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ABSTRACTS OF PAPERS PRESENTED AT THE ANNUAL MEETING

GENERAL SESSION

FRIDAY, NOVEMBER 21, 10:00 A.M.
BLACKMAN AUDITORIUM,
WOODS LABORATORIES BUILDING
GUSTAVE H. LUNDBERG, *Chairman*

Laser Communication Systems. Frederick M. Shofner, University of Tennessee Space Institute. A comparison of microwave and laser communication links is given. General characteristics of laser sources, modulators, and demodulators are described. Optical system limitations, current research activities, and pertinent feasibility experiments are discussed.

Meteoroid Hazard to Space Travel. Ray Kinslow, Tennessee Technological University. Vehicles that probe the outer reaches of space are likely to face collision with nature's debris—meteoroids and small particles moving at speeds estimated to go as high as perhaps 250,000 feet per second. Although the contest between faster projectiles and stronger armor has been the principal motif in military history, the solution to the problem of protecting space vehicles from meteoroid bombardment cannot be obtained by a process of extrapolating our earthly armor-projectile experience. These hypervelocities exceed by more than an order of magnitude the impact speeds common to traditional ballistics and the mechanics of the process is entirely different. This paper describes some of the clues that are emerging from experimentation at the highest velocities attainable in the laboratory, and some of the mathematical models and theories of impact that are being evolved. The results of such research should make space flights less hazardous as man continues his exploration of the solar system.

Preliminary Examination of Lunar Samples from Apollo 11. G. Davis O'Kelley, ORNL. A preliminary examination was conducted on samples returned from the Apollo 11 landing in Mare Tranquillitatus. The rocks are either crystalline of igneous origin or brecias of complex origin. The mineralogy and bulk chemistry of the crystalline rocks are different from any terrestrial rock and from meteorites. Most of the rocks have been exposed to an erosion process which gives them a sand-blasted appearance. The fine material and the breccia contain large amounts of gases which are most likely derived from the solar wind. Radioactive age determinations show that the igneous rocks crystallized (3-4) x 10^9 years ago and that the rocks have been within one meter of the lunar surface for (20-300) x 10^6 years. Major and minor elements in lunar samples are the same as those found in terrestrial igneous rocks an in meteorites, but with significant differences in composition. The level of organic matter is less than 1 ppm. No evidence for biological material has been found.

Research sponsored by the National Aeronautics and Space Administration through interagency agreements with the U.S. Atomic Energy Commission under contract with the Union Carbide Corporation.

Bio-Engineering of Man in Space. L. E. Sissom, Tennessee Technological University. The physical characteristics of man or simulated biological system in an adverse environment are considered. Specific minimum or maximum values necessary for the support of life, such as total and partial pressures, oxygen consumption and carbon dioxide production, temperatures, food, and water balance, are delineated. Space flight data are compared with data produced under normal and adverse terrestrial conditions. The effects of weightlessness and acceleration on the cardiovascular system and the hemodynamic process are evaluated.

SECTION MEETINGS

FRIDAY, NOVEMBER 21, 2:00 P.M.

BOTANY SECTION

WOODS LABORATORIES BUILDING, ROOM 134
S. K. BALLAL, *Chairman*

Forest Regeneration on Two Old Fields in Southwestern Illinois. William C. Ashby and George T. Weaver, Southern Illinois University, and University of Tennessee. Total tallies of trees 2.6 inches DBH or larger and sub-sampling of smaller woody and herbaceous vegetation were carried out on two old fields in Union County abandoned 35 or 40 years prior to 1967. Tulip tree predominated in a closed stand on lower, gentle slopes adjacent to a creek. Sugar maple predominated on flat areas adjacent to a second creek. Slopes above the sugar maple stand were partly forested with sweet gum as the major species and sassafras locally predominant. Habitat factors related to variations in tree regeneration were soil type, physiography, and proximity to tree cover. The findings extend appreciably reports of old-field successional types in southern Illinois.

Classification and Substrate Specificities of the E_1 and E_4 Esterases in Zea mays. P. M. Boaze and J. W. Harris, Tennessee Technological University. Crude extracts of young maize seedlings were subjected to starch gel electrophoresis and stained for esterase activity. The specificity of the E_1 and E_4 esterases for ten substrates were tested. Similar results were obtained with all substrates tested, except naphthol as D acetate. The inhibitory effects of eserine sulfate, diethyl-p-nitrophenyl phosphate, and acetazolamide were tested in order to classify the esterases. The E_1 and E_4 esterases reacted in a manner characteristic of aliesterases, according to Augustinsson's classification.

Two-Dimensional Paper Chromatographic Studies of Pycnanthemum: Labiatae. R. K. Carr, Tennessee Technological University. Methanolic leaf extracts from 56 collections of *Pycnanthemum* representing natural populations of 11 species and a number of interspecific hybrids were analyzed by two-dimensional paper chromatography. The solvent systems used were tertiary butanol, acetic acid, and water (3:1:1 v/v) in the long-dimension and acetic acid and water (2:3 v/v) in the short-dimension. The chromatograms revealed a total of 24 different dark spots when viewed under long wave ultraviolet light. A correlation of spots was made between different collections by comparing the Rf values and color patterns under ultraviolet light with and without ammonia vapors and after spraying with Benedict's solution. *P. montanum* contained the smallest number of spots (4); *P. beadlei* and *P. incanum* contained the largest number (15). The chromatographic patterns could be used to characterize some of the species, but other species (e.g. *P. loomisii* and *P. pycnanthemoides*) gave identical patterns. Although the hybrids contained many of the compounds found in each parental species, the parentage could not be determined from chromatographic data alone.

Problems in Remote Sensing of Natural Areas. H. R. DeSelm, Clifford Amundsen, Paul Krumpe, The University of Tennessee, Knoxville. Ecology has received new tools with which to examine landscapes on a larger scale and with greater ease than formerly with the developement of multispectral sensing from diverse aerial platforms. We are currently using a specially equipped DC-3 to photograph certain local landscapes with Hasselblad cameras containing color and infrared false color film. These are areas for which ground truth at various levels of precision is known. Comparisons of imagery with data will begin in the winter. The kind and validity of predictive statements possible is of interest.

Oak-Hickory Components of the Upland Forests of the Alabama Piedmont. Michael Golden, University of Tennessee. A phytosociological investigation was conducted of oak-hickory forest "remnants" on the Alabama Piedmont. The primary objective was to determine coexistence relationships among the "climax" species found in these remnant stands, with the intention of predicting the probable nature of the "future" climax communities of the area. A leading dominant analysis resulted in a one-dimensional ordination of the 40 stands sampled. Non-climax species were omitted in the analysis. This ordination reflected a compositional gradient of *Carya* and *Quercus* species. Based on the leading dominant table, continuum numbers were assigned to each of the 13 climax species. These numbers are a ranking of each species' presumed ability to compete in the total environment of a stand dominated by *Quercus marilandica.* The numbers were as follows: *Q. nigra* (1), *Q. rubra* (1), *Q. alba* (3), *Carya ovalis* (3), *C. tomentosa* (4), *Q. velutina* (5), *Q. falcata* (5), *Q. coccinea* (5), *Q. stellata* (6), *C. glabra* (7), *Q. prinus* (8), *C. pallida* (8), and *Q. merilandica* (10).

Biological Effect of Gamma Rays and Ethrel on Barley Seeds. Prem S. Kahlon, M. J. Constantin, and B. V. Conger, Tennessee State University, UT-AEC Agricultural Research Laboratory. Seeds (caryopses) of barley, *Hordeum vulgare* cv. Himalaya were exposed to 30 kR of gamma rays and five concentrations of Ethrel; Amchem 68-240 containing 2 chloroethyl phosphonic acid. Radiation and Ethrel independently reduced seedling height; together their effects were additive. Chromosome aberrations were observed following gamma irradiation only. The effect of Ethrel appears to be primarily physiological, whereas that of gamma radiation both physiological and genetical.

Research sponsored by Oak Ridge Associated Universities Summer Participation Program and UT-AEC; Contract No. AT-40-1-GEN-242. Ethrel courtesy of Amchem Products.

