

ABSTRACTS PRESENTED AT THE ANNUAL MEETING  
NOVEMBER 21 AND 22, 1975, UNIVERSITY OF TENNESSEE—NASHVILLE

GENERAL SESSION

ALBERT L. MYERS, *Chairman*

*Energy Is No Problem, People Are.* Wayne Brown, Tennessee Higher Education Commission (20 min.)

The current U.S. Energy crisis is not at this point of energy resources within this country. For a number of years the U.S. Geological Survey has systematically compiled and cataloged fossil and nuclear fuel reserves and resources. These findings coupled with calculations of increasing energy consumption indicate that this country is still many years away from depleting its supply of fossil fuel, and, of course, quite remote from depleting the nuclear sources.

Changing the primary fuel mix has been seen in the nation's past (dominant wood to dominant coal to dominant petroleum) and will be seen again. The absence of a clear plan allows economic and related political manipulation of the available energy commodities.

Scientists and others have tried for years to convince Congress and several administrations of the coming energy problem with its economic and technical aspects. Shortsightedness on the part of many elected officials did not and cannot provide solutions to this matter.

The current energy crisis is, in essence, a crisis of economics, management, and politics.

*Energy Conservation and Conversion Efficiency—Some Current Research Efforts.* William Fulkerson, Oak Ridge National Laboratory (15 min.)

Current Research, Development and Demonstration work at ORNL in the areas of reducing energy use in buildings and improved energy conversion efficiency is described. The need for fuel conservation and improved efficiency is established in the context of the national energy problem of converting from non-renewable fossil fuels of limited availability to coal and ultimately to inexhaustible energy sources. Conservation research at ORNL in the residential and commercial sector includes:

- (1) Studies of the relative savings in money and fuel from increased insulation in buildings as a function of geographical area.
- (2) Estimation of the fuel savings from night thermostat setback also as a function of geographical area.
- (3) Comparisons of the coefficient of performance of air-conditioners from various manufacturers.
- (4) Identification of ways to improve the efficiency of gas furnaces, hot water heaters and mobile homes by both design and installation changes.
- (5) The development and demonstration of the Annual Cycle Energy System, a heat pump-energy storage system, which can reduce electrical energy use in heating, air-conditioning and hot water heating by 50% or more over conventional systems including air-to-air heat pump systems.

Work on conversion efficiency involves: (1) studies of Modular Integrated Utility Systems (MIUS) which are total energy systems for small communities or apartment complexes; (2) development of a coal-fired fluidized bed closed cycle gas turbine to power a MIUS; and (3) development of a potassium vapor topping cycle for central power stations.

*Living Within Our Income.* Ruth H. Neff, Tennessee Environmental Council, Tennessee Botanical Gardens and Fine Arts Center at Cheekwood.

A major energy policy reassessment is underway in our society. We as a people must reevaluate our patterns of energy use. The problems are not all technological—many are legal, economic or social. We must eventually arrive at a steady state

with respect to energy flow, the level of which will most probably be a function of our solar energy income.

All areas of our social institutions must be reexamined in terms of energy efficiency. We must begin to reduce our population, not through disease or death, but by working toward a consistently lower birth rate. We must reverse recent land use trends. We must revitalize mass transit systems as the private automobile is phased out. We must encourage the selection of the most energy efficient means of transporting goods. We must integrate the modes of transport.

Architects must rethink our buildings—with more attention to site, insulation, reduced lighting, improved space heating and cooling. We must improve industrial designs—by eliminating "planned obsolescence" and planning for material recycle and reuse.

We must also alter our energy intensive agricultural practices; perhaps by returning to "organic" fertilizers. We must increase production of natural fibers, and eliminate some uses of synthetics. We must eliminate the enormous energy expenditures in processing and packaging.

Scientists have a unique role in guiding our society toward a zero energy growth society—as advisors to government and as educators.

*Critical Mass: Energy for Every Man.* Jacque Srouji (20 min.)

America no longer enjoys the leisure of a rural society. We are an industrial one and as such, can no longer employ the 'sticks and stones' mentality in dealing with 20th century technology.

In fact, there seems to be an almost anti-scientific crusade raging throughout the country. Combine this with seemingly deliberate distortions on the part of much of the news media plus a power struggle for the minds of the people on the part of a "fundamentalist intelligensia" and you have what we've got—a MESS that's about ready to achieve criticality. The author has found several moods prevalent today:

- You have the average person who thinks that he's too dumb to understand anything beyond the world series or prime time football and acts accordingly.

- You have the professional crusader who acts like a bull (or a cow) in a China shop when it comes to saving the world.

- You have the scientist who shuts himself in an ivory tower and suffers from the 'god' complex.

- Finally, you have the scientist who is not satisfied with test tubes and statistics and feels a need to be needed. He and only he is going to lead the Children of Israel to the Promised Land. . . .

These facts are worth considering:

- Dependence on foreign energy sources is simply no longer a stable factor from both a security standpoint as well as economic. Further defined, it means that when the chips are way, way down, no one is going to help America but the Americans. Let's start acting accordingly. . . .
- More than 75% of the nation's energy consumption is based on petroleum and natural gas. Domestic supplies of these are dwindling.
- Coal, the most abundant domestic fossil fuel provides less than 20% of current energy needs.
- Uranium, the domestic energy source with the greatest energy potential provides about 2% of the nation's energy.
- Solar and Fusion—GREAT for the year 2000 but what about now. The question is how do we get from the here and now to the then and there. The answer is that we utilize the cheapest thing going for the next thirty or so years and somehow manage to squeeze by that boulder blocking our path.

Now, for those who beckon with candles and alternate energy sources—such as the sun, windmills and geothermal—let's remember that historically, it has taken some 60 years from the member at which a transition to a new energy resource was first point at which that resource, in turn, reached its peak use and discernible until that resource, in turn, reached its peak use and began to decline relative to other sources. Domestic supplies of oil and gas appear—according to the Energy Research and Development Administration—to have reached that 60 year peak. Thus, their relative shares in the U.S. energy market are expected to decrease with time. It is essential therefore to plan for this transition from oil and gas to new sources to supply the next energy cycle.

Let us, therefore, begin now to truly build our house of tomorrow. . . .

**Solar Energy—Can The Algae Help.** Dr. Larry W. Jones, University of Tennessee—Knoxville (15 min.)

The efficacy of the use of photosynthetic organisms for the conversion of sunlight to usable chemical energy depends to a large extent upon which product of photosynthesis is accumulated. The most advantageous product would be hydrogen gas produced directly from the photolysis of water into oxygen and hydrogen without the involvement of energy-losing carbon-fixing reactions. We have looked at the green and blue-green algae as possible sources of photosynthetically produced hydrogen.

The green algae have long been known to produce hydrogen gas in the light. But as yet no one has been able to overcome the problems of oxygen-sensitivity of the enzyme (hydrogenase) involved and the long incubation times required. Hydrogen photoproduction stops when oxygen evolution occurs.

The blue-green algae which are capable of nitrogen fixation will also produce molecular hydrogen in the light under conditions where nitrogen and oxygen are not present in the environment. The enzyme (nitrogenase) is also oxygen-sensitive but some filamentous blue-green algae have developed specialized cells (heterocysts) in which low oxygen tensions are maintained even during active photosynthesis. These species of blue-green algae will simultaneously photoproduce oxygen and hydrogen gases at reasonably high rates without long periods of anaerobic adaptation.

While probably not suitable for large scale production facilities, small hydrogen production plants using the blue-green algae are feasible for the underdeveloped countries.

**Extraction of Food Grade Protein From Heat Denatured Sources.** Ernest A. Childs, University of Tennessee—Knoxville (20 min.)

Food processing requires twice as much energy as production agriculture. One of the more energy intensive operations in food processing is production of vegetable protein concentrates. Experiments were performed to determine whether or not ultrasonic energy-aided extraction procedures might be more energy efficient than normal stir-extractions for protein extraction. The use of ultrasonic energy increased protein extraction from screw expressed cottonseed meal 4-fold and 6-fold from heat denatured soybean meal. Energy savings resulted from a 60-fold decrease in reaction time coupled to no need for elevated temperatures during the extraction process. The extracted protein was highly functional for food use binding >3.0g of oil for winter/g protein and emulsifying 300 ml oil/g protein.

**Mathematical Models in the Energy Field.** William F. Grams, University of Tennessee at Nashville (20 min.)

Energy models are discussed in relation to government policy, industry policy, environmental quality and safety, technological development, and energy conservation. Examples of energy models in each of these areas are given. These examples illustrate the role of several mathematical tools in the energy field.

Several predictions of future electricity needs are discussed in detail. The sensitivity of the prediction models to population estimates, rate structure, and to the time period of estimation is illustrated. Examples are given to show the effect of new technology on long range projections.

## BOTANY SECTION

William H. Martin, Chairman

**Induction of Photosensitivity in Dark Germinating Lettuce Seeds.** Lillian B. Nanney & B. P. Stone, Austin Peay State University (15 min.)

