Abstracts of Papers Presented at the Sixty-ninth Annual Meeting, Virginia Academy of Science May 21-24, 1991, Virginia Polytechnic Institute and State University, Blacksburg, VA

Aeronautical and Aerospace Sciences

F-18 HIGH ANGLE-OF-ATTACK AERODYNAMICS. Daniel W. Banks, NASA Langley Research Center, Hampton, VA 23665-5225. In order to be more maneuverable, fighter aircraft have the need to operate at high angles of attack. During these high angle-of-attack or post-stall operations, the flow field around the aircraft behaves differently than during conventional flight operations. Aircraft components other than the wing, in particular the forebody, become crucial in determining the overall aerodynamics. This in turn dictates the stability and control of the aircraft and can lead to adverse phenomena such as tail buffet and wing rock. By properly understanding the physics of these flow fields, these adverse phenomena can be solved more readily and future aircraft can be designed more effectively. This paper will present results from wind tunnel and flight tests of the NASA F-18 High-Alpha Research Vehicle (HARV). The F-18 configuration was chosen because of its interesting high-angle-of-attack characteristics, its unrestricted operational angle-of-attack envelope (within weight and center of gravity limits), and the availability of a flight test aircraft and wind tunnel models.

GENERIC HYPERSONIC INLET MODULE ANALYSIS. Charles E. Cockrell, Jr. NASA Langley Research Center, Mail Stop 413, Hampton, Va. 23665-5225. Hypersonic air-breathing aircraft, such as the National Aerospace Plane (NASP) rely on body-mounted, supersonic combustion ramjet (SCRAMJET) propulsion systems. A characteristic of such a design is that the propulsion system must be highly integrated with the airframe, with the entire underside of the aircraft functioning as part of the propulsion system. One issue related to propulsion/airframe integration is the calculation of aerodynamic forces and moments for each engine component. Additionally, it is anticipated that the design of such a vehicle will rely heavily on computational fluid dynamics (CFD), due to the inability of ground test facilities to model all aspects of the full-scale configuration. In the present study, a computational analysis and an internal inlet drag analysis were performed for a generic hypersonic inlet module. The configuration studied models aspects of forebody and inlet flows seen in designs for body-mounted scramjet engines. Viscous and inviscid CFD solutions were obtained for the inlet flow field with solution accuracy assessed by comparison with experimental data. Internal drag force predictions were calculated based on CFD solutions and experimental data with a comparative assessment made of each approach. The results indicate the feasibility of obtaining drag force values computationally, assess the sensitivity of CFD drag predictions to computational methods, and resolve issues relating to the computation of this type of hypersonic flow field.

BRIDGING THE GAP BETWEEN CONCEPTUAL AND PRELIMINARY DESIGN, S. Jayaram*, Mechanical Engineering Department, Va. Polytechnic Inst. & State Univ.,Va. 24061. Computer aided design systems are available for all stages of the aircraft design process – from conceptual design (sizing programs) to detailed final design (final design CAD/CAM systems). Since 1987, the Computer Aided Design Laboratory at Virginia Tech. has been enhancing a well-known aircraft conceptual design system called ACSYNT (AirCraft SYNThesis). ACSYNT is a device-independent, interactive CAD system for parametric aircraft design. This research and development effort has been undertaken in cooperation with NASA-Ames. In 1990, the "ACSYNT Institute" was formed to support this research program. Current members of the ACSYNT Institute include NASA-Lewis, NASA-Langley, U.S. Air Force Academy, China Lake Naval Weapons Center, Lockheed, Northrop, Boeing, G.E. Aircraft Engines, McDonnell Douglas and Defense Group Inc. ACSYNT allows the designer to create aircraft geometry by specifying shape and size parameters for the components (e.g. span, sweep, fineness ratio, etc.). Recent research has concentrated on the creation of curvature continuous surface models of these designs for use in preliminary design systems (e.g. CFD). Research is also being conducted in analyzing surface data generated by preliminary design systems and automatically obtaining the shape parameters for the aircraft components. This presentation describes these research efforts and highlights some of the problems encountered in the attempt to automate the transfer of geometry data between conceptual and preliminary design systems.

AN EVALUATION OF THREE WING PLANFORMS FOR USE ON A SUPERSONIC TRANSPORT. Glenn L. Martin, Lockheed Engineering & Sciences Company, Hampton, Va. 23666. In the past, many difference wing planforms have been studied for use in supersonic flight; however, rarely were they compared in a systematic manner using a specific set of ground rules. A study was conducted to evaluate three wing planforms - trapezoidal, "M", and arrow - for use on a supersonic transport sized to perform a 5500 nautical mile mission with a payload of 250 passengers at a Mach number of 2.0. Geometrically similar trapezoidal and "M" wings on generic bodies were compared to determine the relative merits of each. Further analyses identified wing geometries for these two planforms which satisfied the aerodynamic requirements. The arrow wing geometry was based on recent High Speed Civil Transport studies. Realistic supersonic transport configurations were then developed using the three planforms. From the results of the study, the advantages/disadvantages of each of the concepts were identified in the areas of packaging, aerodynamics, and structures.

FIVE DECADES OF AEROSPACE RESEARCH. M. Leroy Spearman. NASA Langley Research Center, Hampton, Virginia 23665-5225. This being the 50th anniversary of the Virginia Junior Academy of Science it is appropriate to review five decades of aerospace research, particularly as related to the Langley Research Center of NASA and it predecessor NACA . In the early 1940's, airplanes were propeller driven and were generally limited to a top speed of about 400 m.p.h. In the mid-1940's, jet propulsion for airplanes became a reality and the top speeds began to approach 600-700 m.p.h. New shapes began to appear to accommodate the higher speeds and, by 1950, rocket propelled airplanes had broken the transonic sound barrier and supersonic flight had been achieved. During the 1960's, hypersonic flight was achieved with the X-15 and the first flights into space were made - suborbital and orbital, both unmanned and manned. In the 1970's and 1980's many new airplane designs appeared and the space shuttle first flew. Current research is directed toward various advanced systems that include supersonic civil airplanes and hypersonic research airplanes. Many dramatic changes in aerospace research have occurred over the past five decades and only time will tell what changes lie ahead.

THE NASA HIGH-SPEED RESEARCH PROGRAM. Matthew M. Winston,* Langley Research Center, Hampton, Va. 23665-5225. The High-Speed Civil Transport (HSCT), a proposed new generation of supersonic passenger airplane must be environmentally acceptable in terms of community noise, atmospheric pollution, and sonic boom. It must also offer operational economics sufficient to capture a significant segment of the long-range travel market. The NASA High-Speed Research Program is aimed toward finding solutions to the barrier environmental problems and providing the necessary economic enhancements through advanced disciplinary and systems-level research and technology. The first phase of the program is focused on the environment and includes efforts to: (1) predict the effects of engine emissions on stratospheric ozone; (2) determine the feasibility of reducing the production of harmful emissions through engine combustor design; (3) reduce noise to comply with existing regulations; and (4) to predict and reduce the annoyance of sonic booms. Later phases will focus on design considerations for economic enhancement such as advanced materials and structural concepts, advanced propulsion systems, improved high-lift and cruise aerodynamics, and new cockpit and flight management technology. Together with NASA, contributions to this effort are being made by many persons in the airframe and aircraft engine industries, the atmospheric sciences community, the materials industry, and academia.

Agricultural Sciences *(Business Meeting Only)*

Archaeology

PALEO-ETHNOZOOLOGY IN VIRGINIA: HISTORY, RESEARCH POTENTIAL, AND CONTRIBUTIONS. Michael B. Barber, Jefferson National Forest, Roanoke, Va. 24001. The analysis of archaeologically recovered animal bone has an unfortunately short history within the Commonwealth. Although the interest in archaeology and paleontology per se has roots in the Jeffersonian era, the scientific analysis of faunal material for the purpose of obtaining anthropological insight has only a brief history of 20± years. Although it could be argued that the laundry list approach of the 1950s and 1960s offered some information into the distribution of paleo-fauna and prehistoric utilization patterns, it lacked the appropriate anthropological underpinnings which lead to a better understanding of culture process. A compendium of research potentials of the scientific study of faunal material is presented as well as a history of the discipline in Virginia.

PALEOETHNOBOTANY: ANOTHER FACET TO A MULTIDISCIPLINARY ARCHAEOLOGY. Eugene B. Barfield, Jefferson National Forest, Roanoke, Virginia 24001. Although study of plant remains from archaeological sites began in the 19th Century, it wasn't until the 1930's that real interest occurred in the United States. As the basic tenet of archaeology is attempting reconstruction of the dynamics of past cultural systems, knowledge of subsistence practices, through time, are invaluable indicators in helping define social complexity. This paper will trace paleoethnobotanical evidence across the country into Virginia and discuss cultivation, horticulture and spin-offs and effects of horticulture and domestication on social organization in Virginia prehistory.

MOTHER WHO? ENVIRONMENTAL DEGRADATION OF THE NEW WORLD; PALEO, ARCHAIC AND WOODLAND PERIODS. Lori Barfield, Jefferson National Forest, Dept. of Geog., Radford Univ., Radford, Va. 24142. The earliest human occupants of North America degraded their environment in much the same way as do the present inhabitants. At least in part, aboriginal activities were responsible for the extinction od species and significant modification of their environments. Aboriginal populations were continually forced to adapt to the changed environments which they had created. Of necessity, early North American populations changed their subsistence patterns either as a result of depletion of a food source, population pressure, or development of a market economy. When a resource was plentiful enough that population needs were met by reserves in the environment, little thought was given to conservation. When resources were limited through overuse then aboriginals either adapted themselves and/or their environment to new regimes.

THE REWORKING OF ANGLO-ELEMENTS IN AFRICAN PATTERNS ON AMERICAN SOIL: UNDERSTANDING AFRICAN ADAPTATION TO THE PLANTATION SYSTEM. Alison Bell, Dept. of Anthro., Washington & Lee University, Lexington, VA 24450. In examining studies on African-American music, religion and language, the same pattern consistently surfaces: slaves appropriated elements of Anglo-American culture and reinterpreted them according to Old World perceptions. They adopted English words into west African sentence structures, selected parts of Christianity and shaped them to accomodate African religious traditions, and accepted Anglo-American music only to transform it into ancestral forms. The African influence evident in non-material slave culture includes an intensely communal ethic and unification of secular/religious, public/private. These values are apparent in extant African-American material culture, with manifestations ranging from architecture to quilting designs. No reason exists to assume that this method of cultural syncretism and pattern of reworking does not also extend to the archaeological record. The challenge is in learning to recognize it.

ETHNOHISTORIC AND ARCHAEOLOGICAL INTERPRETATIONS OF DESOTO AND JUAN PARDO'S ROUTES. C. Clifford Boyd, Jr., Dept. of Sociology and Anthropology, Radford Univ., Radford, Va. 24142. The expeditions by Hernando de Soto and Juan Pardo into the southeastern portion of North America in the mid-1500s A.D. are some of the best documented early European explorations of this region. This paper evaluates the accuracy of the ethnohistoric documentation and its use in reconstructing the routes of these entradas. Archaeological evidence, in the form of European trade items and other artifacts and their distribution, are also evaluated for what they reveal about the expeditions and the Native American cultures they encountered. Finally, an anthropological perspective is presented for the interpretation of these events.

BIOLOGICAL RELATIONSHIPS OF LATE PREHISTORIC SOCIETIES IN MIDDLE AND EAST TENNESSEE. Donna C. Boyd, Dept. of Sociology and Anthropology, Radford Univ., Radford, Va. 24142. Relationships among three late prehistoric (A.D. 1300-1600) Tennessee societies are reexamined using current biological data from six archaeological sites representing these roughly contemporaneous cultures. Past research has indicated possible close associations between two of these cultures—Mouse Creek and Middle Cumberland—to the exclusion of the third, Dallas. However, more recent and thorough analysis of skeletal remains from these cultures contradicts previous conclusions regarding interrelations among these groups. Multivariate analyses of craniofacial and mandibular dimensions of individuals from these cultures indicates a closer biological relationship between Mouse Creek and Dallas. More recent archaeological and ethnohistoric data from these six sites support these findings.

A TALE OF TWO TAVERNS: A COMPARATIVE ECONOMIC ANALYSIS OF THE WETHERBURN AND SHIELDS TAVERNS. Tanja M. Dickinson, New Horizons Tech. Center, Hampton, Va. 23666. Two excavated tavern sites from the middle of the 18th century in Colonial Williamsburg, Va. were studied to determine the differences in the two taverns in terms of clientele, quality of accomodations, and equipment used. This was accomplished by researching the time, area, and various taverns of the 18th century. Research on various artifacts and artifact identification was also necessary for the comparison of the two establishments. Upon analysis, it is expected that the Wetherburn Tavern was frequented by persons of a higher social and economic status, while Shields catered more to the middle class.

LINKING ARCHEOLOGICAL CULTURES WITH HISTORIC INDIAN GROUPS. Howard A MacCord, Richmond, Va. Assuming cultural conservatism and lacking evidence of movement, we can with confidence trace Indian groups found in Virginia in 1607 back into prehistory, and in some cases as far back as AD 1400. Primary evidence is in ceramics, house and village types, burial traits, and continuity in toolkit technology, materials and styles. Best evidence applies to groups east of the Blue Ridge. For the Patawomeke group, we can demonstrate a migration from the Potomac Piedmont area to the tidewater Potomac around AD 1450. For areas west of the Blue Ridge, late prehistoric cultures are well defined, but no tribal groups are known. Conclusions are based on recent and on-going fieldwork.