Early Succession on Abandoned Fields in the Land-Between-the-Lakes. Mary L. McReynolds and Edward W. Chester, Austin Peay State University. The revegetation of abandoned cropland within the Land-Between-the-Lakes (Stewart County) was investigated. Ten fields considered representative of the area were selected with the cooperation of Tennessee Valley Authority Biologists. The investigation concerned five fields abandoned for one year and five which had been abandoned for two years. The fields had previously been cultivated in tobacco or corn and were generally lowland or rolling in relief. Data on vegetational composition (frequency, density, constancy, and cover) were obtained during July and August, 1969, and compared with published results of similar studies conducted within the Central Basin. Dominants in the first-year fields included *Digitaria sanguinalis, Ambrosia artemisiifolia,* and *Lespedeza* spp. Dominants in two-year fields included *Lespedeza* spp., *Ambrosia artemisiifolia, Digitaria sanguinalis, Aster pilosus,* and *Solidago* spp. Continuing observations are anticipated.

Some Aspects of Shoot Apex Structure and Development in Foliar Embryos and Adults of Bryophyllum daigrumontiana. James M. Moore, The University of Tennessee at Martin. The development of a foliar embryo begins with the appearance of a small mass of meristematic tissue in a notch of a foliage leaf. In median longisection at right angles to the long axis of the leaf, these masses appear as small domes with little organization except for a single surface layer. Following the initiation of the first few pairs of leaves, the apex appears in saggital section as a low mound. By this time zonation is established and appears to consist of a two-layered tunica, a corpus, a flank meristem, and a rib meristem. In adult plants the zonation established earlier is maintained, but the apex is larger and in saggital section appears to vary from a broad, almost flat dome to one considerable higher.

The Effects of 2-Thiouracil and 5-Fluorouracil on the Morphology of the Leaves of Bunch Bean. Patricia Perfetti and James D. Caponetti, The University of Tennessee at Chattanooga and The University of Tennessee at Knoxville. Seeds of bunch bean were surface sterilized and then germinated for 48 hours in a given concentration of 2-TU, 5-FU or distilled water. The seedlings were then planted in vermiculite, and allowed to grow for exactly four weeks. Watering was done with distilled water. As a result of treatment, the cotyledons persisted in an attached, unshrunken condition at the stronger concentrations. External effects also included a rugose crinkled appearance in the simple leaves at the second node, and a reduction or promotion in the number of leaflets on the leaves at nodes three and four accompanied by asymmetry, distortion and chlorosis of the leaflets. The internal effects on leaves, as observed in transverse leaf sections, were retardation of overall development with persistence of a juvenile configuration of tissues and irregular local increases in the number of cell layers in the mesophyll.

Effect of Ethionine on Invertase Development and Methylation of RNA. B. P. Stone, C. N. Whitty and J. H. Cherry, Austin Peay State University and Purdue University. Aeration of sugar beet disks over a 72 hour period resulted in a linear increase of invertase activity. The presence of ethionine in the incubation medium inhibited enzyme development by 80%. Invertase inhibition by ethionine was reversed with addition of methionine to the tissue. Methyl group incorporation from methionine into RNA occurs during the first 6 hours of tissue aeration. Transfer RNA has the highest specific activity of methylation. Inhibition of methylation of t-RNA by ethionine was reversed with methionine. The level of amino acid acceptor activity of leucine-t-RNA increased during the first 6 hours of aeration. t-RNA extracted from ethionine treated tissue has lower charging capacity for leucine. Ethionine inhibition of invertase may represent its effect on modification of t-RNA and thereby affect protein synthesis involved in breaking dormancy in storage tissue.

The Effect of Exogenous Carbon Sources on the Mycelial Sugar Composition in Aspergillus Niger. F. T. Wolf and S. K. Hasija, Vanderbilt University. *Aspergillus niger* was grown in Czapek-Dox liquid medium in which equivalent amounts of various sugars were substituted for sucrose. Mycelia were harvested after 5, 10, and 15 days of incubation. Equal weights of mycelia were extracted and analyzed qualitatively by bidimensional chromatography for the presence of glucose, fructose, and galactose. Quantitative estimates were made of the one sugar present in the mycelia in the greatest amount. In cultures grown on cellobiose or starch, an oligosaccharide was excreted into the medium. With the single exception of cultures grown on lactose, the principal sugar of the mycelium was invariably glucose. It is apparent that this organism is able to convert a large variety of sugars to glucose.

CHEMISTRY SECTION I

WOODS LABORATORIES BUILDING, ROOM 227

GEORGE E. ROUSE, CHAIRMAN

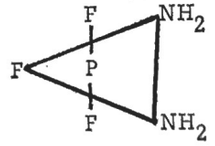
Use of Formal Standard Equilibrium Electrode Potentials in Heterogeneous Electrode Kinetics. Gibson W. Higgins, Memphis State University. In studies of heterogeneous rate constants of electrochemical reactions, the value of the thermodynamic standard half cell potential is commonly used to represent the formal equilibrium potential in theoretical equations. It is well known that this assumption is not always valid, because of experimental activities commonly not being equal unity, as well as there commonly being diffusion coefficient ratios not exactly equal unity for oxidized and reduced forms, particularly where one form is dissolved in the amalgam phase. A theoretical equation for a self-consistent experimental half-cell is derived for use in obtaining realistic formal standard potentials as reference points from which to calculate heterogeneous rate constants and transfer coefficients. The experiments involved the design, construction, testing and use of an amalgam electrode of known, reproducible concentration. Results of calculations of k_h are also given for a few known and experimental systems.

A coordinated Undergraduate—Graduate Program for the Preparation of Junior College Chemistry Teachers. H. Graden Kirksey, Memphis State University. The Memphis State University Chemistry Department began a program to prepare junior college chemistry teachers in June of 1969. This program leads to the Master's Degree in College Teaching, but involves both undergraduate and graduate student participation. During the summer of 1969 six undergraduate students who had completed their sophomore years of college and who had expressed an interest in junior college teaching as a profession participated in an eleven week summer activity developing undergraduate laboratory experiments. A summary of the work done by three students will be presented. The graduate phase of the program will begin in June of 1970. The curriculum for the graduate program will be outlined and related to the needs of students preparing to become junior college teachers.

Phosphorus Difluoride Diamide. Max Lustig, Memphis State University. The interaction between phosphorus trifluoride and ammonia was first reported in 1876 and more recently in 1953 to yield various solid products of the general composition $XNH_3 \cdot YPF_5$ where X and Y are whole numbers ≤ 5. These compounds are reported to melt near 200°. Little physical characterization of these solids were given so the problem invited more attention.

In this work the reaction was repeated at ambient temperature by slowly admitting excess ammonia into a Pyrex bulb containing PF_5. Again, solids were formed, however a liquid phase also was present. This liquid was analyzed to have the composition $PF_3(NH_2)_2$ and was produced in high yield. The compound melts at $40.4 \pm 0.5°$. The liquid has low volatility implying association while the vapor is monomeric.

The nmr spectra are interesting. The ^{19}F spectrum shows two magnetically different kinds of fluorine nuclei having a 2:1 area ratio implying a cis orientation.



By measuring the ^{1}H and ^{31}P spectra and employing hetero and homo decoupling techniques, the following spin-spin splittings are found. $J_{P\text{-}F_2} = 672$ cps, $J_{P\text{-}F} = 860$ cps, $J_{F_2\text{-}F} = 40$ cps, $J_{H_4\text{-}F_2} = 20$ cps, $J_{H_4\text{-}F} = 1.7$ cps. The mass spectrum shows characteristic cracking species. The ion corresponding to mass number 104, $PF_2NH_2^+$ has a relative intensity of 100. The infrared spectrum is also diagnostic.

Diagrammatic Displays and Calculations of Solution Equilibria. William B. Guenther, The University of the South. The use of graphical methods in research and teaching has increased greatly since publication during this decade of methods developed by Scandinavian chemists. Their logarithmic concentration diagrams now appear in most new books on quantitative analysis. Some extensions of these ideas are presented in this paper: 1. The rather tedious calculations needed for construction of abundance and formation curves can be facilitated by easily plotted linear log ratio relations. The curves show the interesting effects of spacing of stepwise equilibrium constants. 2. Exact results to pH problems are obtainable by graphical solution of the two independent conditions that all systems must satisfy: (a) the equilibrium condition as given by the constants, and (b), the proton balance condition as given by the sum of all acidic species.

Steric Effects in Molecular Complexes of Tetracyanoethylene with Aromatic Hydrocarbons. C. C. Thompson, Jr. and D. D. Holder, Memphis State University. Electronic spectra of complexes of tetracyanoethylene (TCNE) with mono- and di-substituted benzenes show multiple overlapping absorption bands. Each of the various electronic transitions is favored by a particular geometrical orientation of the interacting donor and acceptor molecules. These different configurations are termed isomeric complexes. Spectral measurements have been carried out for a series of TCNE complexes dissolved in carbon tetrachloride, chloroform, methylene chloride and 1, 2-dichloroethane. Overlapping absorption bands have been resolved in terms of skewed Gaussian functions by means of an iterative computer technique. From integrated intensities of these transitions the relative contributions of the different isomeric structures have been determined. It is found that changes in solvent as well as in the size of the substituent groups can strongly affect the preferred orientation for a pair of interacting molecules.