Exposure to 24 hours of far-red light induced photosensitivity in *Lactuca sativa* Variety mesa lettuce seeds. This induced photosensitivity to agents such as gibberellic acid, thiourea, dinitrophenol, phenazine methanesulfate, hydroxylamine, and DCMU will be discussed.

**The Effect of Three Zinc Treatments on Selected Characteristics of Corn.** R. L. Tabor, Central Missouri State University (10 min.)

A Mandeville silt loam moderately low in zinc and planted to corn was treated with three different rates of zinc to determine if there were statistically significant differences among selected plant characteristics. A 3x5 randomized block design was employed and sampling of plant height, leaf area, and root volume was done at 30 days. A second sampling that included leaf area, root weight, ear length, and ear weight was completed between 70 and 75 days and yield data was taken at 133 days. Only the characteristic of ear length was found to be significantly different. A severe drought which occurred during the experiment may have affected yield results.

**Numerical Analyses of Selected Red Oak Populations.** Richard J. Jensen, Wright State University, Dayton, Ohio (20 min.)

Three hybrid-containing populations of *Quercus* subg. *Erythrobalanus* (red oaks) were examined by cluster analysis and principal component analysis. The populations sampled were from New Jersey (three species and six putative hybrids), Iowa (four species and two putative hybrids), and Pennsylvania (five species and seven putative hybrids). The analyses were based on 40 quantitative and 23 qualitative observations recorded for each OTU (operational taxonomic unit). In each population those OTUs identified as a given species produce distinct clusters while those OTUs identified as putative hybrids are found occupying intermediate positions in relation to the species clusters. The positioning of the putative hybrids is interpreted as being indicative of their origin.

**The Occurrence of *Castanea dentata* in Plant Communities in Cumberland Gap National Historical Park, Tennessee, Kentucky and Virginia.** Ross Hinkle and Hal DeSelm, The University of Tennessee, Knoxville (15 min.)

As part of a preliminary study of the flora and vegetation of Cumberland Gap National Historical Park, the diameters of chestnut stumps were recorded in 166 sample plots. Also, the density of living chestnut in sapling and subsapling layers along with an estimate of cover in the ground layer was obtained.

Chestnut sprouts were present in 13 of 15 plant communities. Sprouts contributed from <1.0 to 3.6 percent to sapling density and from <1.0 to 19.6 percent to subsapling density. As evidenced by stump data in 7 communities, chestnut reached its greatest basal area (42.3 sq. ft. per acre) in the present Northern Red Oak-Chestnut Oak communities, and its greatest density (18.0 trees per acre) in the Chestnut Oak-Black Gum communities where it had a frequency of 87.0 percent.

**The Cranberry Bogs of Shady Valley.** R. L. Tabor, Central Missouri State University (10 min.)

Shady Valley was once the site of a boreal cranberry bog habitat which is rare in Tennessee. Its location in the southern Appalachians makes it an important link in the boreal forest which extend from the South into Canada. The purpose of the study was to inventory and study the remaining bog acreage in the valley as well as investigating the possibilities of preserving it. The author was able to locate less than one-third acre of cranberry bog in the valley. The various analyses conducted on the bog water indicated that all tested chemical characteristics, with the exception of the silica content, were within expected ranges. The high silica content can be explained by the close proximity of the bog to a small spring which is the source of most of the water in the bog.

**Tennessee Vegetation Studies.** Hal DeSelm, University of Tennessee, Knoxville (10 min.)

Ecological studies have been carried out in Tennessee in three time periods, one to ca. 1900, one from 1900—ca. 1950 and the post 1950 period. At the end of the second period we received the vegetation summary by Braun and had also established well staffed graduate programs in the biological sciences in various institutions in the state. It is fitting to summarize our local knowledge, then, 25 years after Braun's book. This will be accomplished using an environment-community diagram showing the interrelations of plant communities and the relative status of our knowledge about them.

**Global Radiation Beneath the Canopy and in a Clearing of a Mature Piedmont Forest.** William J. March and James N. Skeen, Fernbank Science Center, Atlanta (15 min.)

Three recording instruments were used over a one year period to gather global radiation data under clear skies in a small (375 m<sup>2</sup>) pine sapling-inhabited clearing, under the canopy of a pine seedling-free hardwood forest, and in the open. Curves for the annual cycle of shortwave radiation available to the clearing and under the canopy were bimodal due to the superposition of the out of phase cycles of deciduous vegetation leafing and the actual amount of solar energy above the canopy of the forest. Actual clear sky radiation available in the clearing was above 150 ly/day from March to June but never reached this level under the canopy. These data suggest that 125-150 ly/day may be the clear sky solar energy required for pine survival at the Piedmont study site.

## CHEMISTRY SECTION

Jubran M. Wakim, Chairman

**Hexafluoro Sulfur Compound.** T. A. Furtsch and Joe C. Haney, Tennessee Technological University (15 min.)

Heretofore reported reaction between SF<sub>6</sub> and potential Lewis Acids have indicated the formation of either resulting in products or compounds which involve F- transfer resulting in compounds of the type MX<sub>n</sub>F<sub>6-n</sub>. In this work we report compounds of the type M(CO)<sub>n</sub>+nSF<sub>6</sub>→(CO)<sub>n</sub>-M(SF<sub>6</sub>)<sub>n</sub>. Preliminary results based on Infrared spectra of the products are reported and possible avenues for further work discussed.

**Oxidation of Oximes by Cerium (IV).** R. T. Swindell, H. Shah, S. Putel, Tennessee Technological University (15 min.)

The oxidation of aliphatic aldoximes in methanol by ceric ammonium nitrate proceeds differently than the oxidation of aromatic aldoximes under the same conditions. The aliphatic oximes generally are oxidized to the corresponding aldehyde while the aromatic oximes produce N, N'-dioxides.

**Carbohydrate Content of α-Amylase.** J. M. Wakim, Thomas Butler and Robert Thornberg, The University of Tennessee at Martin (15 min.)

The denaturing agents urea and guanidine hydrochloride cause reversible and irreversible denaturation of *B. subtilis* α-amylase. The amount of activity recovered from completely denatured α-amylase depends on the length of exposure to the denaturing agent. The rate of irreversible denaturation is slowed down by either Ca<sup>2+</sup> or Sr<sup>2+</sup> ions present in the medium.

The denaturing agents convert the protein to smaller size species. The molecular weight of the subunits or fragments as well as the conditions that might favor their reassociation or recovery of biological activity are currently under investigation.

## GEOLOGY AND GEOGRAPHY SECTION

James X. Corgan, Chairman

**Tennessee's Early Technical and Scientific Journals, 1830-1861.** James X. Corgan, Austin Peay State University (20 min.)

In the 1860's, an unfortunate war interrupted the intellectual

growth of North America. During antebellum years at least 18 technical and scientific journals were published in Tennessee. Many were focused on medicine (10) or Agriculture (6) but most contained a wealth of general information, like an outline of college curricula in science, weather statistics and reports on the characters of soils, rocks, crops, etc. Tennessee's antebellum journals add regional and local color to the history of science and technology. Beyond this, they are a unique source of factual data that should be valued by contemporary scholars.

**A Catalog of Earthquake Effects on the Western Highland Rim.** Phillip R. Kemmerly and Lynn D. Lyle, Austin Peay State University (20 min.)

Detailed study of historical accounts of earthquake effects (1811-1968) on the northern portion of the Western Highland Rim suggests that the karst areas experience anomalous ground motion as measured by Modified Mercalli (MM) intensity. Anomalous ground motion is defined as the difference between the MM ratings based on local records and published MM ratings for a given event. The anomalous response is thought tentatively to be the result, in part, of: (1) the delicate nature of the karst terrane; (2) the areal extent of alluvial, colluvial, and loessial deposits; and (3) the thickness and weathering character of the bedrock.

**Jointing Along a Section of the Western Highland Rim.** John D. Weithe, Tennessee Division of Geology (20 min.)

Numerous joint directions were measured in the Chattanooga Shale and the Ft. Payne Formation along a section of the Western Highland Rim. The dominant trend was N55-65° W. for the Ft. Payne Formation and N60-70° W. for the Chattanooga Shale. There was also a strong data cluster for the Chattanooga at N85° W. and both units exhibit a lesser trend at N30-45° E. The northwest set of joints generally exhibited characteristics of shear joints and the northeast set generally exhibited characteristics of tension joints. Other workers found similar joint trends in other areas around the Highland Rim and Central Basin. It is believed they are related to the development of the Nashville Dome.

**Natural Bridges of Tennessee.** James X. Corgan and John T. Parks, Austin Peay State University (20 min.)

At least 22 natural bridges occur in Tennessee. Most have a significant economic potential for development as recreational land and most have not been described in the scientific literature. Natural Bridges are restricted to Middle Tennessee and East Tennessee. Some 31.8% are associated with the escarpments of the Highland Rim or Cumberland Plateau. Tennessee natural bridges belong to four genetic groups: (1) Formed by widening of a joint, (2) Formed by cave collapse, (3) Formed by stream erosion, and, (4) Formed by gravity (rock fall). Most described bridges belong to categories 1 and 2. About 20% of Tennessee bridges are not known in enough detail to permit classification.