ECONOMIC CHANGE AT AN EIGHTEENTH CENTURY PLANTATION. Scott K. Parker and Lynne G. Lewis, Montpelier Res. Ctr., National Trust for Historic Preservation, Montpelier Station, VA 22957. Montpelier, the life-long home of President James Madison in Orange County, Virginia, presents a unique opportunity to study the broad span of Virginia history from the earliest human occupation through the present. Most recently, archaeological research has concentrated on the Madison period of ownership. The plantation was managed by three generations of Madisons, each with its own distinct economic focus. The implications of this will be discussed, with particular emphasis on James Madison, Sr.'s activities as recently revealed through archaeological and documentary research. Of special interest is the shift in the mid-18th century from a tobacco-based to a multi-faceted, entrepreneurial economy. The discovery of a major ironworking industry, operated by African American slaves, as well as other business activities, has shed new light on the understanding of 18th century Piedmont plantation life.

POLLEN, PARASITES, AND PRIVIES: AN ANALYSIS OF AN EARLY EIGHTEENTH-CENTURY PRIVY IN WILLIAMSBURG. Patricia M. Samford, Department of Archaeological Research, Colonial Williamsburg Foundation, Williamsburg, Va. 23187. Recent excavations at Colonial Williamsburg revealed the remains of a privy built, used, and destroyed between 1717 and 1727. In addition to containing household and gunsmithing artifacts from resident John Brush, the privy also revealed large quantities of seeds, pollen, and human parasite egg sacs. The analysis of this material provides information on diet, health, and landscape reconstruction in early eighteenth-century Virginia.

PREHISTORIC ARCHAEOLOGICAL RECORDS OF THE ROANOKE BASS (AMBLOPLITES CAVIFRONS) IN VIRGINIA. Thomas R. Whyte, Dept. of Anthropology, Appalachian State Univ., Boone, NC 28608. The Roanoke bass (Ambloplites cavifrons), once widespread in the Roanoke, Tar, and Neuse River drainages of Virginia and North Carolina, is now rare and, in the Roanoke drainage, nearly extirpated. Archaeological remains of this fish from four late prehistoric sites in Virginia indicate that the species was once more common and widespread and was an important food fish for prehistoric Native Americans residing along the Roanoke River.

THE LATE UNPLEASANTNESS: AN EXAMINATION OF THE ARCHAEOLOGICAL INVENTORY OF CIVIL WAR SITES IN VIRGINIA. J. Mark Wittkofski, Virginia Department of Historic Resources, Richmond, Va. 23219. Until recently, archaeologists have not paid much attention to Civil War archaeological sites. Threats of destruction to these endangered properties have brought about studies by archaeologists throughout the Commonwealth. The Department of Historic Resources has helped lead the effort to protect and preserve the more significant Civil War properties in the state. As part of its program of survey and planning, an assessment was made of the official archaeological inventory of 21,000+ sites to determine the number, type, and nature of Civil War archaeological sites recorded in the files. Presented here, is a brief analysis of this assessment and suggestions for additional research.

Astronomy, Mathematics, and Physics

Efficiency of Blackbody Lamp-Pumped Nd:YAG Laser.[1] Donica Allen* and In H. Hwang*, Dept. of Physics, Hampton Univ., Hampton, Va. 23668. A blackbody pumped Nd:YAG laser system was modeled to determine the optimum pumping condition for the laser system. The efficiency was determined for several blackbody lamp temperatures for three laser materials. Analysis showed the optimum temperature to be about 6000 K for optimum efficiency of the laser system for each material.

1. Work is supported by NASA grant No. NAG 1-1091

DRIFT CHAMBER PERFORMANCE IN A MEDIUM ENERGY PION BEAM. O. K. Baker, R. Carlini*, S. Christo*, B. Kross*, D. Mack*, S. Majewski*, G. Malamud*, A. McCauley*, W. Naing, J. Napolitano*, R. Raney*, A. Weisenberger*, and S. Wood*, Physics Department, Hampton University, Hampton, VA 23668, and Continuous Electron Beam Accelerator Facility, Newport News, VA 23606. Drift chambers are the most commonly used devices for tracking charged particles in intermediate energy nuclear physics experiments. A variety of these chambers will be used at the Continuous Electron Beam Accelerator Facility (CEBAF) for determining charged particle trajectories in electron scattering experiments. We have constructed a prototype of the multiwire drift chambers to be used in the High Momentum Spectrometer (HMS) at CEBAF. This prototype chamber was recently tested in a medium energy ($\approx$ 150 MeV) pion beam with impressive results. An overview of the experimental setup and procedures as well as highlights of the chamber performance will be presented.

THE CONCEPTUAL AND HISTORICAL DEVELOPMENT OF PHYSICAL MODELS AS A TOOL FOR PRESENTING THE PHYSICIST'S STRUGGLE TO UNDERSTAND NATURE TO STUDENTS IN LIBERAL ARTS PHYSICS COURSES. Randall Caton, Jane C. Webb and George R. Webb, Dept. of Physics and Computer Science, Christopher Newport College, Newport News, VA 23606. Helping students grasp the struggle that scientists undergo as they search for models to understand the universe is an important element in a course designed for liberal arts students who are not science majors. We complement the traditional problem-solving and conceptual models with a heavy emphasis on the actual development of the models themselves, talking about the work of individual scientists and of the political and social forces surrounding scientific efforts at model-making. Students are asked to write essays on homework and tests, essays that are more typical of English and history courses. For example, students answer questions such as this one. "Maxwell and Einstein are both associated with radical changes in the model of light. Describe first the model as Maxwell found it, what he concluded, and what Einstein did to the model he inherited from Maxwell. Second, discuss the philosophical positions of Maxwell and Einstein concerning man's position in the universe. Speculate on whether these positions influenced or were influenced by the physicists' models."

ASE OUTPUT FOR SOLAR-PUMPED IODINE LASER.[1] Yong S. Cho* and In H. Hwang*, Dept. of Physics, Hampton Univ., Hampton, Va. 23668. Amplified spontaneous emission (ASE) pulse is obtained from an iodine photodissociation laser amplifier which uses n-C_3F_7I as an active medium and is pumped with a long-pulse solar simulator (full width at half maximum = 1ms). By measuring the population inversion density in the active medium of the amplifier,we have obtained the threshold condition for the ASE. Threshold condition and ASE energy are measured as a function of the flashlamp input energy and of the amplifier length.

1. Work is supported by NASA grant # NAG 1-1091.

A SCHRODINGER SPREADSHEET. Don Chodrow, Dept. of Physics, James Madison Univ., Harrisonburg, Va. 22807. A spreadsheet is used to find the energy eigenvalues and eigenfunctions for the one-dimensional time-independent Schrodinger equation for several potentials of even parity. The spreadsheet's graphing ability is used to help find the eigenvalues and to display the eigenfunctions.

HARD-CORE FLASHLAMP PUMPED UV DYE LASER.[1] Jaeho Choi*, Kwang S. Han*, Dept. of Physics, Hampton Univ., Hampton, Va 23668. A near UV dye laser output was obtained by improving the hard-core flashlamp[2] (HCF) device which has been developed for dye lasers. The electrical discharge in the HCF is initiated by the surface discharge on an alumina insulator. The risetime of the HCF pumping light was ≈1.2 μsec which was fast enough to excite a near UV dye laser. The maximum output energy of the HCF pumped LD 390 dye laser was 67 mJ with argon as a working gas. When xenon gas was used as a working gas, the efficiency of the laser output was 0.1% which was comparable to that of the conventional linear Xe flashlamp. The optimum conditions of the near UV dye laser will be discussed.

1. Work is supported in part by ONR grant # N00014-89-J-1653 and in part by NASA grant # NAG 1-1091.
2. K.S. Han *et. al.*, ILS-V Conf. Bull. APS. 34, 1657 (1989).

A STUDY OF ENERGY TRANSFER(KERMA) OF NEUTRON FOR TISSUE-RESIDENT ELEMENTS. Sang Y. Chun, Dept. of Physics, Old Dominion Univ., Norfolk, VA 23529, John W. Wilson*, and Larry W. Townsend*, NASA Langley Research Center, Hampton, VA 23665. KERMA(Kinetic Energy Released in Matter) values for H, C, N, and O for neutrons of energies from 1 to 100 MeV are studied. There exist two sets of KERMA calculation for light nuclei(A<20) in which the nuclear statistical behavior is inadequate to adopt. One includes neutron energies from 20 to 80 MeV using Intranuclear Cascade Evaporation Code. The other set considered KERMA for thermal neutron using ENDF/B nuclear cross section data. As one of the ongoing data parameterization of nuclear data set for transport code we studied KERMA for tissue-resident elements. To give consistent connection between these two existing data sets, we recalculate KERMA using simple binary collision algorithm. Nonelastic cross sections are adopted from the BRYNTRN(Baryon Transport) computer code and ENDF/B-V nuclear data is used for total cross section of thermal neutron. The results are compared with two existing data sets of KERMA. (This work is supported by NASA grant.)

GAIN STABILIZATION AND MONITORING USING PULSED ULTRAVIOLET LASERS. P. Denholm, K. Giovanetti, C. Hogue and K. Healey. Dept. of Physics, James Madison University. Nitrogen gas discharge lasers emit very short duration bursts of intense ultraviolet radiation. A standard commercially available nitrogen laser can emit 100 μJ of energy in a pulse that has a duration from a few nsec to a few hundred picosec. The wavelength of this radiation, 337 nm, can be used directly to excite optical transitions in plastic scintillator. The ultraviolet radiation therefore produces a similar spectrum to that produced by a charged particle traversing the scintillator. The large amount of available energy, short pulse duration, and the similarity of response of the scintillator to uv light and to charged particles make nitrogen lasers ideal for calibrating and monitoring the time and energy response of detectors that use plastic scintillator. Our experience with gas discharge lasers and their use in calibrating scintillator will be discussed.

PARAMETERIZATION OF OFF-SHELL α - α TRANSITION AMPLITUDE. Rajendra R. Dubey and Govind S. Khandelwal, Dept. of Physics, Old Dominion Univ., Norfolk, VA 23529. Francis A. Cucinotta, NASA Langley Res. Center, Hampton, VA 23665-5225. Using the separable potential model, we consider T-matrix for α - α scattering. The parameters of our model are constrained to phase shift data for the L = 0, 2 and 4 partial wave for the energy range of 0-100 MeV in the lab system. We will use this model to calculate the off-shell amplitude for α - α scattering which is input for a Faddeev model of the ^{12}C ground state. (Supported by the NASA Grant #NCCI-42).

METHODS OF HEAVY ION TRANSPORT STUDIES. Hamidullah Farhat, Dept. of Phys., Old Dominion Univ., Norfolk, Va. 23589, & J. W. Wilson and L. W. Townsend, NASA Langley Research Center, Hampton, Va. 23665-5225. The transport of high energy heavy (HZE) ions through bulk materials is studied with energy dependence of the nuclear cross sections being neglected. The approaches to the problem are both energy dependent and energy independent, where the lower order approximation will be totally energy independent. The first and essential assumption to the energy independent case is the high energy characterization of incident beam. A three term expansion appears to be adequate for most practical applications for which penetration depths are less than 30 g/cm^2 of material. The differential energy flux is found for monoenergetic beams and realistic ion beam spectral distributions. The energy independent case has been solvedto get the total flux and the fluxes of any individual collision terms up to the fourth collision term. An approximate formalism is given to estimate higher order terms.

SERIAL CORRELATION INFORMATION IN RESOURCE OPTIMIZATION MODELS. Lawrence E. Flynn, Dept. of Math., Hampton Univ., Hampton, VA 23668. The explosion of available computational power to apply to hydrological modelling has significantly increased the use of simulation methods (ARIMA, etc.). The basic problems of selecting the physically and economically important characteristics of the historic data to include in such simulation methods remain. The ability to produce and use millions of synthetic flow values in an economic model is spurious unless the proper (relevant) factors are included in the generation of the time series. This talk presents a discussion of a variety of simulation methods based on their relationships with historical data and their compatibility with design and operation optimization models for reservoirs. While the discussion is often based on mathematical analysis, the bottom line should be the ability of a method to work (give good results). Mathematical complexity is not a goal of water resource management.

PHOTODIODES AND THEIR USE AS ULTRAVIOLET RADIATION DETECTORS. C. Hogue, P. Denholm, K. Giovanetti, and K. Healey. Dept. of Physics, James Madison University. Photodiodes have been used to measure both the starting time and the intensity of a pulse of ultraviolet radiation from a gas discharge nitrogen laser. These photodiodes will be incorporated into a laser calibration system that will measure the response of one of the large particle detectors under development for CEBAF, the Continuous Electron Beam Accelerator Facility. The calibration system will consist of a network of optical fibers that distributes pulses of ultraviolet light to various components of the detector. The response of the detector components to a known amount of uv light can be used to calibrate and monitor detector performance. An overview of photodiodes and a description of their use in a detector calibration system will be given.

The Effect of the Buffer Gas Helium on the Vibrational Relaxation of Diatomic Bismuth.[1] Seog S. Jang* and Nelson W. Jalufka*, Dept. of Physics, Hampton Univ., Hampton, Va. 23668. The absorption cross section of the A ← X system of Bi_2, which has a maximum of about $4x10^{-17}$ cm^2, was estimated by measuring the absorption spectrum in the wavelength region 450-650 nm. The fluorescence of Bi_2, excited by a CW Ar^+ laser (514.5 nm) which excites mainly the v"= 4 - v'=19 transition of A ← X system of Bi_2, was measured in the region 480-580 nm at 850°C. The fluorescence of Bi_2 with 3 Torr helium (about 2×10^9 sec^{-1} collision frequency at 850 °C) was recorded. There was no evidence of vibrational energy transfer to adjacent level at a collision frequency of 2×10^9 sec^{-1}. With 15 Torr helium (about 10^{10} sec^{-1} collision frequency at 850°C), the fluorescence disappeared.