A Unidentate Difluorodithiophosphate Complex and a Synthetic Study of some Dithio Complexes. Max Lustig and Larry W. Houk, Memphis State University. We are reporting the first example of a unidentate complex of the recently synthesized difluorodithiophosphate ligand, π-cyclopentadienyldicarbonyliron(II) difluorodithiophosphate, $\pi\text{-}C_5H_5Fe(CO)_2SP(S)F_2$.

(I)

Until this study photo- and thermochemical reactions of the difluorodithiophosphate ion have lead only to bidentate adducts. The method employed for this synthesis is similar to that used by C. O'Connor et al. for the preparation of the only known unidentate dialkyldithiocarbamate compound of iron, π-cyclopentadienyldicarbonyliron(II) dimethyldithiocarbamate, i.e., the reaction between a π-cyclopentadienyldicarbonyliron halide and the appropriate dithio ligand in which the covalent chlorine is displaced as a chloride ion. It is interesting to note, however, when this type of reaction was extended in this work to include the interaction between a π-cyclopentadienyltricarbonylmolybdenum halide and dialkyldithiocarbamates, bidentate complexes were formed involving the displacement of the halide as well as a carbonyl group from molybdenum. The dimethyl derivative has been prepared by an alternate procedure while the ethyl derivative, π-cyclopentadienyldicarbonylmolybdenum(II) diethyldithiocarbamate(II), has not been reported. The infrared spectrum of (I) is diagnostic. The expected two carbonyl stretching bands are observed at 2051(vs) and 1998cm^{-1} (vs, complex). Other bands assigned to the P—F and P=S stretching motions are at 850(ms) and 706 cm^{-1}(s), respectively. The spectrum of (II) has characteristic CO absorptions at 1931 (vs) and 1839 cm^{-1} (vs, complex) and a C≡N stretching mode at 1502 cm^{-1}(m). The corresponding frequency for the dimethyl analogue is centered at 1527 cm^{-1}. The direction and magnitude of the shift are consistent with other studies involving bidentate dialkyldithiocarbamate complexes and have been ascribed to the difference between the (+I) shift of the methyl compared to the ethyl groups. In addition, the region in which these C≡N frequencies are located has been defined for bidentate complexes. Other bands associated with the cyclopentadienyl groups in both compounds as well as those due to the dialkyldithiocarbamate group in (II) are present.

Reaction of Zirconium (IV) Chloride with Some Organic Acids. D. Schwartz and J. R. Ludwig, Memphis State University, United States Steel Corporation, Monroeville, Pennsylvania. Although the reaction of zirconium (IV) chloride with aliphatic acids have been studied, [2-8] there is much disagreement among the various investigators and little, if any, information available in regard to infrared spectra, molecular weight data and x-ray diffraction patterns of reaction products. The reaction of zirconium (IV) chloride with acetic, propionic, n-butyric and isobutyric acids under anhydrous conditions has been investigated in our laboratories in some detail. The initial reaction of aliphatic acids with zirconium(IV) chloride at low temperature (—15°C) appears to yield molecular addition compounds consisting of two molecules of acid to one molecule of zirconium tetrachloride. At room temperature, the adduct releases hydrogen chloride to form substitution products which appear to be $ZrCl_2(RCO_2)_2$. Pure tetracarboxylates of zirconium were prepared from the reaction of zirconium(IV) chloride with an excess of the corresponding aliphatic acid. X-ray powder photographs indicate that these compounds are highly crystalline materials. Molecular weight determinations of the tetrapropionate and the tetrabutyrates in solutions of their respective acids indicate that the compounds are monomeric. Molecular weight determinations of the tetrabutyrates in carbon tetrachloride also indicate monomer formation. Infrared spectra of the tetracarboxylates, together with the molecular weight data, suggest the possibility that zirconium is exhibiting its maximum coordination number of eight in these compounds.

Lithiation of Ferrocene. R. D. Hudgins, V. R. Allen and R. T. Swindell, Tennessee Technological University. The substitution of functional groups onto ferrocene results generally in a mixture of mono- and di-substituted products. Literature reports of the *monolithiated* product refer to positive evidence of this species in the mixture but isolation of this mono-substituted derivative has not been achieved. A previous report suggested the applicability of monolithio ferrocene as a convenient, relatively stable, anionic initiator in the polymerization of vinyl- type of monomers, such as styrene. The tagged end-group of the polymer chain could then be used to characterize the molecular weight of the macro-molecular system via atomic absorption spectrophotometry. Methods attempted in the preparation of the desired monofunctional derivative of ferrocene included: 1) the direct reaction of n-butyl lithium in benzene with ferrocene and subsequent analytical work on the reaction mixture, 2) the continuing investigation involved deactivation of the butyl anion using various chelating agents in selected solvent mixtures followed by direct reaction with ferrocene, 3) the mercuration of ferrocene in benzene-alcohol by mercuric acetate. The mercuriferrocene was then reacted with lithium chloride to give both mono-and di-substituted chloromercuriferrocene. The mono-substituted ferrocene was extracted with methylene chloride and lithiated with n-butyl lithium using benzene. - ether as solvent. The details of synthesis will be described and the results of using the reaction products to initiate styrene polymerization will be described.

Chemical Gems. George E. Rouse, Bethel College. This paper suggests some short-cuts that have proved valuable in the laboratory. Also included are some "dafinitions" which have been garnered thruout the years from test papers and conversations, As a finale, proof is given that even the chemist doing the simplest routine may be living dangerously.

Electret Heterocharge Mechanisms. R. W. Clark and G. R. Bickford, Middle Tennessee State University. Fifty years have passed since Motatoro Eguchi made the first electret. Sporadic research by physicists and some few attempts by chemists have failed to demonstrate convincingly the mechanism responsible for the heterocharge. Using the technique of thermal depolarization sufficient reproducibility is obtained to allow a systematic identification of the important variables of formation and electret composition using the classical electret material, carnauba wax. Results show that thermal "freezing-in" of the charge is not required. A mechanism is proposed based on ions trapped by cracks in the wax.

CHEMISTRY SECTION II

WOODS LABORATORIES BUILDING, ROOM 228
S. K. AIREE, ACTING CHAIRMAN

The Preparation of Some Possible Metabolic and Degradation Products of Endrin. R. E. Whaley, T. M. Brooks, H. G. Allbritten, F. B. Schirmer, Jr., Memphis State University. A brief review of some of the previously reported reaction products of Endrin is presented. These products include: the keto-form, Endrin Rearrangement Product I; the aldehyde-form, Endrin Rearrangement Product II; the alcohol-form, Endrin Rearrangement Product III; an "endo"-hydroxy derivative of Endrin Rearrangement Product I; and "cis"-6, 7-dihydroxy-dihydro-Isodrin. Several attempted preparations of "trans"-6, 7-dihydroxy-dihydro-Isodrin are discussed. A dehalogenated derivative of Endrin Rearrangement Product III is reported. The preparation and partial characterization of a compound having the same GLC retention time as the major component in extractions of Endrin treated soil and vegetative material is presented.

The Identification of Some Possible Metabolic and Degradation Products of Endrin by GLC Analysis. T. M. Brooks, R. E. Whaley, H. G. Allbritten, F. B. Schirmer, Jr., Memphis State University. A report on the identification of some possible metabolic or degradation products of endrin extracted from soil and plant samples is presented. The techniques used in the investigation included gas-liquid chromatography, utilizing electron capture detection with several different solvent systems, gradient column chromatography, and thin-layer chromatography. The data include relative retention times of suspected metabolites and relative retention times of previously prepared standards. These data were compared with the relative retention times of the major components of extracts of soil and plant samples. Mixtures of likely standards were prepared and their composite chromatogram compared with that for the soil and plant extracts. Composite standards and soil and plant extracts were then combined and the chromatogram examined to determine the effect upon the gas-liquid chromatogram of the original soil and plant extract.

A Theoretical Study of DNA Replication. G. E. Bass and L. J. Schaad, Vanderbilt University. Each of the nucleotide bases, adenine, thymine, guanine and cytosine, takes part in either a keto-enol or an amino-imino tautomerism. The rarer form of each occurs in DNA to a much smaller extent than would be predicted from the equilibrium constants of these reactions. Löwdin has proposed a mechanism for DNA replication to account for this. A quantitative theoretical test of Löwdin's mechanism will be described.