**Precambrian Armored Mud Balls from the Ocoee Series, Chilhowee Dam, Central Eastern Tennessee.** Michael L. Jones, Tennessee Division of Geology (20 min.)

On the north side of the dam, 17 armored mud balls are seen hundred feet west of the dam, 17 armored mud balls are seen in a conglomeratic section of the Whillite (or Sanduck) Formation. These mud balls have apparent diameters ranging from 2 to 12 inches, and an average sphericity of about .6. Some have metashale cores; some are pudding balls; and some have granule-bearing metashale cores. Armored pebbles are as large as 2.5 inches in diameter. These pebbles are mostly rounded quartzite, and other lithologies are also present. Mud balls are stratigraphically restricted to the coarse pebbly portions of graded turbidite units which vary from 15 to 30 feet thick. Mud balls and stratigraphic relationships suggest a nearshore environment of deposition below wave base. The turbidite units were deposited downslope and to the southwest of tidal channels, which breached gravely barriers and drained lagoonal tidal deltas.

**Some Field Observations on the Mississippian Formations of the Eastern Highland Rim.** Thomas A. Hart, Tennessee Division of Geology (20 min.)

The author did detailed geologic mapping and described exposures in and near several 7½-minute quadrangles in Warren, Coffee, and northern Franklin Counties, Tennessee. Previous work in this deeply weathered region had been relatively generalized. Detailed data permitted apparently new deductions. The lower half of the St. Louis Limestone contains chert balls and is largely dark fragmental limestone, differing from the underlying light-colored crinoidal limestone of the Warsaw Limestone. Exposures far up in the St. Louis have previously often been taken for Warsaw. The weathered Warsaw is recognized by speckled cherts, their appearance due to crinoidal fragments. However, such cherts occur commonly in the St. Louis, as high as above the middle, in the southerly Tullahoma, Capitol Hill, and Alto quadrangles. New examinations revealed the speckled cherts well up in the St. Louis as far north as McMinnville. In Capitol Hill quadrangle the Warsaw is locally extensively chertified, leading to the suspicion that many southerly exposures have been regarded as Fort Payne Formation that are actually Warsaw. Smaller thicknesses of Warsaw are probably similarly chertified to the north in Centertown quadrangle. The Warsaw Limestone, that is, the section with speckled cherts and subjacent to St. Louis-type chert balls and limestone, diminishes from about 65 to 75 feet near the McMinnville to about 10 to 40 feet in northern Franklin County. Where very thin, the Warsaw contains typical crinoidal and silty limestones and speckled cherts.

*Recent Excavations at The Darks Mill Site (Pleistocene).* James X. Corgan, Tennessee Division of Geology and Austin Peay State University, Michael L. Jones, Tennessee Division of Geology, Brian M. Butler, and Tennessee Division of Archaeology, and Timothy M. Baggett, Austin Peay State University (20 min.)

In 1973 and again in 1975 mining operations of the Monsanto Chemical Company exposed fossiliferous Pleistocene sediments at Darks Mill, Maury County. Monsanto provided equipment and personnel for an intensive study of the site. At least 30 mastodon, several ground sloths, and several dozen turtles occur in a highly variable complex of clays that developed during the infilling of a Pleistocene lake. Preserved lake sediments form an elliptical clay plug roughly 300' x 200' x 35'. Stratigraphic relationships with surrounding phosphate ores are uncertain. Apparently infilling was completed during the Pleistocene, for mastodon remains occur near the top of the clay and a sample from 2 meters below the clay surface was dated at 42,000 ± 8,000 years before present.

## MATHEMATICS SECTION

V. R. R. Uppuluri, Chairman

*Asymptotic Theorems for a Second Order Differential Equation With Constant Delay.* B. M. Sakhare, East Tennessee State University (10 min.)

Initial conditions are given for the equation by:

$$y''(t) + p(t)\{ \int_{t-m}^t y(t-m) \} |y(t-m)|^q = 0$$

where  $m > 0$ ,  $q > 0$  and  $\int_{t-m}^t p(t) dt < \infty$ , so that a solution  $y(t)$  has the asymptotic behavior

$$\lim_{t \rightarrow \infty} \frac{y(t)}{t} \neq 0$$

*Number and Weight Distributions of Randomly Cut DNA.* William H. Olson, University of Tennessee, Knoxville (20 min.)

We give number and weight distributions of randomly cut DNA. These extend the results of Litwin [J. Appl. Prob. 6 (1969), 275-284], Bithell [J. Appl. Prob. 6 (1969), 59-73], and others. In particular, for DNA cut randomly (for example, by sonication) in such a way that the offspring distribution is symmetric, we obtain a recursive relation which leads to an integro-differential equation whose solution provides the desired distributions. The general solution is presented along with the moments of the distributions. The particular case where the offspring distribution is a symmetric beta distribution is developed in detail.

*The Asymptotic Relative Efficiency of a Test for a Zero Regression Coefficient.* G. B. Ranney, University of Tennessee, Knoxville (20 min.)

Information about individuals is routinely collected and maintained in data files by government and private agencies. The persons involved may object to the dissemination of certain sensitive information in the form of individual records, even though this may be considered necessary for legitimate purposes of analysis. The information may, however, be rendered unidentifiable in order to protect the privacy of the individual. Various methods of doing this have been proposed within the framework of randomized response, such as multiplication of a sensitive item by a random component or the addition of a random component to the item.

Another approach is to randomly permute all or some of the observations on sensitive items prior to the release of the data. Such a procedure disturbs the relationship between a sensitive item and other items on the individual records. The degree of disturbance of that relationship is related to the amount of privacy afforded the individual, and both depend on the proportion permuted.

In studying the effects of such a procedure on estimation and testing for a simple linear regression model with a sensitive item as the dependent variable, a test of the hypothesis that the regression coefficient is zero can be proposed and the power of that test examined. This paper deals with finding the asymptotic efficiency of the proposed test using permuted observation relative to the usual test applied to the original observations. Under certain assumptions about the asymptotic properties of the observations on the independent variable, a closed form expression for the asymptotic relative efficiency can be found.

*Some Pedagogical Remarks on the Order of an Element in a Group.* John Kinloch, East Tennessee State University (10 min.)

It is well known that in a group, if an element has order  $n$ , then  $x^k = e$  if and only if  $k \equiv 0 \pmod{n}$ . The converse is also true: If  $x^k = e$  if and only if  $k \equiv 0 \pmod{n}$ , then  $0(x) = n$ . We use this converse to derive, expeditiously, several familiar results in group theory.

*Monte Carlo Calculations Related to Pion Cancer Radiotherapy.* Harvel A. Wright, J. E. Turner, and R. N. Hamm, Health Physics Division, Oak Ridge National Laboratory, Oak Ridge (20 min.)

Negative pions for treating cancer? The question was first posed in the literature in 1961. Although negative pions have been available in some physics laboratories since the late 1940's, they have not been produced with sufficient intensity for radiotherapy. Today, however, new facilities are becoming available and experimental studies of pion radiation therapy are beginning. Because of the expense and difficulty of producing pions in the laboratory, the number and type of experiments which can be performed to assess the potential of pions for cancer therapy are limited. Also, the complex interactions that pions undergo in matter make analytic calculations difficult. However, the availability of high-speed computers with large core memories make it possible to simulate, on the computer, the traversal of a beam of pions in tissue. Computer pions are made to undergo statistically the same interactions that real pions do in nature. Computational programs which have been developed specifically to assist in studies with negative pion beams as a new modality for cancer radiotherapy will be described.

*Contributions of late Professor M. G. Boyce.* B. F. Bryant, Vanderbilt University, Nashville (10 min.)

## MEDICAL SCIENCES SECTION

James W. Wilson, Chairman

*You Learn, I Learn—A Cooperative Effort in Medical Education.* Joel G. Zachry, Instructor of Biology, Roane State Community College (30 min.)

In any discipline there exists a need for practical experience as well as academic expertise if effective teaching is to be ac-

complished. Recognizing the needs of off-campus nursing students and the necessity of instructor knowledge of hospital procedure, Roane State's biology department offered anatomy and physiology 2310-30 at Oak Ridge Hospital of the Methodist Church, Oak Ridge, Tennessee during the 1974-75 school year.

This course for allied health majors was open to all students with hospital staff having priority. Approximately eighteen students completed the three quarters for four credit hours each. The course covered the twelve bodily systems, four per each of three quarters. The classes met two nights per week for two lecturers and one laboratory sessions. The laboratories were coordinated by the instructor but consisted of materials and presentations arranged by the students utilizing hospital equipment and professional resources where applicable. Student participation in their chosen specialty was highly encouraged as labs were assigned.

