

ABSTRACTS OF PAPERS PRESENTED AT THE ANNUAL MEETING

GENERAL SESSION
FRIDAY, DECEMBER 10, 10:30 AM.
CENTRAL AUDITORIUM, BUILDING 4500
FRANK H. BARCLAY, CHAIRMAN

Opportunities for Science Teachers and Students in ORNL Research Through ORINS Programs. Vincent E. Parker, Deputy Director, ORINS.

Oak Ridge Mobile Laboratory Program. L. K. Akers, Special Training Division, ORINS.

ORINS Small College Plan. Louis Rayburn, University Participation Office, ORINS.

The Health Protection Review Program of the USAEC. C. S. Shoup, Oak Ridge Operations, USAEC. A brief review of the origins and management of the Commission's national program of health protection activities, the cooperation with contractors, and the nature of assistance in health physics, industrial hygiene, and nuclear safety matters is presented. Also included is a description of highlights among the activities of health protection staff in the Oak Ridge Operations' complex, including the Radiological Assistance Plan.

SECTION MEETINGS
FRIDAY, DECEMBER 10, 2:00 P.M.
BOTANY SECTION
BT CONFERENCE ROOM, NO. 7-2017, SECOND
FLOOR, BUILDING 9207, Y-12 AREA
JAMES M. MOORE, CHAIRMAN

Morphological Effects Of Ionizing Radiation On Woody Species. Fred G. Taylor, Jr., ORNL. Radiation of higher plants often produces an array of effects ranging from death, growth inhibition or stimulation to various morphologic abnormalities. Morphologic anomalies often include leaf fasciation, stem swellings or changes in leaf color, shape, and texture. Several morphological anomalies as expressed in *Liriodendron*, *Pinus*, and *Sequoia* seedlings following both gamma and fast neutron irradiations are presented; as well as possible consequences of these alterations to plant processes and the total plant.

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

Exposure of Coleus Plants to Gamma Rays and Fast Neutrons. Herman O'Dell, U. T. A. E. C. Agricultural Research Laboratory. The plants used in this study were obtained by removing cuttings from an unnamed variety of *Coleus* developed by exposing plants of the variety "Scarlet Red" to fast neutrons. These plants were pale green with occasional splotches of red. After the terminal bud was removed new apices were allowed to develop from the axillary buds of the two top leaves. After the plants were exposed to gamma rays and fast

neutrons, they were grown under greenhouse conditions. Both gamma and neutron irradiation caused an increase in the number of red spots. The first leaves to appear showed a large number of red spots. The leaves appearing later showed fewer but larger spots. Chimeral sectors were produced by both neutron and gamma irradiated plants. These were yellow, pink and white in color. At this time four of the irradiated plants have regained the capacity to produce red leaves similar to the "Scarlet Red" variety. This reversion phenomenon will receive further study.

Plant Opal and Phytoliths. H. R. DeSelm, The University of Tennessee. Present in many epidermal cells of grasses and sedges are deposits of silica referred to as plant opal. The shape and frequency of these bodies is largely a function of genetic mechanisms within the plant and upon its death and decay they are released to the soil. Semi-quantitative separation of phytoliths from the mineral soils of different origin and at the surface for different periods of time are discussed.

An Analysis of Certain Woody Flora of Montgomery County, Tennessee. S. H. Duncan, and W. H. Ellis, Austin Peay State College. An analysis of the vegetation of Montgomery County was made in an attempt to describe the area in terms of the tree species present and their relative frequency, density and abundance. Special consideration was given to the general composition of the distinct plant communities that characterize this area. In addition to the general distribution of the species, certain ecological relationships of the species and plant communities were described. The Bitterlich variable-radius plotless technique was used for sampling the vegetation at 511 randomly selected points. A total of sixty-six tree species were recorded with various oaks and hickories representing approximately fifty percent of the total basal area and thirty-five percent of the total density. Based on the data collected and observations made in the study areas, six distinct forest communities were recognized.

Starch Synthesis From Sugars In Wheat Seedlings. Frederick T. Wolfe, Vanderbilt University. The green shoots of young light-grown seedlings of wheat rather surprisingly contain no starch, although the enzyme systems for starch synthesis are present, as is also the case in seedlings which have never been exposed to light. When excised shoots of either light-grown or dark-grown wheat seedlings are immersed in sugar solutions, starch synthesis occurs. The preliminary results include data concerning starch synthesis following administration of a number of trioses, pentoses, hexoses, disaccharides, trisaccharides, and sugar alcohols.

Some Cultivars of Manihot esculenta—a "Cytogenetical" Problem. S. H. Sohmer, University of Ten-

nessee. *Manihot esculenta* Crantz, endemic to the American Tropics, is cultivated throughout the tropics. Its tuberous roots are an important source of starch. At present the species is known only from the cultivated forms, or cultivars, which, due to the vegetative method of cultivation, are numerous. Such variation may be due either to the inherent genetic variability present in its ancestor(s), or to continual mutations occurring since it was first cultivated, or most likely, to both. The cultivars differ, even individuals of the same cultivar will often differ, yet, when taken collectively, they present a broad, intergrading spectrum of morphological characteristics which make their taxonomy difficult. Eighty-five cultivars were studied at the *Instituto Interamericano de Ciencias Agrícolas* in Costa Rica, and an artificial key was constructed as a means of isolating cultivars for genetical and cytological work.

The Spread of Bitterweed in North America. Donald Caplenor, George Peabody College. Bitterweed (*Helenium amarum* (Raf.) H. Rock) was discovered in southwestern Louisiana (by present state boundaries) by Robin between 1802 and 1806. Even then, it was considered adventive, probably from the west. During the 19th and early part of the 20th centuries, it migrated throughout the southeastern United States and into the Caribbean Islands. At present it seems the northern limit of migration has stabilized in Central Missouri, and in southern counties of Illinois, Indiana, and Ohio. It is now spreading in certain parts of California. Aspects of this migration are related to the ecology of the species and to patterns of land use.

A Statistical Genetic Analysis of Plant Height in Sorghum. P. W. Watkins, University of Tennessee Martin Branch. The inheritance of plant height in sorghum is of both practical and theoretical interest to plant breeders and geneticists. Most economic characters exhibit continuous variation which is generally explained by the multiple factor hypothesis or some modification of it. Several mathematical approaches to the analysis of quantitative characters have been suggested but information from properly designed experiments is scarce. In this study, inheritance of plant height was studied utilizing the technique suggested by Kenneth Mather for partitioning genetic variances. The results are compared with those reported by Quinby and Karper using techniques designed to study discontinuous variation. In general, the results of the analysis by both methods were in moderately close agreement. This provides some evidence that both types of approaches (quantitative and qualitative) to the analysis of plant height are measuring the same effects and gives further support to the method of measuring quantitative characters by statistical genetic methods.

Some Observations on the Development, Structure, and Plastochronic Changes in the Seedling Shoot Apex of Catalpa Speciosa Ward. James M. Moore, University of Tennessee Martin Branch. The development of the meristem begins soon after germination when divisions in the region between the primordia of the two embryonic leaves result in the establishment of the first

shoot apex with definable zonation. At this stage the apex is flat and consists of two surface layers, a corpus, and rib and flank meristems. By the time the hypocotyl is about 20 mm long the apex usually appears in median longi-section as a low dome when viewed in a plane parallel with the broad aspect of the first leaves, but as a flat area between the first leaves when observed in the opposite plane. As development continues the dome becomes steeper and by the time the seedling is about one in. high the formation of leaf buttresses marks the end of the first plastochron. In subsequent plastochrons the apex gradually becomes broader and flatter. In seedlings 12-15 in. high a third surface layer appears to be established.