Photochemical Deoxygenation of Ketones by Triphenylphosphine. Lyle D. Wescott, Jr., Hugh Sellers and Patricia Poh, Christian Brothers College. The photolysis of ketones in the presence of triphenylphosphine results in the deoxygenation of the ketone to yield triphenylphosphine oxide. The loss of oxygen by the excited ketone may result in the formation of a carbene which can undergo further reaction. This novel reaction may be illustrated by the reaction of triphenylphosphine and benzophenone in an inert solvent:

$$\phi_2C=O \xrightarrow[\sim 3500\ A]{h\nu} \left[\phi_2C=O\right]^*$$

$$\left[\phi_2C=O\right]^* + \phi_3P \longrightarrow O=P\phi_3+\phi_2C:$$

$$\phi_2C: + P\,\phi_3 \longrightarrow \phi_2C=P\phi_3$$

$$\phi_2C=P\phi_3+\phi_2C=O \longrightarrow \phi_3P=O+\phi_2C=C\phi_2$$

In our work such reactions have been carried out and triphenylphosphine oxide has been observed as a product. There is also some evidence to support the formation of tetraphenylethylene; conclusive evidence is being sought.

The authors gratefully acknowledge financial support provided by the Undergraduate Research Participation Program (Grant No. GY 5762) and The Petroleum Research Fund (Grant No. 3995-B).

A Rate Study of the Chromous Reduction of Stable Organic Cations. William T. Bowie and Martin Feldman, Fisk University, Howard University. A new method for the determination of the electronic stabilization energies of a number of organic cations in solution will be presented. This method is the investigation of the rate of reaction of an inorganic reducing agent, Cr (II), with various organic cations such as 2,4,6-triphenylpyrylium, tropylium, flavylium. These rates are compared with 'electromotive force' data as determined by oscillopolarography.

Spectroscopic Studies of Electron Acceptor Strengths. D. D. Holder and C. C. Thompson, Jr., Memphis State University. Theoretical treatments of molecular complex formation predict that the degree of interaction will be strongly dependent on the orbital energies as reflected by ionization potentials and electron affinities of the donor and acceptor molecules, respectively. However, recent results suggest that the spatial characteristics of the interacting π-orbital systems may be a decisive factor in determining the relative donor and acceptor strengths. This suggestion has been examined through spectroscopic measurements on complexes of tetracyanoethylene and (9-dicyanomethylene)-2,4,7-trinitrofluorene with pyrene, hexamethylbenzene and fluoranthene in methylene chloride at 10 and 25°C. From these spectral data association constants, complex absorptivities, free energies, entropies and enthalpies of formation have been computed. Results of these studies clearly support the contention that the relative sizes and geometries of donor and acceptor molecules are major factors contributing to the formation of strong intermolecular complexes.

A Modified Support for Solid-Phase Peptide Synthesis. David L. Marshall, Memphis State University. A new support has been developed which retains the advantages of current solid-phase peptide methodology but has the additional feature of allowing the cleavage of the peptide product with the various protecting groups intact. This approach would permit the use of the solid-phase technique to prepare intermediate sized peptides which could be removed from the support and then suitably purified. Conventional coupling of the purified fragments would then lead to larger polypeptides. The method is based on a new point of attachment of the first amino acid to the polymer support. The usual chloromethylated polystyrene is first converted into a phenol-sulfide polymer followed by esterification of the first amino acid to the phenolic —OH group of the polymer. Additional amino acids are then added in the usual way. To remove the peptide, the polymer is treated with H_2O_2 which oxidizes the sulfide to sulfone and converts the stable anchoring ester into an activated ester capable of acylating an amino acid. Thus by adding an amino acid to the oxidized peptide-polymer, the peptide is removed in the process of acylating the added amino acid. The preparation of the modified polymer and examples of its use will be described.

Morphology of Polyesters. D. P. Dodson and V. R. Allen, Tennessee Technological University. Macromolecules exhibit crystallization characteristics both *unique* to the system and also *typical* of small molecules. The phenomenon of "supercooling", often difficult to achieve in phase transition studies of low molecular weight molecules, occurs almost without exception in high polymers, which are generally heterogeneous in chain length, in chain "backbone" stereostructure, and in regularity of the repeat units. The rate of crystallization of macromolecules and the nature and size of crystallite formed depends primarily on the short range thermal history of the sample and, to a lesser extent, on the chain length and the temperature differential, (Tm — Tc). Thermal annealing of crystalline polymer systems affects the type and size of the crystallite, directly analogous to the macroscopic changes induced by the heat treatment of metals. Samples suitable for study of the influence of "monomer" structure on the crystallization parameters were obtained by "step-reaction" condensation of adipic acid, suberic acid, and azelaic acid with both 1,2- and 1,3-propanediols. For each combination, a series of samples, differing in chain length, were obtained and characterized via "end-group" analysis. A polarizing microscope with "hot-stage" attachment was used for continuous observation of the morphological rearrangements with temperture. The thermal behavior was recorded using a Fisher "DTA:. The sensitivity of the "crystallite" morphology to chain structure and short-range thermal history will be described.

Reaction of Hydroxysteroid Dehydrogenase (Ps. testosteroni) with 5,5'-Dithiobis (2-Nitrobenzoic Acid) and Sodium Borohydride. S. K. Airee and J. M. Stallings, The University of Tennessee at Martin. The relationship between the number of mercapto groups and the enzymatic activity of a commercial (Worthington) preparation of the hydroxysteroid dehydrogenase was examined while studying its reaction with 5,5'-dithiobis (2-nitrobenzoic acid) (DTNB) and with sodium borohydride. The number of mercapto groups reacting per 10^5 grams of the enzyme denatured with sodium dodecyl sulfate (SDS) was found to be 5.7 $\pm$ 0.5. Up to 2-3 of these groups in the native enzyme react with DTNB without any significant loss in the enzymatic activity determined with androsterone or testosterone as substrates. The reaction of the enzyme with sodium borohydride leads to a slight increase in the number of reactive mercapto groups and a slight decrease in the enzymatic activity.

Coordination Compounds of N,N,N',N'-Tetramethyldithiomalonamide. Robert G. Ziegler and William E. Bull, Lincoln Memorial University. The ligand N,N,N',-N'-tetramethyldithiomalonamide (STMM) was synthesized and characterized. Reaction of $Ni(ClO_4)_2$ with STMM under different conditions yielded two different compounds: $Ni(STMM)_2(ClO_4)_2$ and $Ni(STMM\text{-}H)_2$. The first compound, $Ni(STMM)_2(ClO_4)_2$, ionizes in nitromethane whereas the second, $Ni(STMM\text{-}H)_2$, does not even dissolve. Because of its insolubility in all solvents tried, $Ni(STMM\text{-}H)_2$ is thought to be polymeric. Both complexes are square planar and diamagnetic. Other complexes prepared with STMM are the colorless $Zn(STMM)_2(ClO_4)_2$, $Cd(STMM)_2(ClO_4)_2$, and $Pb(STMM)_2(ClO_4)_2$. These compounds are assumed to be tetragedral in structure. While the infrared spectra do not allow unambiguous interpretation, the bonding of the ligands to the metal ions is thought to be through the sulfur atom.

GEOLOGY-GEOGRAPHY SECTION

Woods Laboratories Building, Room 234
A. T. Statler, Acting Chairman

Public Awareness of Earthquakes in Tennessee. James H. Corgan, Austin Peay State University. An earthquake of 5.3 magnitude (Richter scale) produced severe damage in northwestern Middle Tennessee about 11:03 a.m. C.S.T., Saturday, November 9, 1968. This event was used to study attitudes toward and familiarity with natural seismic phenomena among 460 earth science students at Austin Peay State University, Clarksville. A questionnaire survey revealed that of 228 students living in northern Middle Tennessee and vicinity for 5 years or more, only one recalled a previous earthquake. However, a strong shock occurred March 3, 1963 and was thoroughly reported by news media at the time. Furthermore, seismic phenomena are not rare in Tennessee: Moneymaker's studies (1954, 1955, 1957 and 1958) show that 4 to 5 shocks occur annually. Although most are minor it appears the public, and even college students taking earth sciences, are unaware of the fact of seismic activity in Tennessee.