This joint participation yielded several positive results. Students became familiar in greater depth with the structure and function of the human body. The instructor gained valuable experience related to hospital management and the applicability of knowledge gained. In addition valuable personal contacts later assisted in strengthening the on-campus program. The participating hospital staff became lecturers to the campus sessions in their specialty area.

The various professional lecturers who visited the laboratories gained further insight into the enthusiasm for learning held by the supporting staff. Hospital student employees became more familiar with the professional's philosophies and skills in a more relaxed, open atmosphere than provided during emergency team work situations.

*Electron Microscopic Studies of Concanavalin A Mediated Agglutination.* W. A. Simpson, Jr., J. M. Mason, B. R. Jennings, University of Tennessee Center for the Health Sciences, Memphis (15 min.)

The agglutination of rabbit erythrocytes (RRBC) was studied using the electron microscope. A range of concentrations of Con A from subagglutinating to saturation was examined. It is shown that the closest approach between adjacent cell membranes does not vary with concentration, reflecting no functional difference between cells agglutinated by low and high doses of Con A.

Fragmentation of RRBC's at high concentrations of Con A produces morphologically characteristic particles 300-500 nm in diameter.

When studies were carried out utilizing high concentrations of Con A and cationized ferritin, the cells exhibited morphological characteristics consistent with cell fusion.

*Stimulation and Suppression of DNA Synthesis by Lymphocyte Mitogens.* Holland L. Harris, B. R. Jennings, and J. M. Mason, University of Tennessee Center for the Health Sciences, Memphis (10 min.)

Cultures of the 33-H continuous human lymphoblast cell line, probably of the thymus independent (B-cell) type because the cells synthesize gamma-globulins, were used to study the mitogenic effects of various substances including lectins, endotoxin, and antigen. These substances are capable of stimulating mitosis in certain types of lymphocytes. The incorporation of tritiated thymidine was used as an index of mitogenicity. A significant stimulation with pneumococcal polysaccharide, type III, was shown although no experimental intervention was used to attempt to sensitize these cultured cells to the antigen. Phytohemagglutinin stimulated mitosis, as did high concentrations of pokeweed mitogen. Concanavalin A and *Salmonella typhosa* endotoxin suppressed cell division below the rate observed in untreated cultures.

*Antigen Dose Alteration of Actinomycin D and Radiation Induced Immunosuppression.* B. R. Jennings and J. M. Mason, University of Tennessee Center for the Health Sciences, Memphis (10 min.)

Four ug actinomycin D and 100 r X-radiation in combination exhibited less immunosuppressive activity in Hale-Stoner strain Swiss mice stimulated with 9.6 Lf tetanus toxoid (FTT) than when either 2.4 or 4.8 Lf was given. Treatment with either agent alone caused mild stimulations of the response to 2.4 or

4.8 Lf FTT. This immunosuppressive treatment, one day prior to primary antigenic stimulation, only slightly altered the secondary antitoxin response. Ooses of 0.48 Lf FTT stimulated greater antitoxin synthesis than either 0.96 or 1.82 Lf in irradiated recipients adoptively immunized with primed spleen cells from immunosuppressant-treated donors. Elevating FTT dosage increased antitoxin titers from untreated cells. Antigen dose thus produced pronounced effects on antitoxin formation in immunosuppressant-treated mice or spleen cells.

*The Decline in Incidence of Sudden Infant Death Syndrome.* J. M. Mason and J. T. Francisco, University of Tennessee Center for the Health Sciences, Memphis (10 min.)

The number of cases of sudden infant death syndrome (SIDS) in Shelby County, Tennessee, has fallen rather steadily from about 60 per year in the early 1960's to 11 cases in 1974. The effects of declining birth rate and reduced infant mortality over the past 15 years do not fully account for the decreased incidence of SIDS. When these data are analyzed separated into white and non-white groups, it is obvious that the reduction in SIDS is greater in the non-white population. Thus, the increased risk of SIDS in non-white infants, with a factor of about 2, appears to have practically disappeared.

*Pathologic Changes During Mast Cell Degranulation.* James W. Wilson, University of Tennessee Center for the Health Sciences, Memphis (15 min.)

Electron microscopic studies of interstitial mast cells in the lungs of dogs exposed to two hours of hemorrhagic shock, injection of 0.05 mg. of purified Difco *Salmonella typhosa* endotoxin, and dogs treated with Compound 4880 all show a similar morphologic degranulation of the cell with significant changes compared to the same cells from control animals. All three groups of dogs showed changes in capillary permeability with marked interstitial edema. This has been well documented in hemorrhagic and endotoxic shock in the clinical situation. Biopsies from patients undergoing cardiopulmonary bypass procedures show the same type of mast cell morphologic degranulation as has been seen in the dogs. Pre and post pump biopsies were compared and the post pump specimen in all two hundred cases studied, showed significant changes in morphology indicative of the release of the histamine-serotonin-heparin-protein complex known to be stored in these mast cell granules. This evidence is suggestive that mast cells play a role in the alteration of capillary permeability in all of these situations.

## PHYSICS AND ASTRONOMY SECTION

Robert S. McDow, Chairman

*Research in Molecular Spectroscopy at Fisk University.* E. Silberman, Fisk University (20 min.)

The Molecular Spectroscopy Laboratory at Fisk University carries out advanced research in the fields of infrared and Raman spectroscopy. The equipment consists of high resolution spectrometer which cover the range from 30 to 4000 cm<sup>-1</sup> and a complete set of sampling accessories, including high vacuum, low temperature, long pathlength and reflection cells. Current research topics are the vibrational determination of the structure of molecular crystals, the outgassing processes of materials used in spacecraft construction, the evaluation of Raman spectroscopy as a possible method for microanalysis of biological materials and the use of infrared reflection spectroscopy for the determination of optical constants of crystals.

*Report on the Conference on Modular Instruction in Physics.* Robert Sears, Austin Peay State University (15 min.)

A conference was held at Illinois State University for the purpose of examining modular instructional projects around the country, to focus on a collection of courses at the upper division level which use this method of instruction, and to consider the formation of a consortium to facilitate the production and use of modular materials in physics. This presentation is intended to communicate the activities of the conference to those not in attendance.

*Resistance Thermometry at Liquid Helium Temperature.* Franklin Curtis Mason, Middle Tennessee State University (20 min.)

At or below 4.2K, ordinary electrical thermometers are insensitive to small temperature changes, thus requiring the use of more sensitive devices such as germanium and carbon resistors. Factory calibrated germanium thermometers retain their calibration when cycled between 4.2K and 295K, but high cost offsets this advantage. Carbon resistor cost is minimal, but calibration is affected by cycling, therefore necessitating recalibration.

Calibration data were obtained and analyzed by the method of least-squares for a 150-ohm Allen-Bradley carbon resistor. The results revealed that the least-squares coefficients A, B, and C are related by a linear equation in addition to the more familiar  $B^2=4AC$ . Data analysis also suggests that contrary to common belief, cycling only to 77K may affect calibration.

*Heat Loss Coefficients for Solar Collectors.* Patricia Groves Hull, Tennessee State University (15 min.)

The heat loss coefficient for a solar energy collector is defined to be the rate at which heat energy is lost by the collector per unit surface area per unit temperature difference between the collector and ambient temperature. The solar collectors used in this experiment were solar ponds consisting of black PVC bags filled to a depth of about one inch with water and placed on a horizontal surface. Heat losses through the bottom and sides of the collectors were reduced by placing the bags in a shallow box insulated with urethane foam two inches thick. Heat losses through the top were reduced by covering the boxes with a single layer of a transparent material leaving an air space about one inch thick between the collector bag and the cover. Total heat losses for two collectors were determined, one collector with a glass cover and the other with a Monsanto 602 PE cover. The focus of the experiment was the determination of the relative heat losses through the glass and plastic covers. Since plastic is usually much more economical and easier to work with, much cheaper solar collectors can be constructed using plastic as a cover material provided the heat losses through the plastic are not too much larger than those through the glass.

Continuous records of collector temperatures, ambient temperature and solar radiation were kept for the month of July, 1975. From these data, the heat loss coefficients were determined. The heat loss coefficients for the two ponds were very close with the plastic-covered pond having the larger value. The maximum variation between the two ponds was about 12%.

In this paper there is also presented a theoretical method for calculating the heat loss coefficients for a collector having a single cover if certain thermal and optical properties of the collector and cover are known. The experimental values compared favorably with the theoretical values.

The experimental work was conducted at Lawrence Livermore Laboratory, a division of University of California at Berkeley.

*Resonant Stark Effect for a Sequence of Fluorescent Decays.* Martin E. Smithers, David Lipscomb College (10 min.)

The emission spectrum of an isolated atom for decay from some particular excited state to its ground state is sharply peaked at some single characteristic frequency. In the resonant Stark effect, the atom interacts with an intense applied field of the same, or very nearly the same, frequency as that emitted by the isolated atom. The result, for a sequence of fluorescent decays, is a spectrum with three peaks, one at the applied field frequency, and two resonant Stark shifted sidebands. Theoretical calculations for this process agree with the experimentally observed spectrum in this respect.