CHEMISTRY SECTION

EAST AUDITORIUM BUILDING 4500

X-10 AREA, OAK RIDGE NATIONAL LABORATORY

WILLIAM T. SMITH, JR., CHAIRMAN

The Use of a High Speed Computer in Treating EMF Data on Aqueous Electrolyte Mixtures. M. H. Lietzke, University of Tennessee and ORNL. The availability of high speed computers has made it possible to treat emf data on aqueous electrolyte mixtures composed of an acid and a salt in a much more sophisticated manner than previously. In the treatment described the activity coefficient of the acid is measured by the emf technique and then expressed as the sum of a Debye-Hückel term and an excess term. The excess activity coefficient is expanded in a series of interaction coefficients, whose parameters are estimated by the method of least squares, using data at all temperatures, total ionic strengths, and ionic strength fractions of the acid in the mixture simultaneously. From the parameters so obtained it is possible to evaluate the partial molal free energy, entropy, and enthalpy of the acid in the mixture; and in combination with osmotic coefficient data on the salt, it is possible to evaluate the same thermodynamic functions for the salt in the mixture.

Thermodynamic Properties of Some Aqueous Electrolyte Systems. R. W. Stoughton, ORNL. The activity coefficients of both electrolyte components were determined to 150°C and to unit ionic strength for the following three aqueous systems by emf measurements: HCl-NaCl, HCl-BaCl₂ and HBr-KBr. In each case the acid was found to obey Harned's Rule, i.e., the logarithm of the activity coefficient at constant ionic strength was linear in ionic strength fraction of the other component. In none of the systems did the salt obey Harned's rule. The activity coefficient of DCl was measured to 1 m and 225°C and compared with that of HCl. The results indicated that the dielectric constants of H₂O and D₂O are closer together at about 100° than they are at higher or lower temperatures and hence suggest the desirability of measuring the dielectric constant of D₂O above 100°C. The above results combined with those from solubility measurements show the extended Debye-Hückel equation to be useful to 225° as at room temperature.

Rapid Computation of Molecular Integrals Over Gaussian Basis Function. L. J. Schaad, Vanderbilt University. Computing the energy of a wave function constructed from a Gaussian basis involves the evaluation of many thousands of integrals of the form

$$F_m(z) = \int_0^1 \frac{1}{u} e^{-zu^2} du.$$

This accounts for a large part of the total computing time. In the special case when only $(1s) = \exp(-ar^2)$ Gaussian functions are used, then only $F_0(z)$ appear. Series and recurrence methods have been used to evaluate the $F_m(z)$. We have found that, for $F_0(z)$, transformation to an error function and use of Hastings approximation for the error function increases computing speed by a factor of 10 with no loss of accuracy. We are now constructing Hastings approximations directly for the $F_m(z)$ themselves.

Premonitory Effects in Some Solid State Transitions and Melting. M. A. Bredig, ORNL. The majority of solid state transitions in which more or less pronounced changes in the positions of the lattice constituents occur under a given pressure at a certain temperature are, like melting, known as first order phase transitions. In many cases, however, the isothermal process is either preceded or altogether replaced by a gradual one, i.e. one spread out over a temperature range of varying size. This gradual change is structurally of the same nature as the isothermal process. It is of considerable importance for thermodynamic and other evaluations of the transition or melting process not to neglect the existence and extent of these premonitory effects. A number of examples such as transitions in fluorite and antiferroite types of substances, in some sulfates, and in nitrates will be discussed briefly.

Molar Enthalpies of Mixing in the Liquid LiF-NaF System. R. A. Gilbert, and R. B. Bevan, Jr., ORNL.

Some Perchlorate Cobalt (II) Complexes. W. C. Jones and W. E. Bull, University of Tennessee.

Heat and Free Energy of Formation of the Hexachlororhenate Ion and Its Heat of Hydrolysis. R. H. Busey and K. H. Gayer, ORNL.

Separation of Isotopes by Various Methods. R. M. McGill, Oak Ridge Gaseous Diffusion Plant. The increased use in recent years of stable isotopes as chemical and bio-chemical tracers, materials of construction in nuclear reactors, and in establishing primary length, mass, and time standards has renewed interest in methods of concentrating the isotopes in natural mixtures. The principles involved in some of the techniques which can be considered for the large scale separation of isotopes are reviewed and, where possible, illustrated by actual equipment.

The Development of an Information Center for Molten Salt Chemistry. H. F. McDuffie and R. P. Atkinson.

ENGINEERING SECTION

Room No. 7, Building 3500, X-10 Area
James B. Delano, Chairman

Engineering Aspects of Plasma Technology. H. J. Ramm, ARO, Inc. At AEDC several plasma facilities are operative. They include steady state and shock tunnel MHD accelerators, plasma generators for general plasma studies and for high enthalpy wind tunnels. According to their specific purposes and characteristics, the engineering problems of their design and operation are of a wide variety. Examples of adverse conditions which require attention are corrosion of the test chamber through impact of fast (high energy) plasma constituents, flow distortions and instrument misreadings caused by the magnetic fields of high current discharges, unstable discharge of cathodes, deterioration of insulators under extreme temperature conditions, damage to material probes for the diagnostics of the high temperature flows, excessive time constants of power supplies for very short time discharges. Not all of these problems have been overcome yet but an account is given of the progress that has been made toward their elimination.

This work was sponsored by the Arnold Engineering Development Center, Air Force Systems Command, United States Air Force, under Contract No. AF 40(600)-1200.

The High Flux Isotope Reactor. J. W. Hill, Jr., ORNL. The High Flux Isotope Reactor has been constructed at the Oak Ridge National Laboratory to produce transplutonium isotopes for use in the heavy-element research program of the United States. It is a flux-trap-type reactor using aluminum-clad fuel plates containing highly enriched ^{235}U fuel. The reactor is beryllium reflected and is cooled and moderated with light water. Initial targets for isotope production will contain 300 g of ^{242}Pu . The perturbed thermal neutron flux in the target region will be 2×10^{15} neutrons per cm^2 per second. The primary cooling system is designed for a power level of 100 megawatts, and provides for circulation of 16,000 gpm of water at pressures up to 1000 psig. The reactor is presently undergoing low power tests and is expected to reach full power in April, 1966.

Flow in the Entrance Region of A Magnetohydrodynamic Channel. W. T. Snyder, The University of Tennessee Space Institute. During the last decade, the field of Magnetohydrodynamics (MHD) has evolved from the status of an academic novelty to that of a mature research area. At least two promising areas of engineering applications of MHD have been defined, namely MHD power generation and MHD acceleration. Practical operating lengths of MHD devices will result in much of the flow being in the developing region, that portion near the entrance to a channel in which the velocity profile adjusts from an initial distribution to the fully developed profile. A discussion of available analytical techniques for analyzing the non linear MHD equations of motion in the entrance region are presented. Particular emphasis is given to the condition

in which the electric current flows at an angle to the plane of the electric and magnetic field, i.e. with a significant Hall effect present. Analytical results are presented for entrance region distributions of velocity, pressure, wall shear stress, and electric current.