1. Work is supported by NASA grants No. NCC 1-137 and NAG 1-1091

ELECTRON TRANSPORT IN THE STOCHASTIC FIELDS OF RFP ZT-40. Myung-Hee Kim* & Alkesh Punjabi, Dept. of Mathematics, Hampton Univ., Hampton, Va 23668. The three basic mechanisms that produce either classical or anomalous transport are: spatial variation of magnetic field strength, spatial variation of electrostatic potential in magnetic surfaces, and the loss of magnetic surfaces. A Monte Carlo code has been written to study transport due to these three mechanisms interacting with collisional effects. The equations of motion are obtained from the canonical drift Hamiltonian, but non-canonical, rectangular coordinates are used to simulate the particles which pass through or are in very close proximity of the magnetic axis. The code has been applied to the reversed field pinch ZT40 . For ZT40 the Bessel function model has been used to represent the magnetic field geometry. The effects of pitch angle scattering, loop voltage, and the break-up of magnetic surfaces resulting from resistive MHD perturbations on the drift particle trajectories are illustrated. The particle diffusion coefficients are obtained for varying amplitudes of resistive MHD perturbations.

NEW VERSIONS OF THE HILLE-YOSIDA THEOREM. Ridgley Lange, Mathematics, Hampton University, Hampton, VA 23668. In some applications it may happen that the classsical one-parameter semigroup theory on Banach space may be inadequate, because the condition of strong continuity of the semigroup may be too stringent for many situations in which we may still like analogs of the classical results. In this talk we present the construction of a new class of weakly continuous semigroups which are not strongly continuous and which depend on the weaker notion of the Pettis (rather than Bochner) integral in Banach spaces. As a result we call these semigroups "weakly Y-integrable" where Y forms a duality with the underlying Banach space and relative to which the weak integral is defined. We give some elementary properties of weakly Y-integrable semigroups; many of these have classical analogs but are now expressed in terms of the "Y-topology." Finally we state an analog of the classical Hille-Yosida theorem, i.e. a theorem giving sufficient (and necessary) conditions that a given operator A generate a weakly Y-integrable semigroup. Comments on the proof will also be given.

UNIVARIATE IMBEDDING OF MULTIVARIATE STATIONARY SEQUENCES. A. G. Miamee, Dept. of Mathematics, Hampton Univ., Hampton, VA 23668. It is shown that any multivariate stationary sequence can be imbedded in a naturally defined univariate stationary sequence.

NUCLEAR FRAGMENTATION STUDIES FOR CMOS SRAM APPLICATIONS. D.M. Ngo, J.W. Wilson, L.M. Townsend, F.A. Cucinotta, G.S. Khandelwal. Dept. of Physics, Old Dominion University, Norfolk, VA 23529. This report is a development of a simulation technique for modeling the energy deposition by energetic protons in modern integrated circuits. Such a technique allows prediction of the Single Event Upsets (SEU) in microelectronic memories which are exposed to the space radiation environment typical of satellite orbits. The mode examines the process of target nucleus fragmentation by energetic protons and their potential effects on microelectronic devices. The model calculations are compared with the pulse-height spectra experiments of the surface barrier detectors measured by McNulty, Farrel and Tucker for thin slabs of silicon exposed to proton beams at various energies.

The SEU experiments for a 16-K CMOS SRAM (16 kilobits complementary metal oxide semiconductor static random access memory) which are 1μm twin tube technology with different feedback resistor values were conducted at NASA-Van de Graff SEU Facility of Brookhaven National Laboratory.

LINEAR POWER SUPPLY DESIGN. Joseph W. Rudmin, Physics Dept., James Madison University, Harrisonburg, Va. Design of the most widely used of all electronic circuits for the last fifty years--the simple regulated linear power supply--is not correctly taught in any text, nor has it been correctly understood, even in the simplest approximations. Design in the usual sense of choosing devices with the correct relevant parameters in order to achieve a final circuit with predictable behavior, is not even possible, since the transformer manufacturers themselves do not specify and do not even usually KNOW the most important parameter--the resistance of the transformer windings. The design technique recommended by modern transformer manufacturers relies on empirical curves published in 1943, which cannot be validly applied. [1] The history and description of the problem, useful models for transformer behehavior, and approaches to its solution, will be presented. [1] O. H. Schade, Proc. IRE 31, pp 341-61 (1943).

NEW TRENDS IN TEACHING INTRODUCTORY PHYSICS. Raymond A. Serway, Dept. of Physics, James Madison University, Harrisonburg, Va. 22807. The purpose of the Introductory University Physics Project (IUPP), which started in 1987, is to examine the calculus-based introductory physics course and to create new models that will be appropriate for classroom use. This presentation will review the guidelines of this program, and the issues addressed by the various working groups in IUPP. The approaches and contents of two model programs developed at Pomona College and the U.S. Air Force Academy will be reviewed. Finally, the author will suggest a Table of Contents for a textbook which could be used in such new approaches (a two-semester course) which emphasizes the "less may be more" theme.

PERFLUORO-T-BUTYL IODIDE AS AN EFFICIENT LASER MEDIUM FOR SOLAR PUMPING IN SPACE. Bagher M. Tabibi*, Abdulaziz M. Gambo, Demetrius D. Venable, Calvin W. Lowe*, Dept. of Physics, Hampton Univ., Hampton, Va 23668, and Ja H. Lee, NASA Langley Research Center, Hampton, Va 23665-5225. A comparative study of laser characteristics of t-C_4F_9I to that of the widely used n-C_3F_7I under closely-simulated-AMO-solar pumping is reported. The closely-simulated-AMO solar spectrum was obtained by using an acetone-water(1:200) filter around the laser tube. The laser output of t-C_4F_9I was measured to be 2.6 to 5 times that of n-C_3F_7I at fill pressures ranging from 60 torr to 5 torr. The higher laser efficiency of t-C_4F_9I resulted mainly from a better solar energy utilization and consequently, a larger photodissociation rate. The iodide t-C_4F_9I has also shown near complete chemical reversibility. (This work was supported by NASA LaRC Advanced Solar Energetics program under grant # NAG-1-1091.)

THE PHOTOELECTRIC EFFECT - AN OLD EXPERIMENT WITH NEW TECHNOLOGY. Matthew A. Willis and Gerald R. Taylor, Jr., Physics Department, James Madison University, Harrisonburg, VA 22807. A Leybold phototube and Keithley 485 picoammeter have been interfaced to a 386-PC computer to automate the photoelectric effect experiment. The phototube is driven directly by D/A (digital to analog) conversion from the computer. Picoampere photo-currents are measured by the Keithley 485 picoammeter and transferred to the computer through an IEEE-488 interface. The data acquisition and control software is written in GW BASIC. Various light sources, mercury, sodium and a HeNe laser, have been used. A description of the experiment, interfacing and data acquisition is presented.

Biology

DEFOLIATION AND PLANT COMPETITION EFFECTS ON CANADA THISTLE AS INFLUENCED BY PRECIPITATION AND FERTILIZERS. B. N. Ang and L. T. Kok. Dept. of Entomology, VPI & SU, Blacksburg, VA 24061. Field studies were conducted on the effects of level of artificial defoliation, frequency of the defoliation, and plant competition from Tall fescue and Crown vetch on Canada thistle. In a wet year (1989), plant competition had the greatest impact on 4 (dry weight of above, and below ground parts, length of roots $\geq$ 3mm in diameter and number of plants produced per original plant) out of 7 parameters measured, while level of defoliation had the greatest impact on the remaining 3 parameters (% nonstructural carbohydrate content, total nonstructural carbohydrate produced and plant height). However, in a dry year (1990) plant competition had the greatest impact on only 2 (dry weight of above ground parts and length of roots $\geq$ 3mm in diameter) out of the 7 parameters, with level of defoliation having the greatest impact on the remaining 5 parameters. Application of P and K fertilizers in a dry year had no apparent impact on all the parameters measured.

GUIDELINES FOR LABORATORY HANDLING AND MANIPULATION OF THE ZEBRA MUSSEL

Joseph R. Bidwell , J.L Farris*, D.S. Cherry*, Dept. of Biology, Virginia Polytechnic Institute and State University, Blacksburg, Va. 24061, & H.E. Kitchel*, Virginia Department of Game and Inland Fisheries, Richmond, Va. 23230.

The zebra mussel, *Dreissena polymorpha*, is an introduced bivalve whose North American range is currently limited to the Great Lakes. Its potential to proliferate, in addition to documented incidents of impact on native fauna and biofouling of municipal and industrial water systems has generated serious concerns. From past experience in developing control methodologies for the Asiatic clam, *Corbicula fluminea*, researchers at Virginia Tech were asked to conduct laboratory research on the sensitivity of *Dreissena* to various biocides, and in 1990 were granted a state permit to obtain the organisms. Specific concern in holding the mussels included the accidental release of veliger larvae in wastewater or through spills, and the removal and release of adult mussels. In accordance with guidelines developed to address these problems, the mussels are kept in a secure, limited access holding facility, with water temperature kept below 12 °C to avoid reproductive activity. Holding water is also regularly checked for the presence of free swimming veligers, while all wastewater and equipment with which the mussels have had contact is both chlorine and heat treated. A continuing census of adult mussels is maintained to track their use and disposition. Early data suggest that control procedures used on *Corbicula* can be applied to the zebra mussel with similar success.

THE RELATION BETWEEN WETLANDS VEGETATION COMMUNITIES AND GROUND WATER INDUCED SALINITY GRADIENTS. John W. Blankenship, William G. Reay and Dr. George M. Simmons, Jr., Dept. of Biology, Va. Polytechnic Inst., Blacksburg, Va. 24061. Wetlands serve a wide variety of ecological functions, and may be characterized by diverse vegetation communities. It has been shown that plant species distribution and complexity, increase with decreasing salinity concentrations. The objective of this study was to investigate plant species distribution and diversity in relation to interstitial salinity concentrations. Research was conducted along a 360 meter transect incorporating oligohaline to euhaline conditions. Plant species number and percent cover were determined by meter squared quadrat. Interstitial pore water was analyzed for salinity with an inductive salinometer. Results indicate a relation between ground water induced salinity gradients and plant species distribution and diversity. (Partially supported by the Va. Div. of Soil and Water Conservation.)

VARIATION IN MICROTINE BIOENERGETIC STRATEGIES AND THE ADAPTIVE CAPACITY OF THE GUT. Becke A. Bogue & T. L. Derting, Dept. of Biol., Hollins Col., Roanoke, Va. 24020. This study investigated gut morphology and its relationship to energy use in Microtus pennsylvanicus and M. pinetorum. Maximum energy utilization rates of M. pennsylvanicus are twice that reported for M. pinetorum. This may be related to species differences in the adaptive capacity of the gut. Adult females of each species were implanted with thyroxine pellets to increase energy demand and compensatory changes in the gut were determined. In both species body mass and dry matter digestibility did not change significantly with increased energy demand. However, digestion rate increased significantly while the turnover time of digesta and the mass of gut contents decreased. In the gut, caecum length and the mass of absorptive tissue increased. The jejunum mucosa dry mass, ileum dry mass, and mucosa:serosa ratio in the jejunum and ileum each increased significantly. In all cases, the gut changes that occurred were greater in M. pennsylvanicus than in M. pinetorum. The greater ability to M. pennsylvanicus to utilize energy resources may, therefore, be partially due to the greater adaptive capacity of their gut.

THE EFFECT OF REMOVAL OR IMPAIRMENT OF THE VOMERONASAL ORGAN ON RECOVERY FROM REPRODUCTIVE INHIBITION OF PRAIRIE DEERMICE FROM LABORATORY POPULATIONS. Tama C. Cathers, E. L. Bradley, Biology Department, Col. of William and Mary; C. J. Wysoki, Monell Chemical Senses Center, Philadelphia, PA; C. R. Terman, Biology Department, Col. of William and Mary, Williamsburg, VA 23185. The vomeronasal organ (VNO) has been implicated in recovery from reproductive inhibition of mice (Peromyscus maniculatus bairdii) from laboratory populations. We investigated the effects of removal of the VNO (VNX) on recovery from reproductive inhibition. In males, VNX significantly ($P<0.05$) decreased recovery, based on testes and seminal vesicle weights, seminiferous tubule cross-sectional areas, and numbers of elongated spermatids per seminiferous tubule. Partial removal of the VNO, termed VNO-impairment, led to recovery intermediate to that of fully VNX and Sham-surgery animals. In females, no significant differences ($P<0.05$) in recovery were found.

(Supported by a William and Mary Minor Grant)

EFFECTS OF AFLATOXIN B_1 IN SEVERAL STRAINS OF *DROSOPHILA MELANOGASTER* AND POSSIBLE CORRELATIONS WITH MITOCHONDRIAL-DNA. Joseph P. Chinnici, and Christopher R. Warren, Dept. of Biol., Box 2012, Va. Commonwealth Univ., Richmond, Va. 23284. Ten natural populations of *Drosophila melanogaster* were sampled from different localities in Virginia, and a collection (Hale and Singh, 1987) of five different worldwide populations of *D. melanogaster* were tested for levels of response to Aflatoxin B_1 (AFB_1) toxicity. Twenty-five eggs from each sample were fed medium containing various concentrations of AFB_1 (0.00, 0.75, 1.50 ppm). The Virginia and worldwide strains demonstrated a variety of responses including a significant decrease in numbers of pupal cases, adults,female and male body length, and increased egg-to-pupal, and egg-to-adult development times with increasing AFB_1 concentrations. Variation in the mitochondrial - DNA (mt-DNA) haplotypes in the worldwide strain populations appears to be a cytoplasmic contributing factor for the differences seen between strains relatively resistant or sensitive to AFB_1. (Supported by grants from the Undergraduate Research Committee of Va. Commonwealth Univ. and the Virginia Academy of Sciences.)