*The Kearny Fallout Meter.* Cresson H. Kearny, Oak Ridge National Laboratory; and Margaret Cortner, Austin Peay State University (15 min.)

Concentrated efforts have been directed toward designing and testing a reliable fallout meter that untrained Americans can quickly make and use. The Kearny Fallout Meter (KFM) model no. 20B is the best of several different designs that can be made and operated using only materials found in millions of American homes.

The basic design is an electroscope with two 4-ply aluminum

foil leaves, each suspended on parallel nylon threads that are excellent insulators. The leaves are charged electrostatically while inside the ionization chamber, which is an 8-oz. tin can. The gypsum insulation found in most American homes can be dried to  $CaSO_4$  and used as a desiccant in the chamber. From numerous calibration tests in known gamma fields produced by radium or cobalt sources the practical range of dose rates measurable is between .05 R/hr and 40 R/hr, with an accuracy of  $\pm 3.33\%$ .

## SCIENCE AND MATHEMATICS TEACHERS SECTION

### SECTION I

Jack Rhoton, Chairman

*Trends in Science Teacher Inservice Education.* B. W. Benson, University of Tennessee at Chattanooga (20 min.)

The cessation of funding for National Science Foundation implementation projects during the 1976 AY will have a dramatic impact on the inservice education of science teachers. The implications of this action will be reviewed and factors affecting inservice education will be outlined. A model for the inservice education of science teachers will be presented as an attempt to reorient science teachers and college personnel respective to their roles in inservice education.

*Energy Education Materials for Tennessee Science Educators.* John F. Yegge, American Museum of Atomic Energy, Oak Ridge (20 min.)

Tennessee science educators may now take advantage of the education resources at the Science Education Resource Center of the new American Museum of Atomic Energy. Programs with an emphasis on energy and environmental topics are available for teachers and students at all levels.

Programs of particular interest to Tennessee science educators include novel energy games and simulations, units that may be loaned by mail to teachers for classroom use, special classroom and demonstration activities at the museum for students and teachers, and a library of some of the latest science education materials for examination by teachers. Tennessee science educators are invited to participate in the programs of the new Science Education Resource Center.

*A Survey of Research Literature Regarding the Most Important Characteristics of Good Teachers.* Richard K. Fletcher, Jr., Tennessee Technological University (15 min.)

Research findings relating to teacher effectiveness and the qualities which are characteristic of excellent teachers are much in abundance but somewhat lacking in quality. The difficulties associated with the research procedures are related to the lack of universally accepted terminology and measures in the social science and education disciplines. The problems are further compounded by the multifaceted nature of the complex human being and the interaction of the teacher with the students in a social setting. In spite of these problems, considerable progress is being made in establishing supporting evidence which indicates that good teachers manifest such traits as flexibility, clarity, enthusiasm and businesslike patterns of behavior significantly more than poor teachers.

*Evaluation Strategies and Methodologies Utilized in Public School Environmental Education Programs and Projects—A Report From A National Study.* Ronald B. Childress, West Virginia College of Graduate Studies Institute, West Virginia (15 min.)

The paucity of meaningful public school environmental education program and project evaluation is a growing concern among curriculum planners working within the field. Decreasing availability of fiscal support combined with the increasing demand for educational accountability mandates the development of more meaningful and effective strategies and methodologies

of evaluation to facilitate program and project continuation and institutionalization in many settings.

The minimal amount of valid research data available on evaluation strategies and methodologies used in public school environmental education programs and projects is largely discontinuous and fragmentary. During the Spring of 1975, a selected national sample of 536 public school environmental education program and project directors and coordinators were questioned concerning evaluation strategies and methodologies utilized in their respective programs and projects. An analysis of the study findings suggests the need for major planning and developmental efforts relative to program and project evaluation.

*Planning and Implementing an Effective Composting Project Using School Cafeteria Wastes.* John H. Grant, Jr., Davidson County Schools (15 min.)

The initial development of an ecology/environmental studies program at Antioch High School, Davidson County, Tennessee is supported by the planning and implementation of the Antioch Composting Project. Organic solid wastes are removed from the school's cafeteria and used as a part of an on-site composting system. The system processed several tons of organic material in its first few weeks of operation.

Among the important factors considered in establishing the project are student participation, administrative cooperation, site establishment, acquisition of materials, procedures and methods, and use of the product.

The accompanying slide presentation shows how a school composting project can provide: 1) a fundamental basis for the development of an environmental education curriculum; 2) a valuable source of natural, organic soil conditioner/fertilizer to the school and community; 3) the community with evidence that the recycling of home organic wastes is both practical and economical; 4) encouragement to other institutions, businesses, and individuals to recycle "waste" material.

*Mathematics in Kingsport City Schools Yesterday, Today and Tomorrow.* Wanda N. Bledsoe, Kingsport City Schools, Kingsport (15 min.)

The launching of Sputnik I and the rise of computers on the educational scene brought about many changes in mathematics curricula. New programs were developed nation wide and Kingsport found itself weighing the "new math" against the traditional. A need for retraining of teachers developed and many found themselves involved in college courses and/or inservice training. Teaching strategies also underwent many changes—team teaching, cross-discipline teams, independent learning packages and individualization.

As the "new math" fever ebbed, others began to look anew at the secondary curriculum. One such program was the Secondary School Mathematics Curriculum Improvement Study developed at Columbia University. This program is the first attempt in the United States to follow the recommendations of the Cambridge Conference to combine the separate strands of arithmetic, algebra, geometry and analysis into a unified spiral approach. In 1973 this six-year program was adopted by the Kingsport City Schools as the curriculum for the accelerated mathematics students. This program replaces the more traditional one which was first initiated in 1960.

As increased national efforts are being made to adopt the metric system of measurements, Kingsport has found itself preparing for the change. Efforts are being made to prepare teachers to make the transition as smoothly as possible through local inservice training sessions.

*A Summer Triple-Accelerated General Chemistry Sequence.* Anne P. Minter, Roane State Community College (15 min.)

The summer accelerated program enables the student to complete the freshman chemistry sequence, which is normally three quarters in length, in ten weeks. Student performances on the American Chemical Society Cooperative Examination in General Chemistry for the regular year sequence and the summer sequence were compared. Indications are that achievement was higher for the summer group.

*The Energy-Environment Simulator.* John Czirr, Austin Peay State University (30 min.)

The Energy-Environment Simulator is a computer-type game that realistically carries players into the future while they experience problems of energy supply and demand and the interaction of energy with the environment. The simulator will be used to communicate a meaningful picture of energy and environmental relationships as they exist today and as a projection of the future. The players continually make decisions and actively control the path of the game. Five groups of players will be involved simultaneously with the game in an attempt to collectively save the world.

## SCIENCE AND MATHEMATICS TEACHERS SECTION

### SECTION II

*A Portable Model Stand and Models for Demonstrations in Organic Chemistry.* Paul B. Langford, David Lipscomb College (15 min.)

A durable set of models constructed from readily available materials is described. The models are much larger than the usual commercial models and are suitable for classes up to about 100 or more students. Relative sizes of atoms and pi bonds are shown. Three, four, five, and six member ring systems are represented. The entire model set is housed in a roller stand which itself is used to display models.

*Evaluating the Reading Level of Your Science Textbook.* Maurice Houston Field, The University of Tennessee at Martin (20 min.)

As the study of science moves from grade one to the college level, there is a greater dependence on a student's ability to read. In order to make the most efficient use of a student's time the materials to be read and the learner's ability to read must be as closely matched as possible.

Three readability formulas that can be used to aid in the matching process are the Frye, Flesch, and Gunning Fog. All of these techniques require a minimum of time and material. The value of these techniques is dependent on (reading achievement) test data which reflects the actual reading level of the students. A fourth method which can aid in matching reading materials with a specific group of students for whom no test data is available is the *Cloze Procedure*. The latter method is more time consuming, but it is considered by many to be more accurate than the three methods previously mentioned.

*Learning Center Experiences in Science for Preservice Elementary Teachers.* Carlton Stedman, Austin Peay State University (15 min.)

During the Spring Quarter of 1975, preservice elementary teachers at Austin Peay State University designed and prepared learning centers for elementary school students, assembled the centers in volunteered classrooms, and critiqued their effectiveness after observing students perform at the centers. This experience was favorably evaluated by both the undergraduates and the classroom teachers. The use of these centers provided an opportunity for preservice teachers to gain valuable experience in planning and using an individualized strategy which emphasized active participation on the part of both the undergraduates themselves and the children who used the centers. The undergraduate students reported that the centers would have an increased value if they could plan them after they had had an opportunity to assess the abilities of the children who would eventually use the centers. Some sample titles of centers are: Plant growth, Using the Metric System, Learning to Be A Good Observer, How to Graph Data, and Mass and Weight.

*Developing an Inquiry Approach to Advanced High School Biology.* Don K. Simbeck, Loretto High School, Lawrence County Schools (20 min.)