The Role of Wind Tunnels in V/STOL Aircraft Development. Richard A. Kroeger, ARO, Inc. Vertical and Short Take Off and Landing (V-STOL) aircraft are beginning to play a more significant role in the research and developmental planning of the armed forces. Several successful prototypes have been built and flown in the United States and in several European countries. The characteristic of the V/STOL which gives it the ability to perform its unique mission maneuvers has caused some concern among aerodynamicists. This is the high flow downwash angles during hover and transition. The flow becomes so complex over the aircraft that accurate performance and control-ability predictions become difficult, if not impossible. Various forms of testing facilities have been used to measure the questionable aerodynamic parameters. Wind tunnels have been the primary source of this information thus far. The high downwash angles have presented their problems to wind tunnels also. There is poor correlation between various test facilities on the same model. In addition to the problems mentioned above, some of the studies being conducted at the AEDC aimed at their solution are presented. These include the use of an analog flight simulator, the parametric study of aerodynamic derivative sensitivity and a simulation scheme for studying the flow about a V/STOL model in a wind tunnel.

This work was sponsored by the Arnold Engineering Development Center, Air Force Systems Command, United States Air Force, under Contract No. AF. 40(600)-1200.

Slanting Techniques to Develop the Nation's Fallout Shelter System. Stuart R. Daniels, The University of Tennessee. Suburban and rural areas tend to lack sufficient public shelters. In some instances urban renewal projects replace adequately protective structures with inadequate shelters. In lieu of a program of direct federal subsidy to bolster the shelter system, an educational program has been aimed at architects and engineers. Emphasis is being placed on new school construction. The concept of protection factor is used to determine the adequacy of public shelters. Damage limitation studies lend additional significance to the value of 40. To obtain a factor of 40 or more, construction does not need to be massive. Adequate barrier and geometry shielding must be provided to attenuate overhead contribution as well as direct, wall scatter and skyshine radiation from a hypothetical contaminated ground plane. Techniques to slant designs have included: baffled entrances, relocated apertures, selection of standard weight aggregates, installation of solid masonry units or sand-filled units, and floor elevations below grade. Experience with actual designs in Tennessee and Alabama has proved the merit of this program. Additional spaces have been provided, protec-

tion factors have been increased, and additional cost has been minimized or eliminated.

Gas Film Cooling of Hypersonic Nozzle Throats. Hall C. Roland, The University of Tennessee. Analytical and experimental studies of gas film cooling of a small hypersonic nozzle throat have been made. Air was used as both mainstream and coolant fluids. Stagnation pressure from 372 to 459 psia and stagnation temperatures from 2960 to 3710°K. were used for the mainstream. A boundary layer type analysis was made to satisfy the equations of continuity, momentum, and energy. Fluid properties are evaluated locally. The velocities and temperatures at the mainstream surface of the boundary layer are based on mainstream values for frozen flow through the nozzle. The momentum and energy balance include pressure gradient effects. Eddy diffusivities are calculated based on the "law of the wall" with the wall shear stress evaluated using the Blasius turbulent pipe flow equation. The analytical results give reasonably good correlation with data from the present experimental studies. Analytical studies for the limiting case of a nozzle without film cooling give good correlation with data from the Jet Propulsion Laboratory, California Institute of Technology. Visual examination of the nozzle wall after the experimental program indicates that the gas film protected the wall in the convergent section from erosion as well as from extreme temperature.

GEOLOGY-GEOGRAPHY SECTION

Room No. 155, Building 4500, X-10 Area

Harry J. Klepser, Chairman

An Unusual Fossil Assemblage from the Middle Ordovician in Central East Tennessee. R. E. McLaughlin, R. T. Fetters, O. B. Hofstetter III, and S. M. Pickering, Jr., The University of Tennessee. As part of a continuing reexamination of the Middle Ordovician of East Tennessee, a stratigraphic study of beds in the Ottosee position along Alcoa Highway near Knoxville has revealed a fauna of unusual character and preservation. In a lithology superficially resembling shale but in reality a deeply weathered nodular, calcareous, sandy siltstone; numerous specimens have been recovered and are under study. The fauna is distinguished by trilobites referable to the genera *Amphilichas*, *Bumastus*, *Cybele*, *Paraharpes* (*Eoharpes*), *Iliaenus*, and others. Brachiopods of at least 26 genera and graptolites, especially dendroids of six or more genera, are well represented. Bryozoans, sponges, ostracodes, conulariids, stromatoporoids, and echinoderm parts also occur. Especially noteworthy is the apparent reflection of transitional environment and contrasting energy conditions upon the fauna. Further examination of this fauna may confirm the suspected need for revision of previously held views concerning this portion of the Middle Ordovician section.

Isotopic Composition of Lead in Some Galenas From the Southeastern United States. James H. Davis, and D. H. Smith, ORNL. The isotopic compositions of lead in 13 galena samples from the southeastern United

States were determined at the Oak Ridge National Laboratory. The mass spectrometer used is a 2-stage, 90-degree magnetic deflection, 12 in. radius machine. Two lead standards, NBS-200 and GS-4, were run and results compared with those of other laboratories. Samples were obtained from several sources by TVA personnel. Four categories of galenas can be distinguished on the basis of lead isotopic abundances. A sample from central Kentucky is clearly of the J-lead type. Three samples from east Tennessee zinc-and-barite-occurrences have values rather like modern leads similar to those reported for the Mascot and Friedensville mines. Values for three samples from rocks that are probably basement to the Ocoee Series fall in a tight group. Six samples which constitute a fourth group, from radically different geological settings, include the Austinville and Flat Gap zinc mines, a zinc occurrence in the Rome Formation, a sample from Ducktown, and two samples from the crystalline Appalachians. The need for determinates of associated rock leads for comparisons is clearly indicated.

Reliability of Visual Estimates of Grain Abundance.

John M. Dennison, University of Tennessee, and James H. Shea. Earth Science Curriculum Project, Boulder, Colorado. Six 8 x 8 graeco-latin square experiments were conducted to investigate the reliability of visual estimates of grain abundance in artificial mixtures. Variables studied included observer bias and precision, type of grain estimated, true percentage abundance, number of background materials, observer's geologic training, and effect of using or not using a percentage comparison chart. Visual estimates were unbiased but not very precise. Accuracy or precision could not be related to observer differences, number of background materials, or level of training. No significant improvement in accuracy or precision resulted from using a percentage comparison chart. Errors of visual estimates vary with the true percentage in a manner similar to error curves in binomial populations; a visual estimate has a precision approximately equal to counts of 16 grains. Experimental error can be cut in half by using a sample count of size 64 rather than making a visual estimate.

Structure and Stratigraphy of The Rockwood Formation Near Ooltewah, Tennessee. Robert L. Wilson, University of Chattanooga. Recent highway construction along Interstate 75 just east of Ooltewah, Tennessee has revealed several excellent exposures of the Rockwood Formation. This report deals with a portion of the Interstate which begins four miles northeast of Ooltewah at Whiteoak Mountain and extends toward Cleveland for about 8,700 feet. The type area of the Rockwood Formation as defined by Hayes in 1891 is 850 to 1000 feet thick. Recent workers have reported thicknesses which range from 30 to 700 feet. In this area the Rockwood Formation is 432 feet thick and consists primarily of sandstone and shale with scattered beds of hematite rarely more than a few inches thick.

