groups: other, private industry, teacher, government employee. Each was assigned to one major academic field. An attempt was then made to describe time-dependent trends in Academy leadership.

Helminth Eggs from Feces of Larus argentatus, L. marinus and Phalacrocorax auritus in Cobscook Bay, Maine. David Bruce Conn, Lee College.

A systematic analysis was made of feces from *Larus argentatus*, *L. marinus* and *Phalacrocorax auritus* in the Cobscook Bay area of Maine. Helminth eggs found in the feces were described, counted and statistically analyzed to gain insight into the parasite burden of these three avian species in the area.

Of 62 fecal specimens from the *Larus* rookery examined, 50 contained at least one helminth egg. Of these, 45 contained eggs of *Cryptocotyle lingua*. Nineteen contained eggs of *Capillaria* sp. Twelve contained eggs of "type 26a"; possibly a large trematode egg. Six contained Dipylidid-type eggs of a cyclophyllidean cestode. Three contained eggs of a nematode, possibly of suborder Strongylata.

Of 8 fecal specimens from the *Phalacrocorax* rookery examined, one contained a single *Cryptocotyle lingua* egg. The other specimens contained no eggs.

The mean number of eggs per stool was 63.11 for *Cryptocotyle lingua*; 4 for *Capillaria* sp.; 11 for "type 26a"; 7.83 for the cyclophyllidean eggs; and 35.67 for the nematode eggs.

Altitudinal Variation in Size in the Green Salamander, Aneides aeneus. Beverly Mock, Austin Peay State University.

A study was conducted to determine if size of the Green Salamander, *Aneides aeneus*, varies as a function of altitude in the Blue Ridge portion of its range. A sample of 211 individuals collected at elevations ranging from 1,600 feet to 4,400 feet elevation, in the tri-state region of Georgia, North Carolina, and South Carolina, served as a basis for statistical analysis.

The Vanadium Side Stream—Economy through Ecology. W. Thomas Bonds, University of Tennessee at Chattanooga.

The mining and recovery of principal mineral products discard small quantities of potential mineral by-products. One such potential by-product is vanadium (v) oxide, found in some carnotite ores which are primarily mined and processed for uranium (v, vi) oxide.

Recovery of vanadium as a marketable commodity is possible using existing technology in simultaneous solvent extraction processes. Such extraction should prove feasible when applied to existing and future ore processing facilities. Extraction of ponded and stockpiled tailings may be possible.

Our society is dependent upon mineral resources. Research and development is needed (either public or private) to identify these escaping resources and determine ways of recovering them. *Isolation and Identification of Tubificidae: Determination of Bacteria Flora Found in Association with Tubificidae.* Carolyn D. Bohlen, Tennessee State University.

The main objective of this investigation is threefold: (1) isolation and identification of *Tubifex tubifex*, (2) determination of the diversity of aerobic bacteria living in association with the tubificids, (3) conjectures regarding the degree of health hazard