Possible Basement Control of Geologic Phenomena in Tennessee. Stuart W. Maher, Tennessee Division of Geology. Numerous descriptions of mining districts, geophysically anomalous areas, and regional structure, as well as oceanographic data point to major crustal fracture systems in the earth's crust. These fractures are postulated to be the controls for such effects as superjacent deformation features, mafic intrusives, crypto-explosion structures, and ore deposits. This hypothesis is here applied to Tennessee. A pattern of east-west oriented lines connect magnetic deposits, crypto-explosion structures, mafic igneous bodies, and geophysical anomalies. Many ore deposits, magnetic highs, and stream Valley lineations lie along lines striking N.45°E. and N.45°W. The suggestion is offered that the east-west lines are ancient fault traces, episodically reactivated, and the 45° lines are conjugates to them. The data are "permissive", not conclusive, but this model merits consideration.

Proposed State Legislation to Preserve Unique Geologic Features in Tennessee. Robert A. Miller, Tennessee Division of Geology. An act to provide for the recognition and preservation of areas of outstanding scenic and scientific interest, including geologic features, was introduced in the 86th Tennessee General Assembly (HB 936, Ashe et al). Also, House Joint Resolution 88 (Ashe et al), which directs the Department of Conservation to study HB 936 and the problems of natural area preservation, may result in recommended changes in the act or in the introduction of similar legislation. Recognition and preservation of areas of geologic interest presents special problems. The size of some features, their proximity to economically important mineral deposits or to urban developments, and the question of how to establish a program to explain these features to the public are some of the problems. Typical features threatened by construction, mining, or urban developments are fossil localities, classic type sections, and morphological and structural features. To inventory these features and accomplish the goals of such legislative acts as may be passed will require cooperation between various government agencies, earth science departments of universities across the State, geological societies in the region, and the mining industry.

Reflections on the Significance of Cross-bedding in Ancient Sandstones. J. E. Eason and R. E. Bergenback, University of Tennessee at Chattanooga. In April of 1969, a group of undergraduate geology majors from U. T. C. studied a coal strip mine exposure of a sandstone complex located near Phillipsburg, Pennsylvania. This sandstone complex was interpreted as a point bar deposit in a previously published study by a group of Pennsylvanian State University graduate students. Further, the Penn State group suggested that this ancient point deposit accreted in a westwardly direction and that it formed in a north-flowing stream. Statistical studies of dip direction of cross-bedded, mega-ripples or dunes led the Penn State group to this conclusion. However, the U. T. C. group remeasured the cross-bed dip directions in two of the major sedimental units in the point bar deposit. Their results showed a wide variation in the ancient dune orientations and this in turn suggested that stream flow direction on a point bar is quite variable. Therefore, interpretation of averaged values of cross-bed dip directions as an indication of a north-flowing stream is likely in error.

Carbonate Petrography of Middle and Upper Ordovician Rocks in the Central Basin of Tennessee. Jessie Klyce Maniatis, Tennessee Division of Geology. The purpose of this paper is to characterize the carbonate petrography of various Middle and Upper Ordovician

formations in the Central Basin of Tennessee. About 250 hand samples from three formations at three different locations were collected for the study. They were examined by means of acetate peels which were found to be completely satisfactory for all phases of examination except that of optical mineralogy, which was subsequently replaced by X-ray determinations. By these means a set of characteristics for each of the Bigby-Cannon Limestone, the Catseys Formation and the Leipers Formation has been established. Certain rock types common to all three formations are recognized, described and photographed for future reference. Some minor reinterpretations of the geologic history of these three formations are proposed for consideration.

MATHEMATICS SECTION

WOODS LABORATORIES BUILDING, ROOM 230
R. H. KERCE, CHAIRMAN

Some Geometric Models Used in Plastic Surgery. Horace E. Williams, Vanderbilt University. Teachers of mathematics courses particularly at the secondary level are frequently on the lookout for interesting and varied applications of their subject in order to infuse feelings of real world relevancy to their courses. Even very simple applications, especially if they are novel or varied in their scope, are a strong aid to teachers in maintaining interest among the students who do not foresee careers in mathematics, engineering, or physical science. Several interesting and very easily followed applications of geometry are used by practicing Plastic and Reconstructive Surgeons in the course of their work. A few scar revision techniques are presented in hopes that these will be found interesting. The cosmetic and therapeutic implications of this work are not discussed. However, an interesting speaker for a math club might be a practicing plastic surgeon who is willing to show clinical photographs of some of his work and to answer technical questions regarding his experiences.

Computer Assisted Instruction in Math Education. Perry A. Chapdelaine, Tennessee State University. Tennessee State University is host to a National Science Foundation funded project in Computer Assisted Instruction. With assistance from Stanford University, Dr. Patrick Suppes' programs are transmitted via telephone channels to student terminals. Freshmen mathematics students have been divided into control and experimental groups of approximate equal size. Students spend twenty minutes each day at the terminals, primarily in the drill-practice mode and in close coordination with class-room work. Pre and post testing is administered and analyzed for statistical significance. Prior grade school and high school studies show that a student placed ten minutes per day, each day of the school year, at the student terminal and using similar lessons, gains, on the average, two years of mathematical knowledge in one year, disadvantaged making more gains than advantaged. Data collected will hopefully supplement such studies and contribute to knowledge of effective remedial procedures at the college level.

Some Counterexamples in Analysis. R. H. Kerce, David Lipscomb College. It is instructive to illustrate the importance of certain properties of the real number system and of functions in teaching elementary calculus. The three following examples can be appreciated by the average elementary calculus student: (a) A function which is continuous but not bounded on a closed interval. The function is defined on a set of rationals, thus illustrating the importance of the completeness property of reals. (b) A function which has a positive derivative at a point but which is not monotonis in any neighborhood of the point. This illustrates the role of the continuity of the derivative of a function. (c) A function continuous and unbounded on $[o,\infty)$ but whose improper integral on $[o,\infty)$ is convergent.

MEDICAL SCIENCES SECTION

WOODS LABORATORIES BUILDING,
BLACKMAN AUDITORIUM
JOHN M. GINSKI, CHAIRMAN

Production of Crib Death Syndrome Lesions. J. T. Francisco, M.D., J. S. Goodlet, J. S. Bell, M.D., The University of Tennessee. It presently appears that a large but undetermined number of "crib deaths" are a result of smothering by "overlying". Some of the lesions observed at autopsy can be explained by hypoxia, whereas others cannot. Using the rabbit as an experimental model, we have reproduced the lesions that can be explained by hypoxia and partially reproduced the lesion that can be explained by "overlying" and hypoxia (increased chest and abdominal pressure with hypoxia produce an epidural hemorrhage). The epidural hemorrhage was produced in the anesthetized rabbit by placing a weight on the chest and abdomen which impaired the cardiac venous return and increased the venous pressure in the epidural venous plexus of Batson. Control animals subjected to hypoxia without "overlying" (i.e. no weight on chest and abdomen) developed the lesions that can be explained by hypoxia, developed epidural congestion, but did not develop epidural hemorrhages.

Response Energization as a Function of Classical Conditioning of Morphine Abstinence in the Hooded Rat. Ronald C. Trost, University of the South. Following 6 weeks of morphine addiction, 45 male hooded rats were exposed 10 times to a distinctive environment associated with either the onset or offset of morphine withdrawal distress over a period of 15 days. Thereafter, the animals were withdrawn from the drug and tested in terms of activity wheel performance for any possible effects the previous training may have caused. The results of this procedure provided support for the notions that a) a primary motive based on morphine abstinence was conditioned to specific external complexes and b) the event of conditioning could be measured by response energization of wheel behavior.

Lack of Repair of DNA in an Hereditary Ultraviolet Light Induced Skin Cancer (Xeroderma pigmentosum). W. L. Carrier, James D. Regan, and R. B. Setlow, ORNL. Ultraviolet light induces dimers between adjacent pyrimidines in DNA. The dimers have been implicated as the main lesion in the uv damage to the DNA of cells. Radiation-resistant bacterial cells repair damage by the excision of dimers from DNA, whereas sensitive cells do not show many of the features of this repair process. Xeroderma pigmentosum (XP) is a recessively transmitted disorder of man characterized by sensitivity to ultraviolet light. Homozygous, affected individuals, upon exposure to sunlight, sustain severe damage to the skin with the eventual development of multiple skin neoplasias. Skin fibroblasts from a number of affected individuals grown in tissue culture show less than 20 per cent removal of uv-induced pyrimidine dimers from their DNA, while normal cells show as much as 70 per cent. These findings raise the possibility that unexcised pyrimidine dimers can be implicated in the oncogenicity of ultraviolet radiation.