The science faculty of Loretto High began planning for an

## ZOOLOGY SECTION

## SECTION I

Michael L. Kennedy, Chairman

*Changes in Nitrogen and Phosphorus Concentrations in Run-Off Water from Barnyards.* James A. Campbell & Gladys Mayers, Tennessee State University (20 min.)

The concentration of total and water-soluble nitrogen and phosphorus occurring in run-off water from two sites differing in topography, soil type and location were monitored through a Fall, Winter, Spring and Summer season. Soluble fractions of both substances were found to change with season and the amount of rainfall. In order to evaluate the accuracy of field data, simulated laboratory lysimeters were used. The relationship of the quantities of these substances occurring in natural and controlled run-off water will be discussed and correlated with pH, soil type, temperature and kind and number of livestock and also the frequency of occurrence of the livestock in the barnyard.

*Promitosis and Rod Formation in the Limax Amoeba, Vahlkampffia lobospinosa.* Emerson R. Fizer and Walter E. Wilhelm, Memphis State University (20 min.)

Relatively recently free-living limax amoebae have been discovered to be endoparasitic pathogens of mammals including man. Certain genera of the limax group such as *Naegleria*, *Acanthamoeba* and *Hartmannella* have been studied in depth, but little regard has been given the lesser known limax types which may prove as interesting. Included in the latter *Vahlkampffia lobospinosa* first described by Craig (1912).

Nuclear division and trophozoite morphology and function were investigated in *V. lobospinosa*. During karyokinesis the nucleolus remained present and divided to form polar masses. Chromatids separated and were directed to the polar masses by spindle fibers within an intact nuclear membrane. No interzonal body was formed.

Trophozoites contained an inanimate, uniformly rod-like structure 10-15  $\mu$ m in length and 1-2  $\mu$ m in width not previously described. Although it was found in other areas of the cell and within the cytoplasm, this rod most frequently protruded from the uroid.

*Transferrin Inheritance Study in Mus musculus.* Mark A. Castellaw and Charles J. Biggers, Memphis State University (20 min.)

Transferrins of feral and inbred stock (C57BL/6J and CBA/J) of *Mus musculus* were separated by electrophoresis on block polyacrylamide gel and cellulose acetate. The transferrins were identified by Nitroso-R stain and Rivanol precipitation. Two-dimensional electrophoresis, neuraminidase treatment, and densitometer tracings were used in examination of the transferrins. Anodal to all transferrin types a single light band was observed which did not show transferrin activity. The transferrins exhibited two bands per phenotype. Between the homozygous stock mice studied, the transferrin bands differed from one another in electromobility. The fast migrating band of the homozygotes did not appear in the hybrid.

Based on the results of inheritance studies, densitometry, two-dimension electrophoresis, and a comparison of transferrin phenotype, it is proposed that the fast-moving, anodal band present in each homozygote, but absent in the hybrid, is a transferrin subunit which is not specified by a separate gene.

*Effects of Impoundment on the Fish Population of Dale Hollow Tailwaters.* Bruce H. Bauer, Tennessee Tech University (20 min.)

Following the impoundment of Cordell Hull Reservoir its backwaters reached within three miles of the Dale Hollow Dam at normal pool and all the way to the dam at full pool. This impoundment of the rainbow trout fishery already established below Dale Hollow Reservoir has led to the movement of predator and rough fish into the tailwater. Four species of the rough fish family Catostomidae: *Moxostoma erythrum*, *M. carinatum*, *M. anisurum*, and *Catostomus commersoni* have

Advanced Biology Program during the 1972-73 school year. The program was first offered in 1973 with the approval of the State Department of Education.

During the development of this course efforts were made to provide an inquiry approach. The course materials were selected to build on the previous scientific knowledge of the students and consisted of laboratory activities, text materials and various supplemental materials. Methods were planned to involve the student in interpretation of data, use of scientific literature, setting up scientific apparatus and formulation of hypothesis. After three years many materials and pieces of equipment have been selected to fit the program. Working in the laboratory, in the community, and classroom with this approach has been a challenge to teacher and students. The program has stimulated interest in science and mathematics at Loretto High.

*The Revival of Science Fairs in Montgomery County.* Mildred B. Perry, Clarksville High School, Montgomery County Schools (15 min.)

Few subjects are more controversial to science educators than the subject of Science Fairs. Do the kids do the projects by choice? What happens to class work when preparing for a Science Fair? Is this really science, representative of what scientists do? The Clarksville High School Science Department considered these questions and others. We plan our third annual Science Fair this spring, and we hope it will be the great success our past two experiences have been.

*One Earth For All: Treat It With Respect.* Jo W. Clarke, Cohn High School, Davidson County Schools (15 min.)

The Urban Observatory and 17 Metro teachers worked together to develop a comprehensive environmental program designed for a wide range of uses by any community. A set of 100 instructional cards was one facet of the multi-media program developed to stimulate individual and community interest in improving and protecting our environment.

Each card in the kit states a behavioral objective and activities to achieve the objective. They may be used in science classes, or mini-courses in any area of study for a short or extended program.

General Objectives:

1. To identify major problems in today's environment.
2. To lead people to become more aware of our limited resources.
3. To stimulate interest and action in improving the environment by controlling pollution of the air, soil, and water.
4. To lead people to face our energy crisis and to explore solutions to this dilemma.
5. To increase awareness of the relationship of the environment to life styles.

*Teaching Science in the Inner City.* M. A. Covington, Davidson Co. Public Schools, Cumberland Junior High (15 min.)

What are the special problems of teaching science in a highly urbanized community? Large urban centers are made of minority groups. Children of these groups are attending schools often more than fifty years old, these schools are outdated. In terms of their structure; the congestion surrounding them forms an extremely difficult environment for teaching science.

Our concept of pastoral America is largely outmoded. It is necessary to develop real meaning about the environmental problems of living in a large city.

Teachers working in these communities must exhibit special understanding in dealing with students of urban minority groups. Many of these students have been told they are "deprived" resulting in the impression he is a "second class citizen."

Specifically, what must a science teacher do to stimulate learning? This paper will explore the preliminaries necessary for the science teacher to master prior to teaching the normally expected curriculum. Some of these include value clarification, humanistic education and outdoor education that have shown effective in teaching the inner city student.

been reported for the first time as have the following four predators: *Stizostedion canadense*, *S. Vitreum*, *Micropterus punctulatus*, and *Morone chrysops*.

It was the purpose of the present study to monitor changes and this report will concentrate on the changes in the fish population since the most recent re-impoundment study of Little, 1967.

*Quantitative Studies of Chironomids from a Fourth Order Stream.* Thomas R. Baker, James F. Payne, and Paul F. Hendrix, Memphis State University (15 min.)

Rock-basket sampling techniques were employed in an annual study of chironomid immatures from the Loosahatchie River, a fourth order stream in the Chickasaw Basin of western Tennessee. Taxonomic composition of monthly samples was analyzed with respect to seasonal abundance and water quality data. Evidence is given to predict most productive and informative periods for such benthic studies.

*Electrophoretic Investigation of Blood Proteins of the Ord Kangaroo Rat (Dipodomys ordii).* Melvin L. Beck, Michael L. Kennedy, and Charles J. Biggers, Memphis State University (20 min.)

From May 28 through August 31, 1975, 166 *Dipodomys ordii* were live trapped along the South Canadian River in Oklahoma. Specimens were collected from seven localities representing six counties. Specimens were transferred to the Department of Biology, Memphis State University, where they were investigated by polyacrylamide gel electrophoresis. Hemoglobin and plasma proteins (general proteins, esterases, lacto dehydrogenases) were examined and hematocrit counts were recorded. Results showed interlocality and interspecific polymorphism.

*Multivariate Analysis of Intraspecific Variation in the Kangaroo Rat (Dipodomys ordii).* Michael L. Kennedy, Memphis State University (20 min.)

Geographic variation was assessed in 7853 specimens of Ord's kangaroo rat (*Dipodomys ordii*) with univariate and multivariate analyses. A matrix of correlation among 16 morphologic characters was computed and the first three principal components extracted, which accounted for 89.3 percent of the variation in the character set among males and 90.4 percent among females. Three-dimensional projection of localities onto principal components show that for both males and females the large individuals occur east of the Western Cordillera, and smaller animals occur to the west in the United States and Mexico. Populations of the eastern and western parts of the range are linked by intermediates. At least two complexes are formed in the western part of the range. Specimens from Padre and Mustang Islands tend to be separated from the others by principal component II. Other small groups and individual quadrats are loosely connected to the main clusters.

*Electrophoretic Investigation of Blood Proteins and Parotid Venom of Bufo americanus americanus and Bufo woodhousei fowleri.* James T. Mahan and Charles J. Biggers, Memphis State University (15 min.)

Blood and venom samples were collected from 179 toads representing thirteen localities in a six state area. Protein samples were separated using vertical slab polyacrylamide gel electrophoresis. Hemoglobin, venom and plasma general proteins and esterases were compared for the two species. All toad hemoglobin patterns were monomorphic. Interspecific and intraspecific polymorphism was observed in the plasma and venom esterases.