Near the eastern end of this traverse the interstate route passes through Lauderback Ridge. This ridge

is roughly parallel to the trend of Whiteoak Mountain and is composed of a sequence of beds consisting of highly-deformed, nearly vertical strata. Small drag folds, fracture cleavage, and minor thrust faults are also much in evidence. On the west end of this section near Whiteoak Mountain, the Rockwood Formation is 432 feet thick. The highly deformed and steeply dipping strata on the eastern end must account for more than twice this thickness.

The Rudiments of Desalination Geography. Gale Young, ORNL. The evaporation-rainfall cycle of the earth is outlined and some of the rivers which carry the runoff to the sea are looked at. The distribution of rainfall is noted, as well as the distribution of arid regions. Projects for transporting water from one place to another are cited. Desalination is introduced as an option, and possible implications for increasing world food production are considered. The size of the arid regions is compared with the food producing areas now in use, and the location of the arid land by continents is again pointed out.

MATHEMATICS SECTION

Director's Conference Room, No. 284

Second Floor, Building 4500, X-10 Area

James F. Key, Chairman

Some Notes on the General Curriculum in Mathematics for Colleges, Proposed by CUPM. Ralph C. Boles, Tennessee Technological University. The movement for curriculum change in college mathematics can no longer be considered merely novel or transitory. There is a substantial and clear emphasis on improvement of college mathematics programs correlated with the improvement in high school programs. The old structure (algebra, trigonometry, analytical geometry, and calculus) which comfortably regulated college mathematics has fallen apart, and in the wake of the break-up there is much confusion about the role of college departments. A publication by the Committee on the Undergraduate Program in Mathematics, *A General Curriculum in Mathematics for Colleges* should give new stability to college mathematics curricula and minimize the confusion attendant to the transition. This publication is available from: CUPM, P. O. Box 1024, Berkeley, California 94701.

Concerning Negative Bases, Reginald Mazer, Tennessee Technological University.

Geometric Programming Concepts. Horace E. Williams, Vanderbilt University. Geometric Programming is a sub-category of the general field of mathematical programming referred to as convex programming. It is based on the "geometric inequality" and is designed to minimize a broad class of objective functions which are "posynomial" objective functions subject to constraints which are posynomials. Some of the appealing features of geometric programming, where applicable are: (1) The technique adapts well to many types of engineering design problems. (2) The dual program

that is associated with any geometric program has equality constraints that are always linear thus providing for ease of solution. (3) The solutions for the dual program give the relative contribution of each term of the objective function to the optimum value for the objective function. (4) The solution to the dual program gives the maximum value for the dual function which is also the minimum for the objective function. (5) One need not be conservative about introducing additional design parameters to a geometric program since this is frequently an aid rather than a hindrance.

MEDICAL SCIENCES SECTION

Room No. 7-327-D, Building 9207, Y-12 Area
Murray Heimberg, Chairman

Plasma LDH Activity During Development of a Transplantable Leukemia in Two Strains of Rats. David M. Morris, University of Miami School of Medicine. ¹In the Fischer rat bearing a subcutaneous implant of isologous tumor tissue the PLDH activity rose only after the tumor had become palpable. This was true also in the Wistar strain after implantation of the homologous tumor. In both strains the increase in PLDH occurred in the terminal stages, but it was more marked in the Fischer rats. Data suggest a possible correlation between PLDH levels and WBC counts. The high titre of PLDH in the terminal stages may also be correlated with a breakdown in liver function. The increase in PLDH did not seem to be related to the depression of hematocrit seen during development of the leukemia.

The Stimulation of Epidermal Proliferation by a Specific Protein (EGF). S. Cohen, Vanderbilt University Medical School. A heat-stable, antigenic protein has been isolated from the submaxillary gland of the male mouse which, upon injection, elicits precocious eyelid separation and tooth eruption in the newborn mouse. Histological and biochemical evidence has been obtained indicating that the observed eyelid separation is a consequence of a more generalized biological effect, namely, an enhancement of epidermal keratinization and proliferation. The observations reported in the present paper include (1) the demonstration of a direct effect of the growth factor on organ cultures of chick embryo skin, and (2) evidence that the growth factor will markedly enhance epidermal proliferation and keratinization in the absence of any demis.

Effect of Metabolic Inhibitors on Fixation Time in the Spinal Cord of the Rat. Eugene C. Palmer, Vanderbilt University Medical School. Many minutes must pass after an animal has had an experience before an enduring imprintation is formed within its C.N. S. This "fixation time" may be due to continuing physiological activity of neurons involving reverberation of impulses in the appropriate neuronal nets with many repetitions in a fixation time. This time is measurable by cutting

off such activity after beginning (sectioning the spinal cord) and testing for retention of the altered performance. The stimulus was a lesion of the anterior cerebellum in newborn rats. The animals developed an asymmetrical flexion of the opposite hind limb. If the spinal cord in control animals were cut up to 45 minutes after production of the lesions the asymmetry disappeared. If cut after a longer interval than 45 minutes, the asymmetry persisted. Puromycin and actinomycin-D inhibitors of protein and mRNA synthesis, injected prior to placement of the lesion increased fixation time to 83 minutes. Eserine, an inhibitor of cholinesterase, altered the response to 60 minutes. Histamine caused no change in fixation time.

Changes in the Rate of Potassium Outflow from Smooth Muscle by Alterations of the Ionic Composition of the External Bathing Medium. Stanley Van Hagen and Leon Hurwitz, Vanderbilt University School of Medicine. A study of the rate of potassium outflow from isolated longitudinal smooth muscle cells of guinea pig ileum was conducted. The rate of potassium outflow was determined in the presence of different concentrations of sodium and calcium ion and in the presence and absence of acetylcholine. When the muscles were incubated for several hours in a calcium and/or sodium deficient solution, the rate of potassium outflow from unstimulated tissue was augmented. Acetylcholine introduced a pronounced increase in the rate of potassium outflow which was enhanced in calcium deficient solutions. However, a decrease in the sodium concentration reduced the extent to which the rate of potassium outflow could be increased by acetylcholine. A study of the influx of potassium into the cell was also conducted. It was found to be depressed in sodium deficient solutions. It appears, therefore, that the muscles undergo a loss of internal potassium in sodium deficient solutions.

Growth of 9, 10-dimethyl-1,2-benzanthracene (DMBA)-Induced Mammary Tumors During Lactation in the Sprague-Dawley Rat. G. M. McCormick, II, University of Tennessee School of Basic Medical Sciences. Growth of DMBA-induced mammary tumors during lactation was examined in Sprague-Dawley rats. Fifty-day old female rats were fed 20 mg DMBA in sesame oil by stomach tube, and allowed to breed 15 days later. Tumors were detected by palpation and measured periodically. Tumors grew rapidly during pregnancy, regardless of type, but tumor growth during lactation was variable. Some regressed, some continued to grow rapidly, while others maintained a constant size. Tumor growth was dependent on suckling, as virtually all tumors regressed when suckling was prevented. The number of growing tumors was directly related to the number of suckling young. Ovariectomy abolished the growth stimulating effect of suckling, but administration of progesterone to ovariectomized lactators restored tumor growth. These data suggest that progesterone is the primary stimulator of mammary tumor growth during the postpartum period.

This research was supported by Grant CA 05105 from NIH.