Research supported by the National Cancer Institute and the U.S. Atomic Energy Commission under contract with the Union Carbide Corporation. The cooperation of Dr. Edmund Klein of the Department of Dermatology, Roswell Park Memorial Institute, is gratefully acknowledged.

Serratia marcesans: Characteristics and Resistance Frequency at the City of Memphis Hospitals. Patricia W. Belew and B. R. Jennings, University of Tennessee Medical Units. Thirty-four strains of Serratia marcesans isolated at the City of Memphis Hospitals during 1969 were found to be biochemically identical to strains previously described. Seventeen of the strains exhibited hemolysis on human blood agar. Only one strain produced prodigiosin. Retrospectively Serratia isolation reports were reviewed covering the years 1967-1968. The antibiotic resistance frequency of 414 strains was compiled according to source of isolation, 219 from urine, 77 from respiratory tracts, 85 from skin and 33 from blood. Each group contained a predominance of distinct resistance patterns which compared to the overall resistance frequency. Urinary tract isolates were predominately resistant to all the antibiotics tested: tetracycline, chloromycetin, streptomycin, ampicillin, cepholathin, furadantin, nalycixic acid and notably Kanamycin, the drug of choice. Skin isolates were predominately sensitive to all antibiotics tested. Ampicillin and cepholathin resistance stayed intrinsically high throughout most of the 414 isolates.

The Effect of Enovid on the Binding of Thyroxine to Plasma Proteins In Vitro. Henry A. Moses, Clinton Battle and Dottie Watson, Meharry Medical College. Although the Food and Drug Administration endorses the oral contraceptive preparations as safe, there are many aspects of the mechanism of action in as well as the affects of these drugs on mammalian systems. It has been known for many years that there exists more than a casual relationship between the sex hormones and the thyroid hormones. For example, poly cystic ovaries may be induced in the rat by giving human chorionic gonadotrophin (HCG) after inducing a state of hypothyroidism using thiouracil. The administration of thyroxine to rats that were receiving a dosage of *Enovid* previously shown to be adequate to cause ovarian cysts formation prevented the formation of these cysts. Using a Sephadex G-25-40 column equilibrated with tris buffer (0.15M, pH 7.4) the effect of *Enovid* on the ratios of free thyroxine to protein bound thyroxine were studied. Recovery values were above 90 per cent and a sufficient quantity of I^{131} labeled thyroxine was present in the aliquots collected for assay on the counting device available (G-M Scaler - Model 123). *Envoid* (Norethynodrel-mestranol) increased the extent to which human plasma proteins bound thyroxine as indicated using I^{131} labeled thyroxine as a tracer. This finding supports the theory that one level of thyroxine-sex steroid interaction is the plasma protein binding; the binding of thyroxine to plasma proteins increasing without an increase in the thyroxine binding protein of plasma.

Non-Uniform Heating with Microwaves. R. S. Pozos, University of Tennessee. Microwave penetration patterns have been usually studied using biological tissue of muscle and/or muscle and fat. These media have inherent disadvantages since the biological tissue is not always of the same consistency, making analysis difficult. The frequency used for these studies was 2450 megacycles per second, a continuous nonpulsed wave form which represent a wave-length of 12:25 cm. Initially the microwave generator was calibrated using a water load. The water load was an acrylic receptacle with 100 cm^2 frontal surface and radiations were continued over a 10 minute period at a distance 5.00 cm from the front. A new method was developed for assessing the thermal pattern of a microwave frequency. A solid gel composed of cornstarch and water was found most convenient and practical for monitoring microwave thermal patterns. The frontal thermal pattern was not doughnut shaped as previously reported but resembled a "C" shaped field with the highest temperatures on the side of the coaxial cable. The pattern varied in the deeper layers of the cornstarch. Applying our results from the cornstarch experiments to a study on rats, we found that the neck and inquinal regions were selectively heated faster than other areas. Possibly death in rats due to microwave heating is related to heating the neck region. Selective shielding (aluminum foil) on rats seem to bear out this hypothesis.

Mobilization of Norepinephrine and Epinephrine Stores in the Isolated Guinea Pig Heart. John M. Ginski and Gretchen M. Reed, University of Tennessee College of Basic Medical Sciences. Ventricular norepinephrine (NE) and epinephrine (E) in the guinea pig heart (Langendorff preparation) perfused for 15 minutes is significantly less than that of the non-perfused control. The myocardial NE and E content can be maintained at non-perfused levels by using perfusion fluids containing NE, (160 ug/1). If the heart is perfused a total of 30 minutes, 15 minutes with NE (160 ug/1) and an additional 15 minutes without the NE addition, the NE pool is not altered but the E pool is significantly lowered. Pre-treating the animals with bretylium 30 minutes prior to perfusion yields an elevated catecholamine content suggesting that conventional cannulation procedures mobilize NE and E pools. Even though the NE

and E pools are drastically depleted, they can be reconstituted by perfusion with a NE containing fluid.

PHYSICS-ASTRONOMY SECTION

WOODS LABORATORIES BUILDING, ROOM 216
PHILLIP J. LORENZ, CHAIRMAN

A Magnetic Model of Matter. J. E. Rush, University of Alabama in Huntsville. The effect of the existence of magnetic monopoles is explored, following the work of J. Schwinger. A simple argument is presented to show that the assumption of monopoles leads to a charge quantization condition, an idea originally put forth by P. A. M. Dirac. The idea that the baryons and mesons might be built from particles which have magnetic charge is explored briefly.

Further Study into the Conditions in a Plasmajet Plume. Ray Hefferlin, Southern Missionary College. A laminar flow Argon plasmajet has been operated into atmosphere. Numerous measurements of optical thickness, temperatures, and densities had previously been made, so that we had a coherent picture of the conditions in the plume, including its borderline L.T.E. condition. It was found that (1) the axial variation of centerline average excitation-ionization temperature for Argon behaved as theory suggested, but (2) the "impurity" excitation temperatures were so much lower as to suggest a two-temperature model. To test findings (1) and (2) it was desired to extend measurements downstream in the plume. The present work, done under a grant from the Tennessee Academy of Science. resulted in an excitation-ionization temperature for Argon twice as far down the plume as before. Both (1) and (2) were well substantiated.

Supported by the Tennessee Academy of Science.

Some Experiments in Logic Circuits for the Undergraduate Laboratory. Lewis B. O'Kelly, Memphis State University. With the advent of integrated circuitry, logic circuits have come into wide use in laboratory instruments and a need exists for physics students to have some knowledge of these devices. To accomplish this, an inexpensive trainer has been built and several experiments developed for an undergraduate electrical measurements laboratory.

Harmonization of Discordant Spectroscopic Temperature Values, II. Wendell Tollerton, Southern Missionary College.

It is postulated that uninverted excitation and/or ionization temperatures from species seeded in small amounts in optically thin, L.T.E. plasmas, differ in a systematic fashion. The equation $T = a + b\bar{E}_u + clP + d\xi_a + e\xi_i$ is proposed, where $\bar{E}_u$ is the average upper level energy, 1P is the ionization potential, and ξ_u and ξ_i represent the partition functions of the atom and ion of the species according to the assumption $U(T) = u_o e^{+\epsilon T}$ Computor calculations based on an optically thin L.T.E. model are compared with existing data from the NBS copper arc. The comparison demonstrates that d and e stand for a real but small effect, as well as b and c, which have been known before.

High Resolution Total Cross Section of ^{16}O with Li(p,n) Neutrons. R. M. Feezel, C. H. Johnson, and J. L. Fowler, Oak Ridge National Laboratory. The Li(p,n) reaction produced with a Van de Graaff is one of the most useful neutron sources for measuring cross sections with 2 - 3 keV energy resolution. In measuring the total cross section of ^{16}O in the 1.7 to 4.2 MeV range, with the standard transmission technique, we detect Li(p,n) neutrons with a stilbene crystal from which we suppress γ-ray pulses by means of pulse shape discrimination. We bias against the second group of Li(p,n) neutrons somewhat with a pulse height bias setting and correct for the residual effect of these neutrons by measuring the relative counter efficiency and using the known ^{16}O cross section at the energy of the second group. Our measurements on ^{16}O have revealed 5 resonances in the total cross section with widths less than 2 keV.[1] We adjust a set of phase shifts, deduced from previous experiments on differential cross sections, to obtain a fit to the total cross section results.

Research sponsored by the U.S. Atomic Energy Commission under contract with the Union Carbide Corporation.