QUANTITATIVE COMPARISON OF IMMUNE SYSTEM COMPONENTS AROUND NORMAL AND RESORBING MOUSE EMBRYOS. G. A. Clarke and A. F. Conway, Dept. of Biol., Randolph-Macon Col., Ashland, Va. 23005 and C. M. Conway, Dept. of Biol., Va. Commonwealth U., Richmond, Va. 23284. CBA/J female mice mated with DBA/2J males were injected i. p. with 0.2 ml of 250 ug/ml poly I:C in PBS or with PBS on day 6 of gestation and sacrificed on day 7, 8, 9, or 10 of gestation. Implantation sites were removed, separated, frozen in hexane chilled with liquid nitrogen, and sectioned at 20 um on a cryostat. Structures stained by immunoperoxidase procedures against macrophages, asialo GM1 (natural killer cell marker), immunoglobulin A (IgA), and immunoglobulin M (IgM) were counted and evaluated by linear regression analysis. Poly I:C injection did not increase the incidence of resorptions detectable by day 10. Phagocytic vacuoles in trophoblastic giant cells (TGCs) stained strongly for IgA, IgG, and IgM and weakly for macrophage markers and asialo GM1. Cells which stained for macrophage markers were observed in TGC vacuoles, indicating phagocytosis of macrophages. Counts of macrophages and natural killer cells were negatively correlated, suggesting an antagonistic relationship. Counts of natural killer cells were also positively correlated with IgA in TGC vacuoles and counts of macrophages were also positively correlated with IgM in TGC vacuoles.

EASTERN CHIPMUNK (Tamias striatus) NESTS, ACTIVITY, AND FOOD HOARDING. Jack A. Cranford, Dept. of Biology, Section of Ecology and Environmental Biology and Museum of Natural History, Virginia Polytechnic Institute and State University, Blacksburg, Virginia. Adult chipmunks exhibit seasonal patterns of body mass changes which can be identified in a well known field population. In order to characterize these mass changes, individual age cohorts must be well know which requires trapping every 14-21 days for 5 or six days. Using body size, mass and the presence of a well developed temporal ridge juveniles and most subadults can be properly assigned to a cohort. Plots of field mass data show that growth rates of fall and spring born animals differ. Burrow systems are extensive often exceeding 900 cm in length and having from 3- 5 chambers for nesting and/or cache storage. Scatter hoards vary by season and by the association distance between burrows. Field hoarding experiments show that hoarding behavior varys with distance to the source, food amount and type, and the presence of conspecifics.

THE EFFECT OF SOCIAL POSITION ON SERUM CORTICOSTERONE IN PRAIRIE DEERMICE (PEROMYSCUS MANICULATUS BAIRDII). Steven H. Crossman, E. L. Bradley, and C. R. Terman, Biology Department, Col. of William and Mary, Williamsburg, VA 23185. Serum corticosterone levels and adrenal and reproductive organ weights were studied in dominant, subordinate, and control mice (Peromyscus maniculatus bairdii. There were no significant differences discovered between dominant and subordinates or among dominants, subordinates, and controls in any of the measured variables: body weight at death, absolute and relative paired seminal vesicle weights, asbsolute and relative paired testes weight, and serum corticosterone levels. These data suggest differences between Peromyscus and Mus.

(Supported by a William and Mary Minor Grant)

ANALYSIS OF METABOLIC REQUIREMENTS FOR PERITHECIAL DEVELOPMENT IN PODOSPORA ANSERINA NIESSL. Melissa Daly and James E. Perham, Dept. of Biology, Randolph-Macon Woman's Col., Lynchburg, Va. 24503. Induction of sexuality in Podospora anserina requires low concentrations of nitrogen compounds and carbohydrates. Follow-up research in this laboratory shows the importance of zinc in the development of the perithecium. Examination of zinc's role in this formation has led to studies of the participation of the divalent anion as an inorganic cofactor in proteolytic reactions. It has been established in the literature that zinc plays an important role in both aminopeptidase and carboxypeptidase activities. The objective of this paper is to evaluate the requirement for zinc and aminopeptidase activity in perithecial development. To meet this objective, hydrolysis of eighteen beta-naphthylamide amino acid substrates was observed to determine the need of zinc as a cofactor. Of the eighteen hydrolytic reactions, only those involving tyrosine beta-naphthylamide and phenylalanine beta-naphthylamide require zinc.

THE EFFECTS OF PREGNANCY ON THERMOREGULATORY BEHAVIOR OF THE VIVIPAROUS LIZARD CHALCIDES OCELLATUS. Elizabeth F. Daut, Dept. of Biol., VPI&SU., Blacksburg, Va. 24061. Selected body temperatures of the scincid lizard Chalcides ocellatus were measured on a thermal gradient during five (two week) observation periods between April and September. Body temperatures of females and males did not differ in April and September. However, body temperatures of females were greater than males by as much as 1°C in June and July when females were pregnant or shortly post-partum. Maintaining high estimated body temperatures while pregnant may enhance the survival of developing embryos. Individuals also exhibited consistent temperature preferences across the entire study period, that is, individuals with relatively high body temperatures in April exhibited relatively high body temperatures in all other periods (Friedman two-way ANOVA by ranks, $P<0.05$).

LEPTINIDAE (COLEOPTERA) IN VIRGINIA. Ralph P. Eckerlin and Harry F. Painter, Natural Sciences Division, Northern Virginia Cmnty. Col., Annandale, VA 22003. The genus Leptinus includes three Nearctic species; Leptinus americanus, L. occidentamericanus, and L. orientamericanus. The latter species is the only one known to be present east of the Mississippi River. Virginia was heretofore represented by only three records; 34 specimens from "mole fur", Culpeper County; 2 "on mole", Montgomery County; and 2 on Scalopus aquaticus, without other data. New state records from Fairfax, Highland and Tazewell Counties, and a new host record from Condylura cristata are presented. With the addition of Condylura, all 5 mole genera present in North America are known to host Leptinus. In our study, 3 of 44 Blarina brevicauda, 1 of 2 Condylura cristata and 1 of 8 Scalopus aquaticus harbored leptinids. The beetles are blind, dorso-ventrally flattened and covered with caudally directed stout hair or setae. Species are differentiated by genitalic characteristics. Morphological and behavioral characteristics suggest a long association with insectivores as ectoparasites or phoronts.

EFFECTS OF CHANGING LAND USE PATTERNS ON BOBWHITE QUAIL HABITAT IN VIRGINIA. Michael L. Fies, Dept. of Game & Inland Fish., Charlottesville, Va. 22901, Irvin L. Keynon, Jr.*, Dept. of Game & Inland Fish., Ashland, Va. 23005, Jack V. Gwynn*, Dept. of Game & Inland Fish., Charlottesville, Va. 22901. Bobwhite quail (Colinus virginianus) populations have been steadily declining in Virginia for at least 50 years. Loss of farmland habitats and changing farm practices are believed to be the primary factors responsible for this decline. The total number and acreage of farms in Virginia has declined substantially since 1920. Many abandoned fields have reverted to forest that is no longer suitable for quail. A rapidly expanding human population now occupies many areas of former quail habitat. The production of diverse mixtures of cereal grains has been replaced by monocultures of soybeans and improved grassland. Cattle production has increased, while the total acreage of pasture land has declined. The intensity of land use on farms has increased dramatically. Changing farm practices such as the removal of fencerows, fall plowing, double cropping, and the increased use of agricultural chemicals have also been detrimental to quail. The fragmentation of remaining habitats has increased the vulnerability of quail to predation and hunter harvest. Quail populations are expected to continue declining if current patterns of land use persist.

THE MESOZOIC VERTEBRATES OF VIRGINIA. **Nicholas C. Fraser, Virginia Museum of Natural History, Martinsville, VA 24112.** **To assess man's impact on modern biota requires an awareness of past extinction events. Mass extinctions have long been recognized in the fossil record. The end Permian extinction was by far the greatest of these and the terminal Cretaceous event is well known for the demise of the dinosaurs. However the exact nature, timing and causes of such events are still disputed. Large scale global extinctions are known to have occurred at the end of the Triassic period. Research on Late Triassic sediments in Virginia is beginning to shed considerable light on global events at this time.**

MORTALITY FACTORS AFFECTING COTESIA GLOMERATA (HYMENOPTERA:BRACONIDAE), A GREGARIOUS PARASITE OF THE IMPORTED CABBAGEWORM. David N. Gaines and L. T. Kok, Dept. of Entomology, Va. Polytechnic Inst. and State Univ., Blacksburg, Va 24061. Cotesia glomerata oviposits multiple eggs into early instar imported cabbageworm larvae, Pieris rapae (Lepidoptera:Pieridae). The resulting parasite larvae consume their host from within, killing it before exiting to spin cocoons in a mass. C. glomerata cocoon masses were collected weekly in 1989 & 90 from field plots of broccoli and cabbage in order to determine the extent of hyperparasitism. The cocoons were held in containers in the laboratory and all exiting parasites and hyperparasites were counted. Several species of hyperparasites emerged, and dead cocoons were dissected to determine the cause of mortality. Total mortality averaged 44.7% in 1989 and 47.7% in 1990. Hyperparasitism accounted for 10.2 and 39.8% for 1989 and 1990, respectively. A large part of mortality could not be attributed to any single factor, but dissections of dead cocoons revealed failed hyperparasitism to be a factor in only 2.3% of total cocoons. Increased incidence of dead cocoons correlates with rainfall, indicating rainfall as a mortality factor. Superparasitism may also be a factor because higher numbers of dead cocoons were seen in large cocoon masses.

LIFE HISTORY CHARACTERISTICS OF BOYERIA VINOSA (ODONATA:AESHNIDAE) IN A SOUTHWESTERN VIRGINIA MOUNTAIN STREAM. G. H. Galbreath and A. C. Hendricks, Dept. of Biol., VPI&SU, Blacksburg, Va. 24061. Boyeria vinosa were univoltine at the study site on Chestnut Creek Virginia. Development was rapid during the early instars (Jul-Aug) while most weight gain occurred during the final instars (Sep-May). Gut content analysis was used to determine prey preference by comparing the prey consumed with available prey present in the environment over a three year period (1988-90). Prey was selected in roughly the same proportions as they occurred in the environment with Trichoptera, Diptera, and Ephemeroptera larvae comprising the majority of the diet. Ephemeroptera were preferentially selected when abundant. Although Oligochaete abundance was high, B. vinosa did not utilize this prey item. Our data indicate prey activity, microhabitat selection, and seasonal abundance are all important in determining prey preference of B. vinosa.

LAND-USE CHANGES IN SOUTHERN VIRGINIA PIEDMONT, 1917 TO PRESENT. Stanley R. Gemborys & Anne C. Lund, Dept. of Biology, Hampden-Sydney College, Hampden-Sydney, VA 23943. A knowledge of the magnitude of changes in land-use is essential in order to properly evaluate the current composition of our ecosystems and to understand the patterns of development they will follow in the future. We are all familiar with the classical old field-pine-hardwood successional scheme observed in the southern Virginia Piedmont but many of us have limited quantitative knowledge of the area occupied by each of these vegetation types and the dynamic changes they have taken over time. This study deals with the changes in land-use and physiognomy that have taken place near Hampden-Sydney College and in the Appomattox Court House National Historical Park. The land located where Hampden-Sydney College now stands and the surrounding area has been subject to environmental manipulations since at least before 1776, the founding date of the College. The Appomattox Court House area has been inhabited since the late 1700's. Since then, the human population of these areas has changed dramatically. Land uses have also changed significantly. Information developed in this study is based on photo interpretation and measurements of aerial photographs supplied by the Soil Conservation Service of the United States Department of Agriculture. These photos were flown in 1937, 1949, 1972, and 1980 (Hampden-Sydney) and 1937, 1949, 1970, and 1984 (Appomattox). Based on the 1937 photographs and a knowledge of successional patterns, we were able to confidently predict the composition of stands in existence in 1917. Forested land increased from about 40 percent coverage in 1937 to over 90 percent in the mid-1980's, with a corresponding decrease in open land.

TERRESTRIAL MAMMALS OF VIRGINIA: TRENDS IN DISTRIBUTION AND DIVERSITY. Charles O. Handley, Jr. Smithsonian Institution, Washington, DC 20560. The present mammal fauna of Virginia formed during the post-Pleistocene warming trend. Indians had little impact on the fauna, but European introduction of firearms led to terminal exploitation of bison and elk and to deliberate extirpation of large predators. Logging, clearing for agriculture, and urbanization had a negative impact on some forest species and brought gains for some open country species. The present era of conservation attempts to maintain diversity and to stabilize the fauna through protection, restoration, and management. Predictable future threats to mammals are from pressure of an expanding human population, global warming, and severe environmental perturbations such as acid rain and infestations of gypsy moths. Future challenges include maintaining large roadless and relatively trailless wild areas connected by forest corridors, establishing more and larger refuges to protect non-threatened as well as relict flora and fauna, acquiring fundamental knowledge of natural history of all species as a primary management tool, maintaining diversity and ecological equilibrium, and creating an informed and environmentally responsible citizenry through education and public relations.

SUCCESSION AND HUMAN IMPACT EFFECTS ON HABITAT INFLUENCE ABUNDANCE AND SPECIES COMPOSITION--CASE HISTORIES WITH TIGER BEETLES. C. Barry Knisley, Dept. of Biol., Randolph-Macon Col., Ashland, VA. 23005 and James M. Hill, MD National Capital Park, 8000 Meadowbrook Rd, Chevy Chase, MD 20815. Tiger beetles occur in open habitats with bare soil and sunlight. Most species are highly habitat specific. Some Virginia species have probably been extirpated because of habitat disturbance or loss. Other species suffer local extirpation as habitats change through natural processes. Cicindela dorsalis media is abundant in sandy beach habitats of most of Virginia barrier islands, but on Assateague Island is limited to a few portions where ORV and pedestrian foot traffic are low. C. dorsalis dorsalis is common in many Chesapeake Bay beaches in Virginia but has been extirpated from most of the northeast where human impacts have been more severe. Cicindela abdominalis has apparently disappeared from the Zuni pine barrens because of increased density of vegetation caused by fire suppression. The natural succession at a borrow pit in Hanover Co. from an unvegetated open, wet flat to a dense pine woodland over a 10-year period resulted in the disappearance of Cicindela repanda, a riparian species, and changing abundance of C. sexguttata, a woodland edge species, and C. tranquebarica.