Pulmonary Vascular Changes in Newborn Calves at

¹ Present address: NIH fellow Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Simulated High Altitude (10,000-12,000 feet). James E. Leathers and John T. Reeves, University of Kentucky, College of Medicine. The exact site of vasoconstriction which regulates blood flow into the capillaries of the lung is not established. Pulmonary arterioles give rise to short precapillaries at right angles. The origin of these precapillaries would appear to be the ideal site for blood flow regulation. To test this hypothesis, pulmonary hypertension was rapidly induced by placing healthy, newborn calves into an altitude chamber maintained at 10,000-12,000 feet. In about three weeks pulmonary arterial pressure ranged from 60-125 mm Hg., mean pressure, compared to 22-26 mm Hg., mean pressure, in control calves at 1,000 feet (Lexington, Kentucky). Examination of the hearts showed right ventricular hypertrophy in proportion to the severity of the pulmonary hypertension. Correlation of histological sections with microradiographs of the same tissue slice showed massive medial hypertrophy of the arterioles. Smooth muscle was found in vessels down to 30 microns in diameter particularly in the precapillary vessels where greatest increased resistance could occur. However, vessels 30-80 microns in diameter demonstrated a remarkable abundance of muscle; in most instances as serial rings which produced a scalloped or corrugated effect. It appears that increased vascular tone may occur along arterioles 30-80 microns in diameter as a result of a series of constricting muscle rings rather than through constriction at the origin of the precapillaries. We have shown that pulmonary hypertension can be rapidly induced in newborn calves made chronically hypoxic and that microradiography and serial sections of the same tissue provide valuable tools for the study of vascular pathology.

The Inhibition of Hepatic AIB Uptake by Ethanol. J. W. Chambers and R. H. Craig, Vanderbilt University Medical School. Ethanol inhibited the uptake of a nonmetabolizable amino acid, alpha amino isobutyric acid (AIB), by the isolated perfused rat liver. The uptake of AIB by the liver was reduced approximately 80% by the addition of 200 mg of ethanol to 100 ml of perfusate. This inhibition was reversed (1) when pyruvate was added directly to the perfusate, and (2) when the donor rats were pretreated with nicotinamide. Both procedures increased the NAD levels in the liver and presumably increased the metabolism of ethanol. Acetate, the principle metabolite of ethanol, increased the uptake of AIB by the liver but did not reverse the inhibition caused by ethanol. It is proposed that ethanol metabolism shifts the redox equilibrium of the liver toward the reduced state. This results in a diversion of substrate from energy producing reactions which restore the normal ratio of oxidized and reduced cofactors. The active transport system is thus deprived of energy and the uptake of AIB is inhibited.

The Effect of Insulin Deficiency on Triglyceride Synthesis and Transport by the Isolated Perfused Rat Liver. D. R. Van Harken, T. O. Brown and M. Heimberg, Vanderbilt School of Medicine. The incorporation of palmitate-1-C¹⁴ into serum and liver triglyceride was

estimated using perfused livers obtained from chronic alloxan diabetic rats maintained on insulin for two weeks (controlled diabetics) and from controlled diabetics from which insulin had been withdrawn 48 hours before use (diabetics). At the concentration of free serum triglyceride concentration between 0-90 minutes and 90-180 minutes was observed during perfusion of livers from controlled diabetic animals. An increase in serum triglyceride concentration, about 1/3 that observed between 0-90 minutes during perfusion of livers from diabetic rats; no net change in triglyceride concentration between 90-180 minutes was observed. The specific activity of serum triglyceride in experiments with livers from diabetic rats was about 1/3 that observed with controlled diabetics. There was no significant difference in the hepatic triglyceride concentration of the two groups but the specific activity of triglyceride in the diabetic liver was about 1/3 that of the controlled diabetic. These results suggest that the fatty liver sometimes observed in the uncontrolled diabetic develops despite an apparent decreased esterification of fatty acid to triglyceride.

The Effect of Diabetes and Insulin on the Biosynthesis of Serum Proteins by the Isolated Perfused Rat Liver. Henry G. Wilcox Guinn Dishmon, and Murray Heimberg, Vanderbilt University School of Medicine. A marked decrease (2-4 fold) was observed in the extent of incorporation of ¹⁴C labeled amino acids into serum proteins of the perfusion medium by livers from acute or chronic alloxan diabetic rats in contrast to the decrease observed in livers from untreated animals. A decrease in incorporation by diabetic livers into three density (d) classes of serum lipoproteins (d 1.020, d=1.020-1.070 and d=1.070-1.210) was observed also. The decreased incorporation into the d 1.020 lipoprotein class paralleled that observed for serum proteins as a whole. Release of triglyceride (TG) into the perfusate by normal livers was markedly inhibited (an actual uptake) by the diabetic state. Two-day treatment of the diabetic rats with insulin partially restored the capacity of the livers to incorporate amino acids into total serum proteins. Insulin affected amino acid incorporation into the serum lipoproteins to a lesser extent, even though there was an enhanced release of TG into the perfusate by these livers. Diabetes or insulin had no apparent effect on liver protein synthesis. The nonproportionality between synthesis of lipoprotein (d 1.020), the major carrier of TG in the blood, and TG following insulin treatment may indicate that lipoprotein synthesis is not a limiting factor in TG transport from the liver and that this d 1.020 lipoprotein protein may exist in the serum with different degrees of lipid saturation.

In Vitro Incorporation of Palmitic-1¹⁴C Acid Into Irradiated Bone-Marrow Cells. Raymond Pflieger², Fred Snyder, and Claude Piantadosi, The Medical Division, ORINS., and the University of North Carolina, Chapel Hill. Earlier work in this laboratory has demonstrated that fatty acid esterification into triglycerides is stimulated in irradiated bone marrow (Snyder, F. and Wright, R. Radiation Res. 25, 417-422, 1965). Within

one week after total-body irradiation (800R) the triglycerides of femoral marrow increased from 5% to as high as 50% of the net weight (Snyder, F. and Cress, E. A., Radiation Res. 19, 129-141, 1963). This research led to the in vitro experiments with marrow cells incubated with ^{14}C -labeled palmitic acid reported in this paper. K-palmitate- ^{14}C (specific activity = 0.14 microcurie 3.6 mg/flask) was incubated at 37°C from 0.505h in 1 ml of Tyrode's solution containing approximately 150 mg of normal or irradiated (800R) bone marrow. The femoral bone marrow was obtained from female rats (1650200 g) killed 1, 2, 3, 4, and 5 days after 800R total-body irradiation. After incubation, lipid extracts were prepared. Thin-layer chromatograms and zonal scans of these extracts were used to determine the degree and type of incorporation for the labeled fatty acids. Incorporation of palmitic acid into triglycerides and phospholipids of control femoral marrows reached a maximum after 2 hrs. of incubation. The maximum incorporation by irradiated marrow occurred at a later time. At intervals of one day or more after total-body irradiation there was a significant inhibition of the esterification of fatty acids into glycerides and phospholipids (primarily lecithin). The data suggests that triglyceride-synthesizing enzymes are more resistant to ionizing irradiation than the enzymes responsible for phosphatide synthesis.

This research was performed under contract with the United States Atomic Energy Commission.