Undergraduate student from Auburn University and participant in Oak Ridge National Laboratory's Cooperative Education Program.

[1] J. L. Fowler, C. H. Johnson, and F. X. Haas, Proceedings Dubna Conference, 1968, p. 1.

Science and Society in the Classroom. F. X. Hart, The University of the South. The inter-relationship of science and society has recently received considerable national attention. An attempt to introduce discussions on this topic into a science classroom is here described.

Nuclear Quadrupole Resonance in Nitrogen Compounds. Paul J. Haigh, Carson-Newman College. Nuclear Quadrupole Resonance is a branch of radio frequency spectroscopy that provides information about chemical bonds and the structure of molecules; intermolecular bonds and crystal structures; and the nature of molecular motions in solids. The physical basis of this information is the weak interaction between the electric quadrupole moment of certain nuclei and the local electric field gradient caused by the surrounding nuclei and electrons. The research program at Carson-Newman College consists of several parts. 1. The search for new, nuclear quadrupole resonances; 2. detailed studies of selected compounds at various temperatures from 60 to 400°K; 3. numerical analysis of these data to determine molecular geometry and motion; and 4. supplementary studies of the same compounds using nuclear magnetic resonance and measurement of the dielectrics properties in order to get more complete information of these compounds in the solid state.

Physics: The Program for Teachers—A Progress Report of An Impossible Mission. M. R. Mayfield, Austin Peay State University. Physics: The Program for Teachers at Austin Peay State University grew out of a recognition that the obviously poor preparation of high school teachers of physics might be remedied, at least partially, by providing a curriculum directed especially at the preparation of high school teachers of physics. This preparation in the past has been incidental, and curricula for prospective high school teachers generally have been the same as those for prospective research people in physics. The first fourteen months (July 15, 1968—September 15, 1969) of the Program for Teachers have been completed, and this paper is a progress report for that period. Although the material herein contained is structured to inform the National Science Foundation (NSF) of the present status of the Program, hopefully it will also provide information which will be helpful to others who are involved in or who are contemplating a similar program.

Supported in part by the National Science Foundation.

Determination of Rotational Relaxation Times in Gases. F. L. Culp and R. L. Haese, Tennessee Technological University. An equation for the translational Eucken factor of a gas has been deduced on the basis of a comparison of two different theories of thermal transpiration. This equation has been used to compute the Eucken factor for a number of gases. The Eucken factor in turn has been used to calculate a number which can roughly be interpreted as the number of collisions required to transfer a quantum of rotational energy to the translational degrees of freedom. This number has been calculated for N_2, O_2, CO, CO_2, and C_2H_4. In all cases good agreement has been found between the values so calculated and those reported in the literature.

Why Have a Physics Section? Philip J. Lorenz, The University of The South. The program of the Physics Section at annual meetings of the Tennessee Academy of Science from 1960 through 1969 were reviewed. During this ten year period, a total of 59 papers were presented by thirteen Tennessee institutions. The majority of the papers were found to be summaries of research in a particular area over a period of several years. It was concluded that this type of paper was most appropriate for satisfactory communication among neighboring physicists.

Suggestions for broadening the Physics Section program were as follows:

1) Presentation of invited paper,
2) More astronomy papers, and
3) The encouragement of interdisciplinary papers.

ZOOLOGY SECTION

WOODS LABORATORIES BUILDING, ROOM 113
ROBERT G. LITCHFORD, CHAIRMAN

Permanent transparent mounts of Tribolium larvae for parasitological study. Thomas D. Diamond, University of Tennessee. This technique involves whole mounts of *Tribolium* larvae which are cleared in a manner that makes possible the microscopic study of internal structures including ingested oncospheres of embryos which are in the gut or have penetrated the gut lining and are found at other locations in the body cavity of the host. Salmon's (*The Microscope;* Mar.-April; 1951) formula of polyvinyl alcohol and lactophenol type A-3 appears to be the most effective of the media studied. Specimens may be mounted directly from life, arranged as desired for future study, and cured in an oven. They apparently do not deteriorate with age.

Research supported in part by the U.S. A.E.C., Contract AT-40-1-1749.

Effects of single and double infections with Hymenolepis microstoma and H. diminuta on Tribolium confusum. R. A. Prudhon, B. D. Tan and A. W. Jones, University of Tennessee. Four groups of uniform sized beetle larvae were starved for 48 hours. Three of the groups were then exposed to tapeworm eggs for 24 hours, and one group was used as a control. The larvae were observed daily until death or pupation at which time they were dissected and cyst burden, condition of larva, and day post-infection were recorded. The tapeworms directly affected *T. confusum* by extending the larval period and thus delaying pupation. Heavy parasite burdens killed *Tribolium* larvae. The extension of larval period was the same statistically in infections with *H. microstoma* as it was for *H. diminuta,* but fewer *H. diminuta* cysticercoids were required to cause this extension or to kill the host. A preference by the host for *H. microstoma* eggs over *H. diminuta* eggs, when both kinds were available, seemed evident.

Research supported in part by the U.S. A.E.C., Contract AT-40-1-1749.

Position of Oncospheral Hooks in Two Species of Hymenolepis. M. D. Fitzgerald, A. W. Jones and B. D. Tan, University of Tennessee. While human infection with the mouse bile duct tapeworm (*Hymenolepis microstoma*) has not been reported, the eggs of this worm are enough like those of the dwarf tapeworm (*Hymenolepis nana*) to make misdiagnosis possible. Aids in identification of *H. microstoma* are the size of its eggs (about twice as long as those of *H. nana*) and the position of onchospheral hooks within the shell and embryophore. In *H. nana,* hooks are usually oriented longitudinally with respect to polar axis; in *H. microstoma* they are usually at right angles to the axis.

Research supported in part by the U.S. A.E.C., Contract AT-40-1-1749.

Effects of radiation on a cestode: an action spectrum for Hymenolepis microstoma, the bile duct tapeworm of mice. Arthur W. Jones, University of Tennessee. Experiments over nine years using X rays and gamma irradiation upon all stages of the life cycle of the bile duct tapeworm have revealed differences in radiation sensitivity among eggs, cysticercoids, and adults, respectively. Within the 7 - 8 day period of development of the cysticercoid specific effects of radiation correspond with specific events in development. In the adult, the neck region and mature proglottids are resistant, the immature proglottids being sensitive, to radiation. These data can be combined into a spectrum of response to radiation. Exposures necessary to produce measurable effects (anomalies, sterility, etc.) range from about 1.5 Kr for the young proglottid up to 10-20 Kr for fully developed eggs or cysticercoids.

Research supported in part by the U.S. A.E.C., Contract AT-40-1-1749.

Epizootiology of Muscid Trypanosomids. Myrtle M. Fleming and R. Barclay McGhee, Lee College, Univer-

sity of Georgia. A survey of *Musca domestica* for trypanosomatids showed an infection in each season of the year but none from February to June. Infected larvae were present, but the infection was not carried through the instars to the adults. No transmission occurred of cultured *Herpetomonas muscarum* and *Crithidia luciliae*, which Wallace and Clark (1959) had originally isolated from *Phaenicia sericata*, to uninfected flies; neither did infection result from feeding flies cultured *Trypanosoma americanum*, but uninfected flies fed *Crithidia sp.* isolated from *Musca domestica* and cultured for 21 days had a 25 per cent infection. The trypanosomatids are transmitted directly from fly to fly, apparently in the flagellated form; and the rate of infection increases in the presence of raw fruits and vegetables.

Some Teratogenic Effects of Diuretics. John M. Mallette, Jick Wong and Irwin W. Howell, Jr., Tennessee State University. The purpose of the present study was to determine some effects of sulfonamide diuretics following oral administration to pregnant rats. The experimental animals were fed a diet containing 0.6 percent chlorothiazide throughout gestation. The control animals were fed normally without the addition of the test drug. The results indicated that about 4 percent of deformities were found in the treated group of animals however, no deformities were found in the control animals. The most obvious deformities were noted in the right forelimbs of the offsprings, as well as the appearance of hepatomal cells in the liver.

Some Effects of Clomid on Immature Rats Following Subcutaneous Injection. John M. Mallette and William T. Carter, Jr., Tennessee State University. The purpose of this study was to determine some morphological and histological effects of Clomid on the uterus and ovary of immature rats when injected subcutaneously. A total of 30 Sprague-Dawly immature female rats were used: 24 being experimental and 6 for control. Clomiphene citrate was injected subcutaneously at dosages of 5, 15, and 45mg./kg./day. The experimental rats were given clomiphene for a period of 3 weeks, while the control was administered cedar oil. At the end of this period the animals were sacrificed. The results of this study demonstrated that Clomid was toxic at 15mg. and 45mg. dosage levels. At these doses hemorrhaging and tissue deterioration were observed along with a decrease in weight. Using doses of 5mg. there was an increase in weight, however, no toxic effect was observed. The control showed no significant changes in reproductive organs.