POPULATION DYNAMICS OF HOUSE MICE AND MEADOW VOLES ON A DREDGE DISPOSAL SITE. Georgia E. Kratimenos* and Robert K. Rose, Dept. of Biol., Old Dominion Univ., Norfolk, Va. 23529. A tag-and-release study was conducted for one year on Craney Island, a dredge disposal site in Portsmouth, Virginia. Craney Island provides good habitat for a feral population of Mus musculus because it is a highly disturbed area. A grid (.7 ha) was established with Fitch-live traps placed at trap stations at 10-m intervals. Animals were tagged with numbered metal ear tags. Seven species of small mammals were captured of which 65% were Mus musculus and 28% were Microtus pennsylvanicus. On average house mice were captured only twice, while meadow voles were captured three times. No significant differences from a 1:1 ratio were found for house mice; meadow voles had a significant difference (p=.05) in the sexes from a 1:1 ratio in two months of the study and in the total number of captured and tagged individuals. There were more males than females in all cases. Greatest densities for house mice occurred in November 1989, peaking at 104 individuals/ha; meadow voles peaked at 41 individuals/ha in the early fall 1990. Meadow voles were found to breed late into the winter months and then early in the spring, where house mice did not breed during the winter and began breeding later in the spring than the meadow voles.

HUMAN IMPACTS ON BARRIER ISLAND PIPING PLOVERS. John P. Loegering and James D. Fraser. Dept. of Fisheries and Wildlife, Va. Polytechnic Inst. and State Univ., Blacksburg, Va 24061-0321.

The Piping Plover (*Charadrius melodus*) is a small sand-colored shorebird. It has been listed as threatened throughout most of its range, including the Atlantic coast population, since 1986. Predation and human impacts appear to be affecting population levels. Commercial and residential development cause habitat loss. Breeding habitat may also be altered by projects to protect such development such as dune building, dune stabilization, and beach revegetation. Heavy beach use by recreationists can lower reproductive success by disturbing plovers or excluding them from prime foraging areas. Off-Road-Vehicle traffic causes direct mortality on chicks and eggs, and also disturbs adult and young plovers. Breakwater and jetty constructions that prevent natural overwashing reduce the maintenance and creation of nesting habitat. Future development and recreational activities will need to be managed to minimize conflicts with this sensitive species.

EFFECTS OF ADOLESCENT PHENOBARBITAL TREATMENT ON THE MICROANATOMY OF THE CEREBELLAR CORTEX OF MICE. E. A. Martin, P. L. Dementi and A. F. Conway, Dept. of Biol., Randolph-Macon Col., Ashland, Va. 23005. Fifteen one month old female CD-1 mice received 0.165 mg/L phenobarbital in their drinking water for two months while 15 controls received plain water. The cerebellum was fixed by perfusion and embedded in glycol methacrylate. Sagittal sections taken from 1 mm to the right of the mid-sagittal plane were stained with Azure A and Eosin B. Cell counts from the granular, Purkinje, and molecular layers at the deep, middle, and outer areas were sampled on Folium IV (ventral surface), Folium V (dorsal surface), and Folium IX (dorsal surface). No pattern of damage was common to all areas sampled, but significant differences (t-test) in Golgi neuron, granule cell, Purkinje neuron, stellate neuron, oligodendroglial, and microglial populations occurred in specific areas, most often in the outer region of the folia. These results suggest a site-specific rather than a cell-specific pattern of histological damage caused by adolescent administration of phenobarbital.

BENZODIAZEPINES, MAO INHIBITORS AND TRICYCLICS: Determining positive chemotaxis and increased IL-1β production by P338D_1 cells. Rebecca S. McHugh* and Rosemary Barra, Dept. of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. The chemotactic effects of four psychopharmaceutical agents on macrophage-monocyte cultures (P388D_1 cell line) were measured by three different assays, Transwell chambers, Blindwell chambers and Agar diffusion tubes. All three indicated a stimulatory effect from the drugs compared to the control.

Both the blindwell and the transwell chambers showed similar results, with Valium having the more potent effect and the greatest effect at 10^{-8} percent concentration. Tofranil, Zantac and Librium all indicated increased chemotactic effects, Librium having the least stimulation and Tofranil and Zantac having greater effects at higher concentrations.

In the agar diffusion tubes the exact concentrations of the drugs could not be determined in each section, however, this technique does demonstrate significant cellular migration. All the drugs tested had increased migratory effects compared to the control. Although chemotaxis was an apparent property of these drugs, increased secretion of Il-1β by the cells was not detected.

WHITE-TAILED DEER AS KEYSTONE SPECIES WITHIN FOREST HABITATS OF VIRGINIA. William J. McShea and John Rappole, National Zoological Park, Conservation and Research Center, Front Royal, VA. 22630. Two potential pathways by which deer may influence the abundance and distribution of other vertebrate species are, first, directly by competing for limited resources; and second, indirectly by altering habitat features. If deer have a significant impact on forest habitats, evidence for direct competition may be consumption of mast by deer, and evidence for habitat alteration may be reduced densities of understory vegetation. Both mast crops and understory vegetation are limiting factors within forest habitats, as preliminary data indicate small mammal densities in the spring are limited by the size of the mast crop the previous autumn and the composition of the understory bird community is correlated with the density of understory vegetation. The select exclosure of deer from 4 of 8 study areas within the Shenandoah National Park and the Conservation and Research Center will allow deer impacts along both these pathways to be assessed.

LENGTH AND BREADTH OF EGGS OF GLOBODERA TABACUM VIRGINIAE AND G. T. SOLANACEARUM. L. I. Miller*, Dept. of Plant Path., Phys. and Weed Sci., VPI & SU, Blacksburg, VA 24061. Comparisons were made of the lenght (L) and breadth (B) of unsegmented eggs (EUS) and eggs with second-stage juveniles (EJ2) from cysts of type locality isolates of Globodera tabacum virginiae (N1) and G. t. solanacearum (N2) cultured on Solanum carolinense (P1) and 'VA 312' tobacco (P2). P1 and P2 were efficient hosts for N1 and N2. Mean dimensions in μm of 125 specimens were as follows – L EUS: N1P1 963.7, N2P1 921.9, N1P2 939.0, N2P2 923.4; L EJ2: N1P1 981.9, N2P1 932.6, N1P2 958.6, N2P2 943.5; B EUS: N1P1 412.4, N2P1 425.1, N1P2 417.2, N2P2 430.3; B EJ2: N1P1 414.9, N2P1 428.4, N1P2 413.2, N2P2 434.9. Comparisons between the subspecies on P1 and P2 were significantly different (P=0.05) for the B EUS, B EJ2, L EUS and L EJ2 dimensions, except that dimensions for L EJ2 of N1 and N2 on P2 were not significantly different. Dimensions of L EUS and L EJ2 for N2 on P1 and P2 were not significantly different but dimensions were significantly greater (P=0.05) for N1 on P1 of L EUS and L EJ2 than on P2. Dimensions of B EUS and B EJ2 for N1 on P1 and P2 and of B EUS for N2 on P1 and P2 were not significantly different. Dimensions for B EJ2 were greater (P=0.05) for N2 on P2 than on P1.

MORPHOLOGICAL COMPARISONS OF THE CYST PERINEAL REGION AND GRANEK'S RATIOS OF GLOBODERA TABACUM VIRGINIAE AND G. T. SOLANACEARUM. L. I. Miller*, Dept. of Plant Path., Phys. and Weed Sci., VPI & SU, Blacksburg, VA 24061. Comparisons were made of the perineal region from cysts of type locality isolates of Globodera tabacum virginiae (N1) and G. t. solanacearum (N2) cultured on Solanum carolinense (P1) and 'VA 312' tobacco (P2). Mean dimensions in μm or ratio values of 125 specimens were as follows– width of vulval fenestra (W) : N1P1 18.2, N2P1 21.0, N1P2 16.4, N2P2 20.3; fenestral length (L): N1P1 19.7, N2P1 23.7, N1P2 19.1, N2P2 24.9; diameter of fenestra (W+L/2=D): N1P1 18.7, N2P1 22.6, N1P2 17.8, N2P2 22.6; anus to fenestra (B): N1P1 52.1, N2P1 47.9, N1P2 48.3, N2P2 51.1; Granek's ratio (B/D): N1P1 2.8, N2P1 2.2, N1P2 2.8, N2P2 2.3. Comparisons between the subspecies on P1 or P2 were significantly different (P=0.01) for the W, L, and D dimensions and B/D ratios but not for the B dimensions. Dimensions of W for N1 and N2 were greater on P1 than on P2 (P=0.05). The L dimensions for N1 were not significantly different on P1 or P2 but dimensions for N2 on P2 were greater than on P1 (P=0.01). The B/D ratios within nematode subspecies on P1 and P2 were not significantly different.

FREE-RANGING DOMESTIC CAT PREDATION ON NATIVE VERTEBRATES IN RURAL AND URBAN VIRGINIA. Joseph C. Mitchell, Dept. of Biology, University of Richmond, Richmond, VA 23173, & Ruth A. Beck, Dept. of Biology, College of William and Mary, Williamsburg, VA 23185. Imported into the United States in the early 1800s to control rodents in eastern cities, domestic cats (Felis catus) have become major predators of native vertebrates. We studied the diversity and seasonality of cat predation on native Virginia vertebrates in a rural environment July 1989 - November 1990 and in an urban environment January - November 1990. A total of 30 species (8 of birds, 2 amphibians, 10 reptiles, 10 mammals) were captured by a single rural cat. One was a mammal of special concern (star-nosed mole). Four urban cats captured 21 species (6 birds, 7 reptiles, 8 mammals). Mean number of individuals caught per cat Jan.- Nov. 1990 was 26.0 in the urban area; the rural cat caught 83 during this time. Extrapolation of the number of native vertebrates killed annually by all free-ranging cats reveals a large, but unrecognized and under studied, negative impact on the biota of the Virginia landscape.

HYDROPONIC VEGETABLE PRODUCTION USING FISH POND EFFLUENT WATER. Scott H. Newton & Jimmy Mullins, Va. Coop. Ext. Service, Va. State Univ., Petersburg, Va. 23803. Dwarf cherry tomatoes were produced hydroponically in a greenhouse using fish ponds as a source of water and nutrients in a production trial. Two groups of tomato plants were grown side-by-side in an experimental size greenhouse (75 ft. x 14 ft.) on Randolph Farm at Va. State Univ. One side of the greenhouse had plants which received the normal nutrient supplementation of fertilizers to produce maximum fruit yield. The other group of plants received only water from ponds which were being used to produce market size hybrid striped bass. Virginia State Univ. fish ponds are filled by pumping water from the Appomattox River. Raw river water is fairly representative of many ponds in Va., which are typically low in alkalinity and total hardness, but normal with regard to pH ranges. Tomato yield from plants that received pond water was 30% higher than from plants which received commercial fertilizer supplements. It appears that many Va. farm ponds may be used as a source of water for irrigation or hydroponics.

IMMUNOLOGICAL RESPONSES OF FISHES TO GLOCHIDIA OF FRESHWATER MUSSELS. Martin T. O'Connell, Dept. of Fisheries and Wildlife, Va. Polytechnic Inst., Blacksburg, Va., 24061-0321, & R.J. Neves, Va. Cooperative Fish and Wildlife Res. Unit, Blacksburg, Va., 24061-0321. The larval forms (glochidia) of most freshwater mussel species are obligate parasites to specific fish species. The immunological aspects of the host fish-glochidia interaction were studied using the Alabama rainbow mussel (Villosa iris) as the source of glochidia; host species was the rock bass (Ambloplites rupestris) and non-host fishes were common carp (Cyprinus carpio) and goldfish (Carassius auratatus). Ouchterlony double-diffusion tests showed that both the host and non-host species expressed a specific humoral response to glochidial antigens after being artificially infested with the parasites. Further microagglutination tests were completed to compare titers of host and non-host fishes which were either uninfested, infested, or reinfested with glochidia. These tests showed that host and non-host species exhibit humoral responses of similar strengths to glochidia. In addition, fishes infested with glochidia had higher titers than uninfested fishes, and reinfested fishes had higher titers than both uninfested and infested fishes. This indicates that fishes express anamnestic responses to glochidia. (Supported by the Va. Dept. of Game and Inland Fisheries)

SMALL MAMMAL DIVERSITY IN HARDWOOD FOREST AND CLEARCUT HABITATS IN THE VIRGINIA PIEDMONT. John F. Pagels, Sandra Y. Erdle, and Kristen L. Uthus, Dept. of Biol., Va. Commonwealth Univ., Richmond, VA 23284; & Joseph C. Mitchell, Dept. of Biol., Univ. of Richmond, Richmond, VA 23173. In Cumberland County, 753 small mammals were captured representing 17 species. Captures included the uncommon Condylura cristata, and Oryzomys palustris, a species more at home in wetlands farther to the east. The most common species captured were Peromyscus leucopus, Zapus hudsonius, Cryptotis parva, Reithrodontomys humulis and Sorex longirostris. Diversity (H') was higher in the clearcuts, and overall captures were twice as great in the clearcuts as in the forest. Habitat generalists and edge/old field forms represented 64% and 33%, respectively, of the total captures in the forested habitats. In the clearcuts, however, the opposite was found: 61% were edge/old field forms, and 38% were generalists. Except for incidental captures, only Ochrotomys nuttalli and Sigmodon hispidus were confined to a given habitat type, i.e., the clearcuts. Other edge/old field forms, among them C. parva, R. humulis and Microtus pennsylvanicus, although captured in greater numbers in clearcuts, were also captured in the forested habitats, which indicates their ability to inhabit/move through less than desirable habitat when corridors of preferred habitat are not present.

THE EFFECTS OF HABITAT FRAGMENTATION AND LOSS ON DISMAL SWAMP MAMMALS. Robert K. Rose, Dept of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266.