*The Sun-Compass Orientation of Natrix s. sipedon.* John S. Robison and George G. Murphy, Middle Tennessee State University (15 min.)

The ability of the northern water snake, *Natrix sipedon sipedon*, to use the sun for orientation was studied. Animals were retained in an outdoor rectangular terrestrial training pen. Water and rocks at one end of the pen formed a refuge, and animals were displaced to the opposite end daily. Animals were tested after a minimal of four days training. Orientation was tested in an outdoor circular terrestrial area. Snakes were re-

leased individually and in groups. Animals exhibited a bimodal orientation pattern with over 80 percent scoring along the correct axis. Reorientation to new compass directions appeared to be complete after one to two weeks of training.

*Scanning Electron Micrographs of Tennessee Tardigrades.* Diane R. Nelson, East Tennessee State University (20 min.)

Tardigrades from Roan Mountain, Tennessee-North Carolina were killed with boiling ethyl alcohol, dehydrated in absolute isopropanol, transferred to amyl acetate, and dried by the critical point method with CO<sub>2</sub>. The specimens were mounted on SEM stubs, coated with 300 Å of gold-palladium, and viewed with an ETEC Auto Scan U-1 scanning electron microscope at the University of California at Davis. Photomicrographs were taken of the following genera: *Echiniscus*, *Pseudechiniscus*, *Macrobiotus*, *Hypsibius*, *Itaquacon*, *Diphascos* and *Milnesium*. Species identifications were verified by removing specimens from SEM stubs and mounting the individuals in Hoyer's medium on microscope slides. Structural features useful in the separation of similar species are apparent in the SEM photographs but are undetected or only poorly seen with light microscopy.

## ZOOLOGY SECTION

## SECTION II

O. Ray Jordan, Chairman

*Conventional Bioassay and Tissue Bioassay of Zinc Cyanide, Sodium Cyanide and Malathion.* C. B. Coburn and A. A. Friedman, Tennessee Tech University (20 min.)

Extensive experiments with malathion, zinc cyanide and sodium cyanide by both the conventional TL<sub>m</sub> test and a tissue respirometric method have been completed. The respirometric tests have been conducted with catfish, trout and carp liver homogenates. Preliminary analysis of the data suggest that low concentrations (less than 1 mg/l) of sodium cyanide are unexpectedly stimulatory to respiration. The higher concentrations exhibit the normal toxic effects anticipated.

*A Comparison of Electrophoretic Banding Patterns Observed for Proteins from Two Species of the Genus Dorosoma.* Thomas E. Byrne and John W. Harris, Tennessee Technological University (20 min.)

Polyacrylamide gel electrophoresis was used for the taxonomic comparison of lactate dehydrogenase, esterase, and general muscle proteins of *D. petenense* (threadfin shad) and *D. cepedianum* (gizzard shad). Both species were collected in Center Hill Lake, with the aid of the Tennessee Tech Cooperative Fisheries Unit. The organisms were separated by sex and grouped by age into 1, 2, and 3 year old classes. The zymograms for the two species were exactly the same for the general muscle protein and very similar for esterase and lactate dehydrogenase. Also, no sex or age differences were noted. The similarity of the electrophoretic banding patterns obtained for these two species lends support to the hypothesis that hybridization can occur between them.

*Inheritance of Hemolymph Esterases of the Cotton Boll Weevil (Anthonomus grandis Boh.).* Charles J. Biggers and Harold R. Bancroft, Memphis State University (15 min.)

Four esterase regions from boll weevil hemolymph were demonstrated by vertical polyacrylamide gel electrophoresis. They were designated Esterases I, II, III, and IV in order of anodal migration. The inheritance pattern for Esterase II was determined by a series of laboratory matings. The evidence suggests that the esterases in this region are controlled by a pair of autosomal codominant alleles.

*Notes on the Significance of Eye Pattern as a Systematic Character in the Tabanidae of Tennessee.* J. O. Price and J. T. Goodwin, Memphis State University (15 min.)

This study includes an in-depth examination of the eye pat-

terns found in the tabanid fauna of Tennessee. Figures and explanations are provided to show eye size, shape, presence or absence of pattern, and shape and position of patterns on the corneal surface. The absence of eye pattern among all individuals of five genera tends to imply that the unicolorous condition represents a primitive character state, since these genera exhibit primitive character states in other morphological features. In Tennessee, nearly all of the genera with patterned eyes may be separated on the basis of eye pattern alone. In addition, the genus *Tabanus* was examined to determine if eye pattern could be used to illustrate interspecific relationships.

**Geographic Variation in the Dwarf Crayfish, *Cambarellus puer*** Hobbs. Carlene Chambers, James F. Payne and Michael L. Kennedy, Memphis State University (20 min.)

Dwarf crayfishes, *Cambarellus puer* Hobbs, were studied from 39 localities widely dispersed within the known geographical range. Ten general morphological characters were measured and analyzed for all specimens; certain additional sexual characters were also included. Numerical data were statistically treated; sexual dimorphism and geographic variation are discussed.

**A Comparative Study of the Hindlimb Musculature in Four Species of Salamander.** A. A. Thompson, D. I. Pay and J. W. Nagel, East Tennessee State University (15 min.)

There is a paucity of anatomical description of the salamander muscular system in the scientific literature. In an investigation preliminary to a more thorough anatomical research, we studied the major hindlimb musculature in four salamander species, *Desmognathus quadrimaculatus*, *Eurycea bislineata*, *Plethodon glutinosus* and *Plethodon yonahlossee*. Eight pelvic girdle muscles were dissected, examined and compared as to sites of attachment, shape and proportionate size to body area. In all specimens of each species, a distinct muscle, neither diagrammed nor mentioned in any available reference literature, was noted.

**Some Observations on the Ecdysis Pattern of the Fly *Megaselia scalaris*** Loew (Phoridae). D. B. Benner and Burl McCosh, East Tennessee State University (15 min.)

The dipteran *Megaselia scalaris* shows an unusual pattern of imago emergence. For the first two days only males ecdyse. After day three the frequency of males declines as the number of females increase to a peak at about day seven. Fifty percent of the total males have emerged by day three, while fifty percent of the females have not ecdysed until day eight. The last two days no males ecdyse, but the number of females is also greatly reduced. In this study a significant excess of males was observed. It is suggested that this emergence pattern reduces inbreeding because early ecdysing males would disperse and mate with females from adjacent populations as sibling females would not be available. Likewise, late emerging females would be more likely to mate with males from other populations.

**Growth Responses of Chicks Fed Microbial Protein Produced from Organic Wastes.** O. L. Adams and E. J. Thornton, Tennessee State University (20 min.)

Microbial protein was recovered from the mold mycelia which was produced when potato waste materials were homogenized and added to a mineral salt containing a culture medium suitable for the action of a strain of *Aspergillus niger*.

The new product containing approximately 29.0 percent protein was added to chick starting rations, replacing soybean protein, and fed to chicks for a period of four weeks.

Results of the feeding trials showed that fungal protein was effective in supporting body maintenance but was ineffective in stimulating growth. Palatability of rations and poor feed consumption were factors contributing to slow growth. However, feed utilization was less of a problem as shown by nitrogen retention trials.

Carcass quality, pigmentation, deposition of fat and uniformity in size were similar in all groups.

Fungal protein has the potential for use as a source of protein in chick rations. However, additional research is needed to further study such factors as feed consumption, feed utilization and palatability.

**A Telemetric Study of Activity of the Red-Eared Turtle, *Chrysemys scripta elegans*.** Thomas H. Florence, Jr. and George G. Murphy, Middle Tennessee State University (15 min.)

A transmitter was attached to the carapace of each of six red-eared turtles, *Chrysemys scripta elegans*, which were free-ranging in the West Fork of the Stones River, Rutherford County, Tennessee. They were released at the point of capture and monitored with a portable receiver and directional antenna for one to three month periods in the summer of 1974. Movements over 24-hour periods were variable (hourly mean 11.2m). Extent and duration of diurnal movements were greater than nocturnal movements. Individual home ranges varied from 2,688 to 11,352 m<sup>2</sup> (X=6,566 m<sup>2</sup>) and centered around prime resting sites. Nocturnal activity not associated with reproduction was observed for the first time during this study.

**The Effects of Ciba-Geigy Synthetic Juvenile Hormone on Fecundity and Total Sterol Levels in the Cotton Boll Weevil, *Anthonomus grandis*,** Boheman. Thomas G. Bird and Harold R. Bancroft, Memphis State University (15 min.)

Ciba-Geigy 13353, a compound with juvenile hormone properties was topically applied at 50 and 75 microgram levels per insect to the cotton boll weevil. Observations on egg production were taken at 4 adult ages. Sterol level were determined at day 1 to determine carry-over from the pupal stage to the adult and at day 7 upon termination of all tests. Response to treatment was statistically significant in reduction of egg production and in reduction of total sterol as compared with appropriate control insects.