Studies into the Distribution of Macrocheles muscaedomesticae (Acarina: Macrochelidae) via Attachment to the House Fly. W. E. King, Union University. The phoretic relationship between *Macrocheles muscaedomesticae* (Scopoli) and the common house fly, *Musca domestica* (Linn), was partially interpreted. Wild house flies bore mites at a rate of approximately 2% and emerging flies were attacked at a rate of from 5-13% under various laboratory conditions. Several environmental conditions show direct influence on rate of mite attachment; these include intensity of available light, also atmospheric temperature, and humidity. Age of the house fly also influences phoresy between these organisms, the mite attaching more readily to sexually mature flies than to freshly emerged flies.

Limnology at Reelfoot Lake Biological Station. Clay M. Chandler, Bethel College. Organization, techniques, and results are described for a field course in limnology that was sponsored by the University of Tennessee at Martin and the Tennessee Academy of Science at Reelfoot Lake from 1 July through 17 July 1969. Enrolled for the course and quartered at the lake were five students and one instructor: George L. Freeman, William S. Seymour, Joel S. Smith, Marvin D. Strickland, John T. Van Dyck and Clay M. Chandler. Field and laboratory work was devoted primarily to a cursory investigation of the limnology of shallow (2.8 - 4.6 m) Upper and Lower Blue Basins of Reelfoot. Data are presented for temperature, dissolved oxygen, free carbon dioxide, methyl orange alkalinity, pH, specific conductance, gross production, bottom fauna, and plankton. Moreover, by way of comparison the same type of data is presented for a rather deep (12.5 m) overflow area adjacent to Reelfoot Lake.

Some Biological Effects of Bleachery Mill Effluent. Max O. Ley, Jr., The University of Tennessee at Chattanooga. Metaphytic and metazoan populations of Crawfish Spring Lake, Chickamauga, Georgia, have been studied to determine biological effects of bleachery mill effluent. Populations inhabiting the spring fed area did not compare with populations downstream from the bleachery outfall. Standard indicator species, as well as indigenous species were used to evaluate the extent of biological rearrangement. Standard water quality tests performed include DO, pH, NO_2/NO_3, H_2S, total hardness, chlorides, and turbidity. The significance of collected data will be discussed.

COLLEGIATE DIVISION

SATURDAY, NOVEMBER 22, 9:00 A.M.
BLACKMAN AUDITORIUM,
WOODS LABORATORIES BUILDING
RICHARD J. RARIDON, CHAIRMAN

Algorithms for Sequential Retrieval in Reactive Interpreters. Allan D. Rhodes, the University of the South. The Interpreter accepts and stores in random order, statements to which the programmer has assigned statement numbers determining their order of execution. When a command is given to execute in ascending order, all statements numbered from A to B, the Interpreter scans to find the smallest number in that range and executes that statement. For the next statement, it finds the smallest number which is both in the range, and is greater than the past statement number.

The Construction and Application of a Simple Rat's Nest Calorimeter. William D. Miller, Memphis State University. A laser energy meter is described. The detector element consists of 1,000 ft. of #40 copper wire packed randomly inside a 50ml beaker. The beaker is wrapped with aluminum foil and placed inside a styrofoam box so that light coming through the flat glass window at the top of the insulating box will be totally absorbed by the copper wire. The change in resistance due to the change in the temperature is measured by a d. c. wheatstone bridge. Calibration is accomplished by heating with known current pulses.

Modification of Droplet Formation by Application of Moderate Electrical Potentials. Alan P. Biddle, University of the South. Preliminary measurements were made on the formation of water droplets (resistivity .72 Megohm-cm) in a 1 mm glass capillary. It was found that droplet charge, eccentricity, and formation rate increased non-linearly with increasing potential for either polarity. The radius, however, decreased with increased potential. Asymmetries were noted with respect to the polarity of the applied potential. Results with no applied potential indicated a negative sign preference in charge formation. Droplet size proved to be uniform at each potential, as did charge. A slight anomaly was indicated in the neighborhood of —3000V. The asymmetries in the neighborhood of O potential were probably the result of water-glass contact potentials.

The Effect of Ethionine on Iron Metabolism. H. Walker and H. A. Moses, Fisk University. The amount of iron in the body is only about 45 mg/kilogram of body weight. However, its essentiality is appreciated when one considers the role it plays in the hemoglobin molecule and heme containing proteins involved in biological oxidation. Iron absorption and liver iron have been shown to be related to ethionine intake. The affinity of iron for cell parts has been correlated with the immediate reduction in protein synthesis that occurs in the presence of ethionine. We have studied the effects of ethionine, an antagonist of the dietary essential amino acid, methionine, on the distribution of iron in subcellular fractions. It appears that ethionine increases iron in the microsome fraction at low dosages. At higher doses, there is probably an ethionine induced necrosis which gives the impression that iron is not accumulated. Apparently, ethionine inhibits protein synthesis and acts as an antagonist for methionine rather than having a direct effect on iron metabolism itself.

Polyesterification Kinetics and Monomer Structure. W. H. Anderson, Tennessee Techological University. Study of the reaction kinetics of homologous series of monomers illustrates conclusively the analogous nature of the polycondensation of diacids and diols compared with simple esterification of monofunctional reactants. Strong acid catalyzed "step-reaction" condensation of difunctional reactants, such as adipic acid with diethylene glycol, follow *psuedo-* second-order kinetics, showing clearly the failure of chain length to influence the reactivity of the functional group. As in simple esterification, however, the *structure* of the difunctional reactants and the presence of bulky or polar substituents influence strongly the velocity of the reaction and the properties of the polyester. Studies were made of the dependence of the reaction kinetics on the structure and composition of the reactants. Specifically, various combinations of difunctional acids; adipic, azeleic, and suberic, with 1,2- and 1,3-propanediol and with cyclohexanedimethanol were reacted at 150°C to 180°C. The extent of reaction was measured by end-group analysis via titration of residual acid. Linear second-order plots were obtained. The relative velocity constants will be related to monomer structure and activation energies compared with mono-functional systems.

Crystallization Kinetics and Polyester Chain Structure. R. K. Stevens, Tennessee Technological University. Crystallinity in high polymers enhances markedly the mechanical properties, such as solubility, hardness, and strength. The extent of crystallinity and the phase transition temperature in a polymer depend on several factors: (1) structural regularity in the "backbone" chain; (2) interchain secondary valence bonding; (3) the polymer chain length; and, to some extent, (4) the short-range thermal history of the sample. The rate of crystallization primarily involves two phenomena: (a) the thermal-history sensitive rate of crystallite nucleation, and (b) the temperature and structure dependent rate of crystallite growth. The isothermal overall rate of crystallization was measured on a series of polyesters using dilatometer techniques. The thermal history was varied and the polyesters were different in regularity of the repeating segment. A polarizing microscope with "hot-stage" attachment was used to measure the isothermal radial growth rate of spherulite formation. The observed kinetic data will be interpreted in terms of the structural regularity of the polymer, the chain length, and the immediate thermal history of the sample.

A Preliminary Study of the Estrous Cycle of Meriones unguiculatus. Mike Shehi and Cathie Rowland, University of Tennessee at Chattanooga. This study concerns the stage length of the Mongolian gerbil's (*Meriones unguiculatus*) estrous cycle. It was possible, by means of vaginal smears, to observe the estrous stage in progress. The average length of the cycle, estrus to estrus, was found to be four and one half days. The length of the cycle stages will be discussed.

A Preliminary Survey of the Pteridophytes of Northeastern Tennessee. Ronald W. Pearman and Charles R. Smith, East Tennessee State University. From April through September, 1969, the authors conducted a survey of the pteridophytes of northeastern Tennessee. The study area incuded the counties of Carter, Johnson, Sullivan, Unicoi, and Washington. Information from other authorities, both published and unpublished, as well as original information gathered during the course of this study, is included so that all available information on the pteridophytes of the area has been consolidated and supplemented for easy reference in the future. A table including fifty-three species, representing twelve families of pteridophytes and the counties from which they have been reported is included. As a result of this work, sixty-five previously unpublished county records, representing thirty-one species of pteridophytes, have been established.