In the 1890's, five new species of small mammals were described from the Great Dismal Swamp of Virginia and North Carolina. Since relegated to subspecies status, these taxa seem to have developed during the Holocene in association with the emergence of the Dismal Swamp. The Dismal Swamp, a forested wetland with a mosaic of vegetation types, formerly extended from the Chesapeake Bay to the Albemarle Sound but has been shrinking since the 18th Century due to efforts to drain the land for cultivation. More recently, much of the historic Dismal Swamp has been fragmented into subdivisions and industrial parks, and although more than 40,000 ha has been placed in a national wildlife refuge, habitat loss continues there through biological succession. Thus, the distinctive taxa of the region confront habitat loss via destruction, succession, or fragmentation, and for some, interbreeding with upland subspecies.

ONTOGENETIC CHANGES IN MICROHABITAT USE BY AGE-0 SMALLMOUTH BASS. Matthew J. Sabo & Donald J. Orth, Dept. of Fish. and Wild. Sci., Va. Polytechnic Inst. and St. Univ., Blacksburg, Va. 24061. Microhabitat use of age-0 smallmouth bass (Micropterus dolomieui) in the North Anna River, Virginia, was recorded throughout the period from May to August 1990. Larval smallmouth bass were initially restricted to microhabitats available within a defined brood site which was defended by an adult male. Dispersal habitats contained significantly lower mean water column velocities and more large cover than was available in brood sites. Larvae were more frequently observed occupying the entire water column in the dispersal habitats than in brood sites. As the summer progressed, age-0 bass continually moved into shallower habitats. Juveniles longer than 30 mm occupied habitats with higher mean water column velocities than 15 mm larvae occupied, and juveniles occupied higher nose velocities in August than they previously had occupied in July. Because availability of microhabitats did not change over the summer, we suspect that changes in microhabitat use were associated with predator avoidance behavior or changes in foraging tactics.

EFFECTS OF AERATION ON PRODUCTION OF HYBRID STRIPED BASS IN EARTHEN PONDS. Ephraim R. Seidman* & Scott H. Newton, Va. Coop. Ext. Service, Va. State Univ., Petersburg, Va. 23803. Aeration in fish ponds permits higher stocking rates, reduces water needs, and diminishes risk of mortality due to low dissolved oxygen levels. Phase II hybrid striped bass production trials have been completed without aeration at stocking rates of 20,000 and 40,000 fish/ha at Va. State Univ. In 1990, juvenile hybrid striped bass (mean weight 425 mg) were stocked at 60,000/ha in six 1,000 m^2 earthen ponds. Aspirator-propeller 1 HP aerators were placed in three ponds and operated daily from approximately 1700 to 0800 hrs. Growth rate and harvest weight in aerated ponds were greater than in non-aerated ponds. Mean growth rates were 0.69 and 0.40 g/day and mean harvest weights were 96.9 and 56.0 g for aerated and non-aerated ponds, respectively. Average gross pond production was greater (2,961 kg/ha) in aerated than in non-aerated ponds (2,215 kg/ha), although average survival was higher for non-aerated (67%) versus aerated ponds (52%). Mean Food Conversion Ratios were 1.47 and 1.63 for aerated and non-aerated ponds, respectively. These data suggest that production can be improved with the use of aerators when hybrid striped bass are cultured at 60,000/ha.

PHYLOGENETIC RELATIONSHIPS IN THE PROSIMIAN GENUS *EULEMUR* BASED ON A STUDY OF METACHROMISM. Douglas H. Shedd, Dept. of Biol., Randolph-Macon Woman's Col., Lynchburg, Va. 24503, & Joseph M. Macedonia*, Dept. of Zool., Univ. of California, Davis, Ca. 95616. The principle of geographic metachromism proposes that irreversible changes in the melanin banding patterns of hairs can be used to assess phylogenetic affinties among closely-related mammalian taxa. This study investigates metachromism in the genus *Eulemur*, using hair samples from animals at the Duke University Primate Center. Data gathered included the number of melanin bands present in hairs from species and subspecies comprising this genus, supplemented by information on melanin bandwidth, facial coloration, and hypertrichy. Our results support some existing phylogenies for the genus, but do not support the widely held belief that *E. f. fulvus* is ancestral to the entire genus.

THE IMPACT OF HUMAN ACTIVITIES ON THE UPLAND FORESTS OF WESTERN VIRGINIA. S. L. Stephenson, Dept. of Biology, Fairmont State Col., Fairmont, WV 26554, H. S. Adams, D. S. Lancaster Cmnty. Col., Clifton Forge, VA 24422, and M. L. Lipford,Virginia Natural Heritage Program, Richmond, VA 23219. Forest communities dominated by such species as red oak (Quercus rubra), chestnut oak (Q. prinus), white oak (Q. alba), and red maple (Acer rubrum) still cover large areas in the mountains of western Virginia. Although various human activities (e.g., lumbering operations, fires, and the clearing of land for agriculture) have had an impact upon these forest communities, the very limited data available from surveyor's records and other early accounts at least suggest that present-day forests are compositionally fairly similar to presettlement forests. Indeed, the most important change in composition that seems to have occurred is the almost complete elimination (at least from the forest canopy) of the American chestnut (Castanea dentata) by the chestnut blight. Prior to the blight, which was introduced into North America at the beginning of this century, chestnut was one of the most abundant trees in the upland forests of the mid-Appalachians. However, the potential for even greater change would seem to exist as a result of the spread of the gypsy moth (Lymantria dispar) into western Virginia, since oaks are among the tree species most susceptible to defoliation by this introduced insect pest.

CONTROLLED SPAWNING OF THE MARGINED MADTOM AND WHITETAIL SHINER. Joseph N. Stoeckel and Richard J. Neves, Virginia Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, Va. 24061. The margined madtom and whitetail shiner were used as surrogates in experiments to develop spawning techniques for the federally threatened and closely related yellowfin madtom and turquoise shiner. Experiments to induce spawning naturally or with injections of luteinizing hormone releasing hormone analogue (LHRHa) + pimozide administered over an extended period were unsuccessful. Females failed to ovulate and aggression of whitetail shiner males often resulted in mortality of other whitetail shiners. Hormone injections immediately after capture can induce ovulation in whitetail shiner females. Greater than 20% of whitetail shiner females ovulated following injections of LHRHa + domperidone (dom), human chorionic gonadotropin (hCG) + carp pituitary extract (CPE), or injections of LHRHa + dom followed by hCG + CPE. Higher fertilization rates were obtained with domesticated fish than wild fish, and when spawning occurred within twenty-four hours following 2 hormonal injections. Large tanks are requisite to holding whitetail shiners in captivity. Maturation, but not ovulation, of margined madtom ova was achieved following injections of either LHRHa + dom or hCG + CPE. Motile sperm was not observed in margined madtom males. Satisfactory ovarian development in captive fish was achieved with a diet of commercial flake food for whitetail shiners, and self-manufactured moist pellet for margined madtoms. (Supported by the US Fish and Wildlife Service and the Virginia Department of Game and and Inland Fisheries).

HISTOCHEMICAL LOCALIZATION OF HYALURONIC ACID DURING EARLY CHICK ORGANOGENESIS. John K. Stratmann, and Carolyn M. Conway, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284, Chick embryos were obtained at various stages of development (72, 96, and 120 hrs), fixed, embedded in glycol methacrylate, and sectioned at 3 um. A biotinylated probe specific for hyaluronic acid (followed by strepavidin-peroxidase complex) was used to localize regions of the embryos containing free hyaluronate. A number of parameters including method of fixation, embedding medium used, probe concentration, and incubation temperature and time, enzymatic digestion of sections, and strepavidin-peroxidase concentration and incubation time. These modifications were compared to see which permitted the greatest penetration of the probe, thus allowing satisfactory staining and identification of the extracellular regions containing hyaluronic acid. The very best staining resulted from fixation using the AMeX method, embedding in Immuno-Bed , incubation with probe at 37°C, and increased strepavidin-peroxidase concentration. Using this technique, hyaluronic acid was localized in a variety of regions throughout the developing embryo. In some areas, there was no staining whatsoever while other areas differed from diffuse background staining to heavy localized staining. The regions that had the most interesting staining patterns were the developing heart, chondrocytes, and mesenchyme in the region of the developing brain. These regions also seemed to vary in staining pattern and intensity for the different developmental stages observed. Our results support the theory that each cell's contribution to the extracellular matrix is different and that the changing extracellular environment may be guiding the development of cells into different tissues and organs.

REDUCTION OF REPRODUCTION AT VARYING DENSITIES IN NATURAL POPULATIONS OF WHITE-FOOTED MICE (PEROMYSCUS LEUCOPCUS NOVEBORACENSIS). C. R. Terman, Lab. of Endo & Pop. Ecol., Biology Dept., Col. of William and Mary, Williamsburg, Va. 23185. White-footed mice on an 11 ha area were studied monthly with 600 live traps and 254 nest boxes from 1983-1989. Location, sex, age, body weight, and reproductive condition of individual animals were recorded. Data from nest boxes were consistent with those from trapping, but rarely did more than 40% of the population occur in the nest boxes and use declined to less than 10% of the population during the summer. Trappability was greater than 90%. The number of adults varied from 22.9/ha in March 1983 to 0.3/ha in November 1984. Significantly more males than females were captured during the study. In 58 of 72 months, a smaller % of males than females was reproductively mature. The proportion of adults reproductive during May, June, and July was significantly lower than during February - April and August - October. Factors producing this significant retardation of reproduction are unknown. (Supported by a William and Mary Faculty Summer Research Grant and by the Thomas F. and Kate Miller Jeffress Memorial Trust.

EFFECTS OF LOW-INTENSITY URBAN DEVELOPMENT ON THE STRUCTURE AND FUNCTION OF A STREAM FISH ASSEMBLAGE. L. Alan Weaver & Greg C. Garman, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284. The recent effects of increased imperviousness of the watershed, removal of riparian vegetation, and stream channel modification on a Piedmont stream fish assemblage were assessed in Tuckahoe Creek, Va. Data collected in 1958 prior to extensive watershed disturbance allowed for the testing of several hypotheses concerning the ecological effects of low-intensity urban development. Total fish species richness declined from 31 in 1958 to 26 in 1990. The number of species lost from each of six sites ranged from two to 11. Bluegill (Lepomis machrochirus) replaced johnny darter (Etheostoma nigrum) as the numerically dominant species (all sites). Other hypothesized taxonomic shifts were documented for the period between 1958 and 1990. The diets of four selected species (bluegill, johnny darter, common shiner (Notropis cornutus, & bluehead chub (Nocomis leptocephalus) were evaluated for changes in composition, niche breadth, and utilization of terrestrial arthropods. Terrestrial prey comprised 5.3% of the bluegill diet (all sites) in 1958 which increased to 9.1% for 1990.

HISTORIC TRENDS IN WETLAND PROTECTION IN THE STATE OF VIRGINIA. Harold J. Wiggins, U.S. Army Corps of Engineers, Norfolk District, Fredericksburg Field Office, 10703 Courthouse Rd., Suite 270, Fredericksburg, Va. 22407. Recent Virginia state legislation involving inland non-tidal wetland area brings greater coordination between federal, state and local jurisdictions. The Chesapeake Bay Preservation Act of 1988 as mandated by state law compells local planning departments to recognize and identify non-tidal wetland area as Resource Protection Areas (RPA's) and Resource Management Areas (RMA's). The Virginia State Water Control Board has recently asserted its certification of authority for discharges exceeding 1 acre in headwaters and isolated waters. As a result of an interagency agreement wetland area can be assessed and delineated to concur with a unified definition. This federal definition has brought greater jurisdictional regulation to wetland habitats in Virginia. Palustrine, forested, broad leafed, seasonally saturated wetlands (PFO1A's) have received greater protection as a result of the unified federal definition. The Norfolk District of the Army Corps of Engineers has opened four new field offices in Virginia in early 1991. Greater Corps involvement with more field offices will minimize and regulate wetland losses.

LAND USE, ENVIRONMENT, AND THE REGENERATION OF PINUS PUNGENS. Charles E. Williams, The Nature Conservancy, 1110 Rose Hill Dr., Suite 200, Charlottesville, VA 22901. Table mountain pine, Pinus pungens Lamb., is a disturbance dependent conifer endemic to the central and southern Appalachian Mountains. Although generally widespread, recent evidence suggests that P. pungens may be declining in parts of its range due to fire suppression. I present a three phase conceptual model which suggests that changes in the areal extent of P. pungens is the result of human land use in conjunction with environment. Presettlement phase: prior to European settlement of the Appalachians, P. pungens populations are mainly restricted to xeric ridgetops and rock outcrops, but periodically spread into other parts of the landscape following lightning-generated fires. Expansion phase: after settlement, P. pungens populations expand into more mesic sites with increased clearing and burning of forests. Decline phase: changes in land use and suppression of fires result in the decline of P. pungens, and the increase of tolerant hardwoods, on mesic sites; unfavorable disturbance regimes and competition with hardwoods cause P. pungens populations to retract to xeric sites.

Botany

DENDROECOLOGY OF RED SPRUCE (PICEA RUBENS) IN THE SOUTHERN APPALACHIANS. H. S. Adams, D. S. Lancaster Cmnty. Col., Clifton Forge, VA 24422 and S. L. Stephenson, Dept. of Biology, Fairmont State Col., Fairmont, WV 26554. Dendroecological (tree-ring) analysis of increment growth cores collected from red spruce (Picea rubens) trees at a number of localities in Virginia, West Virginia, Tennessee, and North Carolina indicates that a growth-trend decline has occurred since the 1960s. This decline is similar to that reported for this species in the northeastern United States during the same time period. Tree-ring data we have obtained for other species of conifers in the same general region and elsewhere strongly suggest that the recent decline in growth of red spruce (and perhaps for the two species of fir [Abies balsamea and A. fraseri] commonly found as associates of red spruce) is both anomalous and unique. Undoubtedly, research efforts over the next decade will provide a clearer picture of the changes occurring within the red spruce forest type in the southern Appalachians. These data should help answer the question as to whether the general health of red spruce is seriously declining.