## COLLEGIATE DIVISION

Richard J. Raridon, Chairman

**Parasites of *Sciurus carolinensis* in Bradley County, Tennessee.** David Bruce Conn and Myrtle M. Fleming, Lee College (15 min.)

Of ten eastern gray squirrels examined for parasites, eight were found to be infected in some manner. Each of these eight was infected with at least one type of ectoparasite, whereas only six were infected with both external and internal parasites.

Parasites found included eleven fleas, Dolichopsyllidae; 150 lice, Haematopinidae; 66 mites, Dermanyssidae; 25 mites, Lixodidae; two ticks, Ixodidae; 215 roundworms, Trichostrongylidae; nine tapeworms, Taeniidae, including two cysticerci and seven adult worms; and one unidentified tapeworm cyst.

**Comparative Physiology of Two Genera of Chironomid Larvae.** Sara Murphy, Vanderbilt University (15 min.)

Manometric techniques used in measuring oxygen consumption of two genera of chironomid larvae indicated wide variability of utilization among individual larvae. The oxygen requirement of the genus *Conchapelopia* appeared to be greater than that of the hemoglobin bearing *Glyptotendipes*, with the pigment-free genus showing a more directional and drastic response to lower water temperatures. Results indicate the potential of recognition of habitat preferences by study of these genera.

**The Silurian Rockwood Formation: A Subtidal Pro-delta Sequence?** Ann Holmes, Rudy Nowlin and Richard E. Bergenback, University of Tennessee at Chattanooga (15 min.)

Preliminary study of a roadcut exposure of the Silurian Rockwood Formation, along Interstate 24 east of Tipton, Tn., entailed determination of the geometry of bedded units, small- and large-scale sedimentary structures, texture and composition with the view of developing a model of sedimentation.

The upper (Chattanooga Shale) and lower (Shellmound Formation) contacts of the Rockwood are not exposed here. Much of the Rockwood consists of light greenish gray shale. Thin-bedded (1"-4" thick), laminated, cross-bedded, rippled, burrowed and dolomitized calcarenite makes up most of the rest of the Rockwood. Two thin beds (up to 4" thick) of hematitic oolite are located in the upper one-third of this exposure.

**Lower Pennsylvania exposures along the W road on Signal Mountain, Tennessee.** Mary Hillis and Richard E. Bergenback, University of Tennessee at Chattanooga (15 min.)

Roadcut exposures of the Pennsylvania Raccoon Mountain formation and Warren Point Sandstone, located along the W road on the southeast side of Signal Mountain (Chattanooga, 71½' 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 A, (2) Type B, and (3) Type F beds. Type A beds are considered as remnants of ancient beach faces, Type B beds may represent filled-in large scale ripple troughs—formed by longshore currents or on top of tidal deltas. Type F beds may represent tidal channel infillings.

Flaser bedding and a coal deposit in the 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, tidal delta, and beach face deposits were extant in this area during deposition of lower Pennsylvanian rocks.

**A Survey of Secondary Forests on Limestone Soils in the Great Valley of Upper East Tennessee.** Geoffrey W. Jordan, East Tennessee State University (15 min.)

This study involves a Bitterlich survey of 15 old growth forest stands located on limestone soils in the great valley region of upper East Tennessee. Stands showing extreme or very recent disturbance were not considered. From the data collected, frequency, density, basal area, and importance value for each species were calculated. This data provides information with respect to the original vegetation, the importance of natural and human disturbance, variation, and past and present successional trends within the forests.

**Heavy Metals: A Study of Cadmium Toxicity.** Richard A. Roy and Henry A. Moses, Meharry Medical College (15 min.)

Twenty-five albino rats have been used in a study of cadmium toxicity. These animals placed on the experimental regime at fifty-six days of age were divided into three groups. Group one consisting of nine animals, received distilled water and laboratory chow. Group two (eight animals) received cadmium as the nitrate solution in the amount of 0.5 mg%. Group three (eight animals) received cadmium as the nitrate in the amount of a 1 mg% solution. All animals were housed in individual cages. Food and liquid were available *ad libitum*. The cages were placed in a constant temperature animal room. Records were kept of the weight patterns of the animals. Urine was collected at intervals and checked with a Bili-Labstix (Ames Laboratories) for abnormal constituents and amino levulinic acid (ALA) was quantitated. The data collected and evaluated over a twenty week period indicated that the gain and maintenance of weight for experimental and control animals does not differ. Liquid consumption and urine excretion during this period for both groups have remained at a constant level. Levels of glucose, protein, and urinary pH measured with a Bili-Labstix indicated no difference due to cadmium consumption. Quantitative determination of ALA in the urine indicates that damage to the metabolic pathway leading to heme synthesis has not occurred after twenty weeks, so as to cause an increase in ALA excretion of the experimental animals.

**An Upper Ordovician skeletal sandbar deposit in the Fernvale Limestone, Dade County, Georgia.** Hardin Satterfield and Richard E. Bergenback, University of Tennessee at Chattanooga (15 min.)

Red and gray mixtures of interlensing calcirudites (biomicrocrines and biosparites) of the Fernvale Member of the Upper Ordovician Shellmound Formation near Interstate 24 in Dade County, Georgia are composed of laminated, poorly sorted, partially winnowed bryozoa, echinoderm and brachiopod debris associated with red and green shale laminae. These sediments are interpreted as having been deposited in an intertidal skeletal

sandbar environment. Red and gray colors probably indicate relative degrees of subaerial oxidation of iron-bearing sediments. Dolomite, probably penecontemporaneous, occurs in the micritic phase of these limestones. Debris from nearby bryozoan thickets and crinoidal (?) meadows likely enabled continued growth of this skeletal sandbar.

**The Upper Ordovician Shellmound Formation: A Lagoonal, Tidal Delta, Skeletal Sandbar Sequence?** Evelyn Brown, Jean Manley and Richard E. Bergenback, University of Tennessee at Chattanooga (15 min.)

Roadcut exposures, at the intersection of Interstate 24 and Georgia Route 298, Dade Co., Georgia, reveal parts of the Upper Ordovician Shellmound Formation.

The lower contact (Leipers Limestone) of the Shellmound is present in several exposures, but the upper contact (Silurian Rockwood Formation) is not exposed here.

The lower part of the Shellmound contains gray shales and thin-bedded, laminated, cross-bedded, rippled, burrowed and dolomitized calcarenites that may represent lagoonal deposits. Thin beds of hematitic oolite are present here.

The middle part consists of two gray shale units and red-stained calcirudite (large bryozoan zoarial fragments) that shows cross-bedded, cut-and-filled structures. These may represent a tidal delta deposit.

The upper part contains gray shales and calcarenites that are likely of lagoonal origin. Further, the Fernvale Member of the Shellmound Formation is present here and has been interpreted as a skeletal sandbar deposit.

**Acylation of Cottonseed Flour to Increase Functionality.** K. K. Park and E. A. Childs, University of Tennessee, Knoxville (15 min.)

One of the major barriers to utilization of a variety of high protein plant flours and meals is their limited functionality for use in manufactured food products. One approach to over-considered the matter further, he will be ready to make a final the protein molecules of the flour. These experiments were undertaken to determine the effects of acylation reactions on the functionality of cottonseed flour. Glandless cottonseed flour was reacted with succinic or acetic anhydride at pH 8.0 and OC. This resulted in an increase in specific viscosity which reflects a lengthening of the polymer molecules in the flour. This increase in polymer length to 1.5-2.0 fold increase in water-holding capacity, a 3-7-fold increase in oil-holding capacity, and similar increases in emulsifying and foam capacities. Acylated flours appear to hold promise for use in food systems.

**In Vitro Characterization of Dietary Fiber Functionality.** J. L. Forte and E. A. Childs, University of Tennessee, Knoxville (15 min.)

It has been suggested that an inadequate intake of dietary fiber in the Western diet has led to increases in the incidence of atherosclerosis, diverticulosis, appendicitis, and cancer of the rectum and colon. This study was undertaken to quantify characteristics of fiber which might lead to maintenance of health. The water and oil holding capacity of cereal, fruit, and vegetable fibers was determined as an index of the effects of fiber on stool volume. All fibers bound > twice their weight in water and oil. The taurocholate binding capacity of cereal fibers was evaluated as an index of cholesterol absorption. Fiber was found to bind as much as 10 mM taurocholate/100 mg fiber. The binding of aflatoxin to fibers was measured as an index of their ability to bind and eliminate carcinogens which might be ingested with the diet. Vegetable fibers bound up to 50% of aflatoxin in solutions.

**Analysis of Oil from Black Shale from Cheatham County Tennessee.** Mark Wright, David Lipscomb College (15 min.)

The purpose of this research was to remove and analyze the oil obtained from Black Shale. The shale was prepared for analysis by crushing it in to pieces of which the largest was approximately 1 cm. in diameter. The crushed shale was then heated to 600 degrees Centigrade. Oil was collected between the temperatures of 480-450 degrees Centigrade.