PHYSICS-ASTRONOMY SECTION
Isotopes Auditorium, Room 126,
Building 3047, X-10 Area
L. O. Love, Chairman

The "New" Courses in Introductory Physics: A Report on the Minnesota Meeting of the Commission on College Physics, May 1965. Isabel H. Tipton, The University of Tennessee. On May 6, 1965, five years after the birth of the Commission on College Physics, the Commission returned to the room in which it was conceived in the Physics Building on the University of Minnesota campus in Minneapolis for a conference on New Materials for Introductory Physics Courses. Most of the documents under scrutiny were made available to the participants in advance of the meeting. These included the Feynman Lectures on Physics prepared at Caltech; the first two volumes of the Berkeley Course Text; Physics, A New Introductory Course from MIT; the Lambe and Fowler notes used at Washington University; samples of notes from the Byrn Mawr combined chemistry and physics course; and bits from a few others. The program consisted primarily of short talks delivered by participants with experience in the production or trial use of the new materials. As each course was discussed, representatives of the institutions at which the new materials

were created described the successes and difficulties encountered in the early trials. Persons who had used the new materials at other institutions in a variety of ways also related their experiences. This paper reports some of the details in the presentation of these courses that cannot be surmised from reading the texts and some of the reactions to these new materials on the part of the students who took the courses, the instructors who taught them, and the participants in the conference who evaluated them.

Optical Physics Research-Education at Southwestern. E. A. Barnhardt, Southwestern At Memphis. Research and education in the field of optical physics and radiometry at Southwestern is described. The premise of a unilateral effort and the attendant benefits have indicated that a one-research program can be successfully carried out by a small staff. A curriculum modification has resulted in the availability of students for the research program by the junior year. Additionally, the early introduction to research problems and exposure to a staff actively engaged in research have resulted in the entrance into graduate school of 91 percent of the students receiving the B.S. degree over the last eight years. It is pointed out that the ratio of staff members per field of research is comparable to that in large universities if the small college confines its activities to one or two fields of endeavor.

Experimental Nuclear Physics at the Oak Ridge Isochronous Cyclotron. C. B. Fulmer, ORNL. The Oak Ridge Isochronous Cyclotron is used to accelerate beams of various types of charged particles to a wide range of energies. These energetic particles are directed by a beam handling system to several experimental stations where a variety of nuclear reactions are studied experimentally. The experimental facilities include a high resolution magnetic analysis system and a 20,000 channel pulse height analyzer with a two-dimensional address. Nuclear reactions in which the bombarding particle "picks up" one or more particles from the target nucleus are studied to obtain information about both the target nucleus and the product nucleus. The nuclei are thus taken apart, bit by bit, to find out how they are put together. Other types of nuclear physics experiments at ORIC include stripping reactions, compound nucleus reactions, elastic and inelastic scattering with both unpolarized and particle beams, and nuclear spectroscopy of deformed nuclei. (2) the stored energy is converted to kinetic energy of the ions as a result of collisional de-excitation between pairs of metastable ions. The ions then escalate in energy to very high values (up to 5,000,000°K).

The Efficiency of A NaI Crystal for a Line Source. M. V. Yester, Christian Brothers College. The efficiency of a 3" x 3" NaI detector was computed for a one inch radioactive line source. The efficiency of a detector is defined as the ratio of the gamma rays detected to the gamma rays emitted from a radioactive source. Obtaining the formula for the efficiency, the trapezoidal rule was employed to perform the numerical integration of the equation. A program was then written for

² A predoctoral fellow from the University of North Carolina at the ORINS Medical Division, sponsored by a USAEC Predoctoral Fellowship.

an IBM 7074 computer to carry out the integration. By making a sample calculation, the program was proven to be correct. The accuracy was checked by comparing the results with a table of efficiencies, and the calculated results were found to be within 2% of the given values. For a source of 0.75 inches, a source-to-crystal distance of 10 cm and an energy of 48.4 kev, the efficiency given by the tables was 0.03264. The calculated value for the same conditions was 0.03211; the difference between the two values was 1.65%.

Symmetry of Molecular Orbitals in Magnesium Porphin. Larry D. Johnson, University of Tennessee. The magnesium porphin molecule, of D_{4h} symmetry, is viewed as being a planar structure composed of a central magnesium atom surrounded by four pyrrole residues, each of C_{2v} symmetry, the latter connected by four methine carbon atoms. Components of the final molecular orbitals are generated from the pyrrole residue molecular orbitals and from the methine carbon atomic orbitals by means of projection operators of group theory. In certain cases these components are the final molecular orbitals of magnesium porphin; in other cases the components are used in calculating the elements of an overlap matrix from which the final molecular orbitals are obtained. Detailed examples of the use of the projection operators are presented.

Project Plowshare—The Peaceful Uses of Nuclear Explosives. John W. Landry, ORNL. Some possible industrial uses of nuclear explosives behind "Project Plowshare", the research and development program toward the industrial and scientific application of nuclear explosives, include: (1) Using the blast for excavating navigation and irrigation canals, railroad passes, and harbors; stripping overburden and crushing ore; producing dams; creating underground reservoirs for storing water and petroleum materials; modifying underground rock formations so that water-bearing formations are recharged and obstructions to flow are removed; preparing ore bodies for in-place-leaching and block-caving methods of mining; preparing naturally-heated rock so its heat can be extracted for producing power and for desalting sea water; preparing oil-shale deposits for in-place burning to produce petroleum; and for improving the porosity in gas- and petroleum-producing rock. (2) Using the heat for creating oil fields in bituminous-sand deposits, desalting sea water, and producing chemicals. Possible scientific uses include using the blast for determining the internal structure of the earth and for advancing seismology, using the neutron radiation for neutron experiments and for producing new elements and isotopes, and using the nuclear and thermal effects for meteorological and space research.

A movie shows excavation of a crater 1280 feet wide and 320 feet deep by 100-kiloton detonation in a Plowshare experiment of July 6, 1962.

SCIENCE-MATHEMATICS TEACHER SECTION
Physics Conference Room, No. 22 & 24, Corridor G,
First Floor, Building 4500, X-10 Area
Powell Puckett, Chairman

What Should Science Teachers Do About English?
C. P. Keim, ORNL. The number of persons associated with scientific research and development, that is, the discovery and application of scientific knowledge, is at an all-time high and continues to increase. If science is to be meaningful, prospective scientists must write about science. They must learn to do this in the public schools and in college. They cannot wait until they are engaged in full-time scientific professions. The science teacher himself must be able to write simply, clearly, and effectively. He must demonstrate this ability to his students and teach them to write. This can only be done by having the students write. The teacher cannot say, "I teach science, leave English to the English teacher." All teachers must consider the complete person. Listed below are some practical steps science and English teachers can take. (1) They can grade scientific reports and papers by basic grammatical standards. (2) They can work with the English teachers on setting up some basic grammatical and compositional standards for science reports and papers. (3) They and the English faculty can compile a reference list of well-written scientific writings of the past and scientific writings of our day, including science fiction by reputable authors and novels written by nonscientists relating to science, for example: *Arrowsmith* by Sinclair Lewis. The doors are open for science teachers and English teachers to work together.

What Colleges Expect of High School Students in Science. Roger Rusk, University of Tennessee.

Mathematics for the Sake of Science and/or Itself. Mary Laycock, Oak Ridge High School.

Inertia of the Eye. John Ergen, Oak Ridge High School.

ZOOLOGY SECTION

Room No. 7-325, Building 9207, Y-12 Area

John M. Mallette, Chairman

Synthesis of the Polypeptide Chains of Hemoglobins in the Red Blood Cells of the Developing Chick Embryo. R. C. Fraser, The University of Tennessee. There are three principal hemoglobins present in the avian embryo. Their concentrations change in a definite sequence during embryonic development. Acrylamide gel electrophoresis has indicated that there are also three polypeptide chains which make up the three types of hemoglobin molecules. Similarly concentrations of these polypeptides change during embryogenesis of the chick. Evidence dictates that in the earliest embryo studied there is but one form of polypeptide chain, later there is another added, and finally with the appearance of the third there is a concurrent decrease in concentration of the first form. Based on some observations and a few assumptions, the conclusion has been reached

that the average ribosome in the primitive red blood cell of the five-day embryo is capable of synthesizing one complete polypeptide chain in approximately one minute.