THE STATUS OF POPULATIONS OF HELENIUM VIRGINICUM BLAKE (ASTERACEAE), A VIRGINIA ENDEMIC SNEEZEWEED. Nancy E. Van Alstine, Virginia Dept. of Conservation and Recreation, Div. of Natural Heritage, 203 Governor St., Suite 402, Richmond, Va. 23219. Helenium virginicum is a Virginia endemic plant and state endangered species known only from seasonally wet sinkhole ponds and meadows in Augusta and Rockingham counties on the west side of the Blue Ridge. In 1990 a survey was conducted to reassess the known populations and search for new populations at sinkhole ponds identified from aerial photos and maps. H. virginicum populations were found at eleven out of 16 previously known population sites and at two out of 22 new sites searched. Two of the revisited sites without current populations had suffered major drainage changes. Only three of the revisited populations and the two new populations were in relatively undisturbed sinkhole ponds; seven were in habitats disturbed by grazing, mowing, or drainage control. Some of these disturbed sites supported the largest populations, but their long-term survival could be threatened by increasing residential land use and drainage control. The site of one of the revisited populations, although privately owned, is managed as a preserve by The Nature Conservancy. Three of the population sites, located within George Washington National Forest, are included within lands proposed as Special Management Areas.

WAS VIRGINIA A PLEISTOCENE REFUGIUM FOR SHALE BARREN ENDEMICS? Rodney L. Bartgis, Maryland Natural Heritage Program, Tawes State Office Building, Annapolis, Md. 21401. Previous researchers had compared the current distribution of plants endemic to the central Appalachian shale barrens with the suspected evolutionary history and dispersal mechanisms of each species, but no correlative patterns were determined. Based on a more complete survey of the shale barren flora than was previously available, the strict endemics have two distributional patterns: some species are widespread throughout the shale barren region while other species have a distribution restricted to the southern half of the region. The latter species typically have distributions with a focus in the James River watershed of Virginia, but show differential emigration patterns into adjacent watersheds. It is suspected that the observed patterns indicate that currently widely distributed species were probably widespread during the last glacial maximum, but that climatic events restricted the other endemics southward into a refugium centered in the James River watershed.

ESTABLISHMENT OF PUCCINIA CARDUORUM, AN EXOTIC RUST PATHOGEN OF MUSK THISTLE, IN VIRGINIA. A. B. A. M. Baudoin, Dept. of Plant Pathol., Physiol. and Weed Sci., R. G. Abad, and L. T. Kok, Dept. of Entomol., Va. Polytechnic Inst. & State Univ., Blacksburg, Va. 24061. A strain of a rust fungus (Puccinia carduorum Jacky) from Turkey was released in 1987 in field plots near Blacksburg, VA, to be evaluated as a biological control agent for musk thistle (Carduus thoermeri Weinmann). Musk thistle plants were inoculated with urediniospores of the fungus both in the fall and spring. Small numbers of rust pustules were found only in fall-inoculated plots in late March or early April, prior to spring inoculations, indicating that the fungus had overwintered. Disease development and spread was limited during the rosette stage; in non-inoculated plots, rust was generally not detected until May. In each of 3 years, disease became severe only when the plants bolted. The rust was detected only a few hundred meters from the release site in 1988, but in 1989 traces of rust were detected at naturally occurring musk thistle stands up to 7 km away. In 1990, severe rust was detected at these distant sites during flowering, suggesting that the pathogen is now probably established in western Virginia. (Supported in part by a cooperative grant from the Foreign Disease and Weed Research Unit, USDA-ARS.)

MICROSCOPIC ANALYSIS OF ROOT EMERGENCE IN LEMNA GIBBA. Catherine A. Boyd, M. H. Renfroe, P. T. Neilsen, and J. Winstead, Dept. of Biol., James Madison Univ., Harrisonburg, VA 22807. All roots of Lemna gibba are considered to be adventitious in origin, as there is no radicle present in the mature embryo. Roots originate in the subepidermal layer of the ventral surface of the frond. The epidermis covers the developing root primordium forming a sheath. The sheath is penetrated by the root cap, which in Lemna is well developed and persistent during the life of the root. As the root elongates the sheath remains as a persistent feature at the base of the root. The site of emergence appears to be morphologically determined.

HARDWOOD FORESTS IN THE COASTAL PLAIN OF VIRGINIA EAST OF THE SUFFOLK SCARP. Penny Cazier and Stewart Ware, Dept. of Biol., Col. of Wm. and Mary, Williamsburg, VA. Twenty-three predominantly hardwood forest stands on low, level uplands in the eastern Coastal Plain were sampled and their composition analyzed for correlation with edaphic factors. In five stands the leading dominant was Liquidambar styraciflua, and Acer rubrum led in four stands. These species were found on all remaining sites, and were major associates where Liriodendron tulipifera was important. Quercus alba was usually associated with Pinus taeda in wetter sites, and sometimes with Fagus grandifolia. In two stands the leading dominant, Q. nigra, was associated with Q. alba and P. taeda. Stands with high importance of Q. pagoda usually contained Q. michauxii and sometimes Q. phellos. Quercus laurifolia was the leading dominant in two stands containing Nyssa sylvatica var. biflora, L. styraciflua, and A. rubrum. The poorly drained non-alluvial sites sampled in this study contain a mixture of southern swamp species and Southern Mixed Hardwood Forest species.

FOREST COMPOSITION, ENVIRONMENTAL VARIABLES, AND LAND USE HISTORY IN THE NORTHERN NECK OF VIRGINIA. Elizabeth E. Crone and Stewart A. Ware, Dept. of Biol., Col. of Wm. and Mary, Williamsburg, VA. Twenty-four forest stands in Westmoreland State Park in the Northern Neck of Virginia were quantitatively sampled. Vegetation ordination (DCA) separated the stands into four distinct groups. Group I was dominated by Quercus prinus and Q. alba and was located on the left (low pH, low Mn, high % clay) to center portions of the first DCA axis. Group II was characterized by abundant Fagus grandifolia and fell in the lower (high slope, high Ca, north-facing) portion of the ordination. Group III was characterized by Liriodendron tulipifera and the absence of I.V. > 10% for oaks or beech and was located at the right (high pH, high Mn, low % clay) side of the ordination. Group IV consisted of two stands at the extreme upper right corner of the ordination (high Ca, flat) that were dominated by Q. falcata. Acer rubrum was also important throughout the study area. Most of the stands in the highly dissected study area fell into Group I, but it is possible that the prevailing vegetation of the Northern Neck, if fully forested, would be more like the stands in Group IV. Most of the Northern Neck is topographically more similar to the level, inland Group IV stands.

RESIDENT ENDOPHYTIC FUNGAL POPULATIONS IN STRESSED AND NON-STRESSED SCARLET OAK (Quercus coccinea) IN THE JEFFERSON NATONAL FOREST AT BLACKSBURG, VA. Gonzalo Guevara, R. J. Stipes and D. Wm. Smith, Dept. Plant Pathol./ Phyiol./Weed Sci. & Forestry, Virginia Tech, Blacksburg 24061. A survey for endophytic fungi in living, standing, stressed or non-stressed scarlet oak trees was conducted. Fungi were aseptically isolated from increment samples placed onto antibacterial potato-dextrose agar at 25C. 26 samples from Poverty Creek (non-stressed) and 23 from Brush Mountain (stressed) trees were studied. 50% of the samples from the non-stressed trees were sterile, 23% yielded Paecilomyces aff. variotii, and 27% were colonized by numerous other fungi. On the other hand, 100% of samples from stressed trees (Brush Mountain) were colonized by fungi; 74% yielded P. aff. variotii, and 26% other fungi. Other less frequently observed fungi were Stereum aff. complicatum, S. ostrea, Schizophyllum commune, Hymenochaete sp., Poria sp., Hypoxylon atropunctatum and H. punctulatum. Attempts to find Graphostroma platystoma and Eutypa spinosa from standing trees were unsuccessful. These findings support our hypothesis that cull (stressed) trees in woodlots commonly used by shiitake farmers are poor choices for shiitake logs because they may contain aggressive competitors of Lentinus edodes, the shiitake mushroom fungus.

TEMPERATURE AND pH GROWTH OPTIMA ON LABORATORY MEDIA OF Lentinus edodes (SHIITAKE MUSHROOM) AND THE MAJOR SHIITAKE LOG "WEED FUNGI," Graphostroma platystoma and Eutypa spinosa. Gonzalo Guevara and R. J. Stipes, Dept. Plant Pathol., Physiol. & Weed Sci., Va Tech, Blacksburg 24061. Temperature (5-40C) and pH (3.5-7.0) growth ranges were investigated for G. platystoma and E. spinosa ("weed fungi"), and L. edodes (shiitake) VT17; glucose-yeast extract agar, and glucose-yeast extract-wood decoction liquid media were used for these tests, respectively. Mycelial growth, measured linearly or as dried miomass, was the criterion used. The cardinal temperatures for growth of G. platystoma were 10C (min.), 25-28C (opt.), and 32C (max.). The cardinal temperatures for growth of E. spinosa were 15C (min.), 28-32C (opt.) and ?C (max.). The cardinal temperatures for growth of L. edodes were 5C (min.), 25C (opt.), and 32C (max.). The optimum pH ranges for growth of G. platystoma, E. spinosa and L. edodes, respectively, were 6.5-7.0, 5-7, and 3.5-4.5. These findings suggest that L. edodes is acidophilic, and therefore would likely grow well in oak logs with highly acidic sapwood. The data further indicate that shiitake log inoculation should be done during the late winter/early spring when temperatures are lower, and therefore more suitable for the growth of L. edodes and less suitable for the growth of the "weed fungi."

COMPARATIVE WHITE ROTTING POTENTIAL OF THE SHIITAKE MUSHROOM (Lentinus edodes) FUNGUS AND THE TWO MAJOR SHIITAKE LOG "WEED FUNGI" IN THE VIRGINIA HIGHLANDS. Gonzalo Guevara, J. G. Palmer and R. J. Stipes. Dept. Plant Pathol., Physiol. & Weed Sci., Virginia Tech, Blacksburg, VA 24061. The comparative maximum decay potential of pin oak (Quercus palustris) sapwood by Lentinus edodes (LE) and the two major shiitake log "weed fungi" (Graphostroma platystoma (GP) and Eutypa spinosa (ES)) was evaluated. We used the ASTM (Amer. Soc. for Testing & Materials) method in which weight losses of inoculated wood blocks were determined by monitoring pre- and post-rot values. Moisture and temperature were carefully regulated during the experimental period. GP and ES caused 20% and 16% losses, respectively, while LE strains VT17, U8, W4 and WG induced respective weight losses of 16%, 13%, 19% and 16%. A control standard, Trametes versicolor, yielded a 16% loss, while a non-inoculated control remained changeless in weight. The comparable weight loss induced by these competitive weed fungi found in shiitake logs supports our hypothesis that these weed fungi are major deterrents to long-term fruiting performance of logs of Virginia shiitake farmers. A number of companion studies on the shiitake production problems are in progress, and are being presented at this conference.

SENSITIVITIES OF LENTINUS EDODES, GRAPHOSTROMA PLATYSTOMA AND EUTYPA SPINOSA TO FUNGITOXICANTS. Gonzalo Guevara and R. J. Stipes, Dept. Plant Pathol., Physiol. and Weed Sci., Virginia Tech, Blacksburg 24061. Shiitake growers in VA are experiencing considerable losses of the fruiting life of oak logs due primarily to competing Ascomycetes ("weed fungi") present in tree tissues before felling. We surveyed several shiitake farms, and although the fungal flora differed among them, the predominant colonizing fungi were identified as Graphostroma platystoma and Eutypa spinosa. The fungitoxicity tests showed that these "weed fungi" are sensitive to Arbotect 20S and Lignasan BLP fungicides at acceptably low concentrations, while Lentinus edodes (shiitake fungus), VT17, was not. G. platystoma was inhibited at 10-1000 ug/ml by both fungicides, and E. spinosa was inhibited at 1.0-1000 ug/ml with both fungicides, while L. edodes VT17 was not. We used standard potato-dextrose agar in these tests, and sensitivity was determined by mycelial growth inhibition. These findings suggest that shiitake farmers might be able to control "weed fungi" by soaking their logs in these fungicides previous to inoculation with L. edodes, while doing no harm to L. edodes. If these fungicides were labeled for this use, residue analyses must be done on the mushroom produced by treated logs, with tolerance limits established.

GENETIC UNIFORMITY OF EL ARBOL DEL TULE (THE TULE TREE). Gustav W. Hall, Dept. of Biology, Col. of William and Mary, Williamsburg, VA 23185, George M. Diggs, Jr.*, Dept. of Biology, Austin Col., Sherman, TX 75090, Douglas E. Soltis* and Pamela S. Soltis*, Dept. of Botany, Washington State Univ., Pullman, WA 99164-4230. An electrophoretic analysis of enzymes was conducted on leaf material from each of eight major segments of the Tule Tree, an immense specimen of Montezuma Bald-cypress, Taxodium mucronatum, from Oaxaca, Mexico. This quite famous tree, some 36 m. (118 ft.) in girth, has been variously interpreted as a single enormous individual or as a natural grafting of several individuals. For comparison, two nearby conspecific individuals were also analyzed electrophoretically. That all segments of the Tule Tree were heterozygous for shikimate dehydrogenase-2, and the neighboring trees both homozygous, is consistent with the hypothesis that the Tule Tree is one genetic individual. The literature on the Tule Tree, including the controversies over its age and whether it was personally observed by Cortes and by Humboldt and Bonpland, is reviewed.