The Immunologic Competence of Pituitary Homografts in the Chick Embryo. Benny M. Miles and John M. Mallette, Tennessee A. & I. State University. The purpose of the present study is to show that the pituitary gland of the chick contains lymphoid elements and is capable of producing immune reactions characterized by (1) degenerative changes in the section of the chorio-allantoic membrane adjacent to the graft, (2) abnormalities in the spleen, and (3) death of the embryo. This conclusion was drawn as a result of historical examination of the spleens of embryos after pituitary homografts from donors were made on the chorioallantoic membrane. The success of the homografts varied directly with the age of the donor. Further, immunologically competent cells were found to develop earlier in the pituitary gland than in splenic tissue.

*Distributional Records of the Pumpkinseed (*Lepomis gibbosus*) and Red-breast Sunfish (*Lepomis auritus*) in Tennessee.* Richard B. Fitz, TVA. Two sunfishes, the redbreast and the pumpkinseed, with no previous distributional records in Tennessee, are reported for several east Tennessee waters.

*Age and Growth of White Bass (*Roccus chrysops*) in TVA Reservoirs.* Gordon E. Hall, TVA. Ages, average growth-rates, and length-weight relationships of this species are presented for 12 reservoirs of the TVA system. Data, based on 1,500 specimens, are discussed with reference to storage and main-stream reservoirs and steam plant basins. The average total length for one-year-old white bass in Tennessee Valley waters is 7.6 inches and for succeeding years 11.5, 14.3, 15.2, 17.0, and 18.1 inches. Corresponding weights at those ages are 0.2, 0.7, 1.4, 1.7, 2.5, and 2.9 pounds respectively. Few live longer than four years. Growth is considerably faster in storage than mainstream impoundments, including associated steam plant basins. Growth in Tennessee Valley waters compares favorably with that in other regions. Management implications are that increased harvest by commercial methods would not be detrimental to populations of this fast-growing, short-lived fish.

Sensory Hairs in Bats. Marion H. Garrett, Siena College. Short hairs with greatly enlarged follicles which are richly supplied with nerve fibers and suspended in vesicles of blood have been found in the face and chin regions in four types of bats: *Antrozus pallidus*, *Myotis lucifugus*, *Lasionycterus noctivagens*, and *Pipistrellus subflavus*. Sudoriferous glands containing prominent myoepithelial cells spiral upward along the sides of the vesicles to the surface of the skin. Small bundles of striated muscle fibers pass upward along the sides of the vesicles and terminate in the skin. Greatly enlarged sebaceous glands are associated with these follicles but never open into them. These hair follicles appear to be specialized to receive stimuli and transmit

nerve impulses, and may play an important part in echolocation.

Localized Contractions in Striated Muscle Fibers. Marion H. Garrett, Siena College. Localized contractions in striated muscle fibers which terminate in the facial skin of bats have been observed in this study. In these areas of contraction the fibers are appreciably thickened, the cross striations become obscure, and the myofibrils are often seen more clearly. As many as three closely-placed areas of contraction have been seen in one fiber. It is possible that waves of contraction passing through muscle fibers may be responsible for muscle tone.

The Effect of Ante-Mortem Injections of Enzyme Preparations on Tenderness of Poultry Meat. O. L. Adams, Miriam M. Abernathy, Miriam G. Towns, and E. J. Thornton, Tennessee Agricultural and Industrial State University. Six trials, involving 56 Rhode Island Red mature hens were conducted to compare the tenderizing effect of enzyme preparations (Papain-100-S, Prolase-EBS-1000 and Prolase-MT-7820) injected into the abdominal cavity and jugular vein. Ante-mortem injections of 10, 15 or 20 milligrams per body weight of enzyme preparations into the abdominal cavity has no significant ($P < 0.05$) effect on tenderness of the breast muscle (Pectoral major) or the thigh muscle (Biceps femoris) as indicated by taste panels and shear force evaluation. In trial II, a significant difference was obtained by the taste panel when 10 milligrams of papain or Prolase EBS 1000 were injected into the jugular vein ($P < 0.05$). However no significant difference was found when Prolase MT07820 was used. There were no differences obtained from the results of the taste panel or shear force evaluation when the birds were slaughtered 4, 6, or 10 minutes after injection. The results of these trials indicate that further study is desirable, using higher concentrations of enzymes and longer periods between injection and slaughtering.

Notes on the Ecology of Sponges. J. Gerald Parchment, Middle Tennessee State University. Possible factors that may be significant in the distribution of the fresh-water sponge, belonging to the genus *Spongilla*, are water color, organic content, and chemicals in solution. An investigation of the chemical-physical conditions of Stone River in Tennessee revealed low water color values for the entire river system (mean value was 35.4 ppm.). Even though the fresh-water sponge, *Spongilla lacustris*, has been associated with high water color and organic content, it was found to be quite abundant at one station. This sponge did not appear at any of the other stations except as gemmules in the plankton.

Effects Produced in Living Cells by the Ruby Laser Microbeam: A Cinematographic Record. Robert L. Amy Southwestern at Memphis and Rainer Storb, University of Washington. KB tissue culture cells, red blood cells, protozoa and spermatozoa have been irradiated with a ruby laser microbeam and a cinematographic record has been made of their reactions. Since non-colored

cells show no visible response to the beam, cells containing no natural pigment were stained, prior to irradiation, with low concentrations of Janus green B. The ruby laser source, which was mounted on a phase-contrast microscope, had an optical pumping system input of 2.6 kv with a rated maximum output of 0.5 joule delivered in 500 microseconds. The energy density of the beam was controlled by a neutral density filter of graded transmittance. The target area of the cell was precisely located before each irradiation by focusing a beam of ordinary visible light, which passed through the same optical path as the laser light, onto the selected region. Under these conditions when the laser was energized, a focused beam of coherent light (wavelength = 6943 Angstroms) approximately 6 micron in diameter was produced at the predetermined spot. Both television and photographic cameras were incorporated into the system so that viewing and photographing were possible at any time during the experiment.

This work was done at the Centre National de Transfusion Sanguine, Paris, France. R.L.A. was supported in part by PHS fellowship (6F3 HD-24, 094-01A1) from the Institute of Child Health and Human Development; R.S. was a NATO fellow.

SIXTEENTH ANNUAL MEETING
OF THE COLLEGIATE DIVISION

TENNESSEE ACADEMY OF SCIENCE

SATURDAY, DECEMBER 11, 9:00 AM.

CENTRAL AUDITORIUM, BUILDING 4500, X-10 AREA

RICHARD J. RARIDON, CHAIRMAN, ORNL

A Preliminary Report on the Vascular Plants of the Land Between the Lakes Park, Tennessee. R. L. Riggs and W. H. Ellis, Austin Peay State College. In June of 1965 a grant was given to the Biology Department of Austin Peay State College by the Tennessee Valley Authority for use in compiling an inventory of the vascular plants, the higher cryptogams, and the herptiles of the 170,000 acre Land Between the Lakes Park. This paper is a progress report on the summer and fall vascular flora. During the summer and fall 478 species were collected, identified, and preserved according to standard herbarium procedures. The species collected were representatives of 94 families and 285 genera. The families with the most representatives were the Compositae with 39 genera and 88 species, and the Gramineae with 23 genera and 42 species. A preliminary checklist has been prepared to serve as a basis for further field work.

Control of Antheridial Formation In Fern Gametophytes. Sara Kaltenborn, The University of Tennessee. Several years ago Döpp, Voeller, and others, reported that a substance produced by fern gametophytes could cause the formation of antheridia by young gametophytes days, or even weeks, earlier than expected in untreated plants. These reports suggested the possibility of research toward two further goals; first, production of antheridia on gametophytes which are

normally sexless, and second, control of the formation of antheridia on normal gametophytes to improve methods of cross-fertilization. In several months of experimentation, we have been able to duplicate some of the results of other workers and to make some discoveries which indicate the complexity of the situation, but we have been unable to achieve either goal. Attempts to inactivate the substance by raising the pH of the medium have been unsuccessful.

A Revised Annotated Check List of the Order Caudata (Amphibia), In Davidson County, Tennessee. Thomas E. Ashton, Belmont College. Six families of the order Caudata with a total of eighteen species and subspecies are included in this revised annotated check list for Davidson County. Range extensions were made, adding two species to this area. A key, compiled by the author, deletes two subspecies, which had been previously reported here. Of the eighteen species and subspecies, one (*Cryptobranchus alleganiensis alleganiensis*) was not collected by the author. In this case, preserved material was used. *Hemidactylium scutatum* and *Pseudotriton montanus montanus* were collected outside of Davidson County, but are included due to records indicating their presence. Distribution in the county is given, denoting in some cases a very sharp range discontinuation at the boundary between the Highland Plateau and Outer Basin. Further ecological study is needed.

Consistency in Axiomatic Systems. Charles G. Morgan, Memphis State University. In general, there are two types of consistency proofs: direct and indirect. Direct proofs of consistency seek to show that a given formula and its negation are both not derivable within a particular formal system. Indirect proofs of consistency involve the interpretation of the formal system to fit assumption that it is impossible for contradictory conditions to exist at the same time. A direct proof for the consistency of the formal system which defines logic has been given by Ernest Nagel and James R. Newman in their book *Gödel's Proof*. However, it may be shown that this proof presupposes the consistency of the system. Nevertheless, by joining the formal logical system to the formal system for a semi-group, the semi-group may be shown to be consistent if the logical system is consistent. The same process may be used to prove larger systems consistent. However, the German mathematician Kurt Gödel has proven that the formal system which defines our ordinary number system cannot be proven within the system to be consistent. In fact, if such a proof were available, then that in itself would be a proof of the inconsistency of the system.

Cutaneous Study of the Dorsal Region in Myotis Lucifugus. Beatrice Chan, Siena College. Slides were prepared of skin from the dorsal region of the *Myotis lucifugus*. Stains used were a triple stain for DNA, proteins and carbohydrates and Holmes' stain for nerve fibers. The skin in this region consists of two main layers, the surface epithelium, or epidermis; and the subjacent connective tissue layer, the dermis. Beneath

the latter is a loose connective tissue layer. Some round structures, about 140 microns in diameter were observed in the epidermis of the dorsal region. These structures appeared to contain several finger-like projections extending toward the structures on the surface of the skin. The projections appeared to be surrounded by nerve fibers and may be cutaneous receptors.

Determination of Aggregation Number by Nuclear Resonance. William J. Busler, Christian Brothers College. Varying amounts of dimethyl formamide (DMF) were added to 0.1 formal solutions of dinonylnaphthalenesulfonic acid (HD), and the position of the peak due to the acid proton on an NMR spectrum was observed in each case. Complexing between the two caused the proton signal to move upfield with increasing concentration of DMF. An equation was derived relating observed frequency to degree of complexing. The equilibrium constant for the complexation was then expressed in terms of known concentrations and the aggregation number of HD. In order to determine the aggregation number, x , test values of x were substituted by computer into the equilibrium expression, and the value of x giving constant K values for all concentrations was adopted as the correct aggregation number. At 35°C, my value was identical with the literature value determined by other methods. Similar

experiments at other temperatures revealed a linear relationship between Centigrade temperature and aggregation number.

Effect of Temperature on Fecundity in Two Species of Parasitic Wasps. Carolyn Ann Crane, Southwestern at Memphis. The reaction of the ectoparasitic wasp *Bracon hebetor* to temperature has been widely studied. However, very little information of this sort is available for a relatively new species, *Bracon serinopae*. Since the two species are closely related, comparative studies should provide data regarding their relative usefulness in experiments. Accordingly, I have investigated the effect of temperature on fecundity. Virgin females, incubated at 25°C, 30°C, 35°C or 40°C, were transferred daily to individual culture cups and each was provided with a freshly stung host. The number of eggs laid in a twenty-four hour period and the number of days each female laid and survived were recorded. Eggs were incubated at each temperature to determine the length of the various phases of the life cycles. Resulting data from the two species were compared at the four temperatures used. In addition, randomly chosen eggs were measured and their sizes were compared.

This work was supported by the National Science Foundation.

NEWS OF TENNESSEE SCIENCE

Dr. A. J. Sharp, professor of botany at the University of Tennessee and president of the Botanical Society of America, has been recently honored as a "Distinguished Service Professor" at U-T.

The honor, which also carries with it an annual salary supplement of \$2,000, was given to Dr. Sharp by President Andrew D. Holt of U-T and announced at the semiannual Board of Trustees meeting last month in Memphis.

Dr. Sharp, an authority on mosses, has conducted research in the United States, including extensive studies in the Great Smoky Mountains National Park, Mexico, Guatemala, and in the Far East and Asian Countries. His most recent research abroad was at the Hattori Botanical Laboratory in Nichinan, Japan, in 1964-65 under a National Science Foundation grant. While in the Far East he conducted field studies in India and the Philippine Islands.

Dr. Sharp received the B.S. degree in botany from Ohio Wesleyan University in 1927, the M.S. in botany from the University of Oklahoma in 1929, and the Ph.D. in botany from Ohio State University in 1938.

The Tennessee Academy of Science has received a grant from the National Science Foundation to support the Collegiate Division of the Academy during the 1966-67 school year. The grant of \$4,670 will be used to help promote scholarship and research among the

undergraduate college students in Tennessee. Specifically, most of the money will be used to defray the expenses of students attending the meetings of the Collegiate Division and presenting papers on their research interests.

The activities of the Collegiate Division are coordinated by the state sponsor, Dr. Richard J. Raridon of the Oak Ridge National Laboratory, and three regional sponsors, Professor Robert G. Ziegler of Lincoln Memorial University, Dr. Robert E. Martin of Tennessee Tech. University, and Brother Carney of Christian Brothers College.

The National Science Foundation has again underwritten a part of the program of the Tennessee Junior Academy of Science. Thirteen grants were made to Junior Academies for 1966-67 to provide travel and subsistence for selected students and their teachers to attend a state-wide meeting at which each student will present a formal paper to an audience of professional scientists who will serve as advisors, critics, and judges. The sponsor for the activities of the Tennessee Junior Academy is John H. Bailey at East Tennessee State University.

Construction of a new biochemical-ultrastructural laboratory including installation of a Philips EM 200 electron microscope and supporting equipment has just been completed at George Peabody College for