PHYTOPLANKTON COMPOSITION AND ABUNDANCE IN A POLLUTED RIVER SYSTEM: THE ELIZABETH RIVER. Mary F. Hanover and H.G. Marshall, Dept. Biological Sciences, Old Dominion University, Norfolk, Va. 23529-0266. The main branch of the Elizabeth River is located in Norfolk-Portsmouth port complex in Virginia. The Elizabeth River has been characterized as a highly polluted system, where industrial wastes, petroleum products and other contaminants from port operations have contaminated the waters and its substrate. Our studies indicated an abundant and diverse phytoplankton component is present, consisting of mainly neritic species common to the lower Chesapeake Bay. Phytoplankton concentrations are at 10^6 cells/l, with picoplankton levels at summer highs of 10^8 cells/l. Growth maxima occur in spring, summer and fall, with higher concentrations associated with downstream stations, except for picoplankton. Cell concentrations were generally higher below the pycnocline for diatoms, silicoflagellates and cryptomonads. One toxin producing dinoflagellate was present, but no blooms were noted during a 12 month study period. Supported by the Virginia Water Control Board.

TAXONOMIC STUDIES OF NEOTROPICAL AMANOA (EUPHORBIACEAE). W. John Hayden, Dept. of Biol., Univ. of Richmond, Richmond, Va. 23173. Recent study of neotropical species of the genus Amanoa has resulted in several taxonomic adjustments. Four new species, A. congesta, A. gracillima, A. nanayensis, and A. neglecta have been published, largely from materials that had been erroneously referred to A. quianensis, the most abundant and widespread species in the genus. Lectotypes have been selected for A. caribaea and also for A. quianensis, in which the selection was complicated by inclusion of one of the new species, A. neglecta, among the presumed syntypes. Amanoa robusta Leal was discovered to be a later homonym; this species has been renamed A. sinuosa. Delimitation of new and previously named species is supported by pollen and foliar epidermal sclereids in addition to features of gross morphology.

Convergence In The Early Evolution Of Megaphyllous Leaves. Stewart A. Hill and Stephen E. Scheckler, Dept. of Biol., V.P.I. & S.U., Blacksburg, Va. 24061. Megaphyllous leaves are believed to have evolved independently in several groups descended from trimerophytes (an Early to Middle Devonian group of plants). At least two of these descendent lines, leading to modern gymnosperms and ferns respectively, pioneered similar morphological strategies for light reception. By the Late Devonian, both early gymnosperms and pre-ferns had derived a frond-style of megaphyll, with bifurcated pinnae bearing laminated pinnules of the Sphenopteris type. That the fronds of these two groups were independently achieved, however, is shown by differences in the basic architecture of their fronds. Nonetheless, the striking similarity between early gymnosperm and pre-fern fronds has led to some confusion with respect to the attribution and evolutionary analysis of fossilized frond fragments from Late Devonian to Carboniferous aged rocks. Our recently discovered Late Devonian plant with Spenopteris like foliage demonstrates the difficulty of assessing the affinities of such fossils, while exemplifying their importance to the evolutionary analysis of extinct plants.

LIGHT RESPONSE OF THE SHALE BARREN ENDEMIC *ERIOGONUM ALLENI* TO SHADE TREATMENTS. Suzanne M. Hill, Biology Dept., Virginia Polytechnic Institute and State University., Blacksburg, VA 24061. Shale barrens are unique habitats occurring throughout the Appalachians and range from southwestern Virginia to southern central Pennsylvania. Although sparsely vegetated overall, shale barrens support a community of endemic, or near endemic, plant species. Since shale barrens have a relatively open canopy, the herbaceous layer is routinely subjected to full sunlight; a marked difference from the environment experienced by herbs in surrounding deciduous forests. It has been hypothesized that the shale barren endemic *Eriogonum alleni* is an obligate heliophyte (a high light requiring plant). This was tested in the field and laboratory by manipulating total irradiance. *E. alleni* plants were maintained under moderately (47 %) and heavily (73 %) shaded conditions. Photosynthesis was monitored, and light response curves were obtained. *E. alleni* has, thus far, demonstrated characteristic responses of a high light adapted plant.

COMPARISONS OF STOMATA AND CULTICLE DURING IN VITO CULTURE AND ACCLIMITIZATION OF BETULA PENDULA ROTH.- Joressia A. Jamison, M. H. Renfroe and J. Winstead, Dept. of Biology, James Madison Univ., Harrisonburg, VA 22807. The acclimatization or hardening-off of European white birch (*Betula pendula* Roth.) grown in vitro was studied using scanning electron microscopy. Comparisons were made among leaves of plants in culture, plants at time of transfer from in vitro conditions, plants one week after transfer to soil, plants acclimated from in vitro conditions, and seedlings. Leaves of plants in vitro had the largest stomata and the least amount of cuticle development. Leaves from acclimated plants were almost equal to seedlings in stomatal length, stomatal density, and cuticle development. Leaves from plants at time of transfer had the highest stomatal density. Generally, cuticular wax was thicker on the adaxial side of the leaf while stomatal density was greater on the abaxial side of the leaf in all observed groups.

THE TAXONOMIC SIGNIFICANCE OF HAIRS ON GOLDENRODS EUTHAMIA AND SOLIDAGO. Miles F. Johnson, Dept of Biol., Va. Commonwealth Univ., Richmond, VA 23284-2012. Hairs (trichomes) from leaves, stems and achenes of Solidago and Euthamia from Virginia are investigated with scanning electron microscopy. Although these genera have been lumped in many regional manuals, the trichomes are notably different in morphology between genera and support trichome morphology supports the current concept that these genera are separate entities. Trichomes from Solidago are simple, uniseriate and multicellular with variation noted in length of trichome and in the number of cells per trichome. Species grouped by Cronquist (Vascular Flora of the Southeastern United States, 1980) show similarities in trichome morphology. Trichomes from achenes are uniform and offer little taxonomic value. This research was supported by VCU and the Virginia Academy of Science Virginia Flora Committee.

A PHYLOGENETIC ANALYSIS OF THE GENUS PRUNUS (PRUNOIDEAE, ROSACEAE). John G. Kell and Khidir Hilu, Dept. of Biol., Virginia Polytechnic Inst. & State Univ., Blacksburg, Va., 24061. Phylogenetic relationships among the fifteen Sections, representing all five subgenera (Laurocerasus, Padus, Cerasus, Prunophora, and Amygdalus), of Prunus are investigated using cladistic analysis of morphological and chemical data. Fourteen cladograms of equal length and with a consistency index of 0.60 were produced. The cladistic relationships among sections in the consensus cladogram are not consistent with the monophyly of two of Rehder's five subgenera,; both subgenus Cerasus and subgenus Prunophora are paraphyletic. The three monophyletic groups in the genus are Laurocerasus, Padus, and the combination of Cerasus, Prunophora, and Amygdalus. However, relationships of sections within Prunophora and Cerasus are not fully resolved and need further study. The subgenus Laurocerasus is the sister group to the rest of the genus.

GEOGRAPHIC PATTERNS IN FOREST COMMUNITY COMPOSITION IN THE RIDGE AND VALLEY PROVINCE, VIRGINIA AND WEST VIRGINIA. David M. Lawrence, Institute of Geographical and Geological Sciences, George Mason University, Fairfax, VA 22030. The upland forest communities on Massanutten Mountain, Virginia, and North Fork Mountain, West Virginia, were sampled in an effort to discern geographic patterns in forest community composition in the Ridge and Valley Province. The forest communities on Massanutten Mountain, at the eastern extreme of the region, were found to be more xeric in character than those on North Fork Mountain, at the western extreme of the region. The influences of a variety of environmental factors are suggested to account for the differences among forest communities on the two mountains.

DYNAMICS OF SIZE DISTRIBUTION PARAMETERS IN JUVENILE LOBLOLLY PINE (PINUS TAEDA L.) STANDS. Jiping Liu and Harold E. Burkhart, Dept. of Forestry, Va. Polytechnic Institute & State Univ., Blacksburg, VA 24061-0324. Spacing trials have been established at four locations in the Piedmont and Coastal Plain regions of Virginia and North Carolina. The ground-line diameter (GD), later diameter at breast height (DBH), total height (TH), and crown height (CH) of each tree have been measured annually since 1983. Based on statistical analysis on the data, the parameters examined, such as coefficient of variation (c.v.), Gini coefficient (g.c.) and skewness, of tree size distributions were found to be significantly correlated with stand age and with number of trees per unit area. Some subtle differences were found among the distributions. The c.v. and g.c. of CH decreased with both age and density (p-value<.0001). However, those of GD, DBH and TH decreased with age, but increased with density. Competition resulted in increased negative skewness. The kurtosis values were not found to be significantly different among densities, but kurtosis generally increased with stand age, ranging from zero or slightly negative for very young stands to a positive value for older stands. Tests of normality were applied for distributions of these variables. Although all variables were approximately normally distributed, the trends in p-values over time varied among them.

EFFECTS OF PARTIAL DEFOLIATION ON FRUITING AND SEED SET IN FOUR SPRING WILDFLOWER SPECIES. Marion Blois Lobstein, NVCC-Manassas Campus, Manassas, VA 22110 & L. L. Rockwood, Dept. of Biol., George Mason Univ., Fairfax, VA 22030.
In order to determine the effect of defoliation on subsequent reproduction in perennial herbaceous plants, portions of leaves were experimentally removed from four species of understory spring-flowering plants in Loudoun County, VA in April 1990. Fruits were collected in May and June from control and experimental plants. 50% defoliation had no signifiant effect on the number of plant fruiting in Jeffersonia diphylla, Sanquinaria canadensis, or Erythronium americanum. 100% defoliation did significantly effect the percent of plants fruiting in S. canadensis. The percent of Trillium sessile plants fruiting was not effected by either 33% or 67% defoliation. In fact, defoliation short of 100% had no significant effect on any measured aspect of seed or fruit production in E. americanum, T. sessile, or S. canadensis with the exception of S. canadensis where there was a significantly higher number of undeveloped embryos in 50% defoliated plants versus control plants in which no leaves were removed. Aspects of fruit and seed production measured in control versus defoliated plants were: percent fruiting, mean number of seeds per fruit, mean fruit mass, mean seed mass per fruit, and mean mass per seed.

EFFECTS OF ELAIOSOME REMOVAL ON GERMINATION OF SEEDS: A RESEARCH SUMMARY. Marion Blois Lobstein, Dept. of Biol., N.V.C.C.-Manassas Campus, Manassas, VA 22110 & L. L. Rockwood, Dept. of Biol., George Mason Univ., Fairfax, VA 22030.
Since 1984 the authors have investigated the hypothesis that elaiosome removal might enhance the germination rate of seeds from ant-dispersed plant. In the past two years (1989-90, 1990-91) the authors have standardized their technique which has produced more consistant results. In brief, intact seeds and seeds in which elaiosomes have been removed have been placed on foam pads in petri dishes. The seeds have then been incubated for 3-4 months at 27.5 C and 15 C for 12 hours each per day, for 3 months at 20 C and 10 C for 12 hours each per day, 3-4 months at 5 C for 24 hours per day, and back to 20 C and 10 C for 12 hours each per day to simulate seasonal changes for summer, fall, winter, and spring. This treatment regime has produced high germination rates for Sanquinaria canadensis, Asarum canadense, Jeffersonia diphylla, and Viola striata. Only in S. canadensis did elaiosome removal enhance germination rates significantly for the last two years at rates of 56.7% and 46.7% versus 23.3% and 13.3% respectively ($p<0.001$). For both years germination rate of Dicentra cucullaria and Trillium sessile were low at 3-4% and 0% respectively for both treated and control seeds.

ON THE TRAIL OF FERNALD II. THE INTERDUNAL WETLANDS OF VIRGINIA BEACH. J. Christopher Ludwig, Department of Conservation and Recreation, Division of Natural Heritage, 203 Governor Street, Suite 402, Richmond, Va. 23219. During the late 1930's and early 1940's, eminent Botanist, Merritt Lyndon Fernald explored the flora of Virginia's southeastern corner, looking for new, unusual, and rare plant species. During his early explorations, he described the unusual flora of numerous wetlands between dunes along the coast of the Atlantic Ocean and the Chesapeake Bay in what is now Virginia Beach City. Fernald's wetlands were revisited as well as additional areas where this flora may persist. Results of exploration into the interdunal wetland flora is presented emphasizing the occurrence and status of the region's rare plant species.

STEM PHOTOSYNTHESIS: AN ADAPTATION TO STRESSFUL ENVIRONMENTS. Erik T Nilsen, Department of Biology, VPI and State University, Blacksburg, Va. 24061. Stem photosynthesis is recognized as an adaptation which increases carbon gain for plants in stressful environments. Stem chloroplasts have a reduced capacity compared to leaves on the same plant. In some cases, stems transpire without positive carbon gain (Soybean). In the case of Sparteum junceum stems have a higher temperature optimum. lower quantum yield, and greater resistance to atmospheric or soil induced drought. In addition, during nitrogen limitation stem photosynthesis is favored over leaf photosynthesis. Stems can contribute about 50% of a plants daily carbon gain, particularly during stressful conditions.

DIAGNOSTIC CHARACTERISTICS OF MAFIC WETLAND VEGETATION IN VIRGINIA. Thomas J. Rawinski, Va. Dept. of Conservation and Recreation, Div. of Natural Heritage, 203 Governor St., Suite 402, Richmond, Va. 23219. Certain wetland soils containing high magnesium relative to calcium can be described as mafic, and one plant species, Sanguisorba canadensis, is especially diagnostic of these wetland environments and their vegetation in Virginia. The Braun-Blanquet approach to community classification and interpretation was used to identify two mafic wetland plant communities, the Sanguisorba canadensis - Parnassia grandifolia Association and the Sanguisorba canadensis - Scirpus cyperinus Association. These Associations are placed within a provisional classification of soligenous wetland vegetation. A harsh edaphic environment, as suggested by low calcium:magnesium ratios, best explains the stunted condition of certain woody species and the occurrence of so many rare plants in these communities. A limited literature review suggests that Sanguisorba canadensis is also diagnostic of mafic wetland vegetation beyond Virginia.

EARLY DEVELOPMENT OF ADVENTITIOUS SHOOTS IN AFRICAN VIOLET. Michael H. Renfroe, Dept. of Biol., James Madison Univ., Harrisonburg, VA 22807. African violet leaf explants were cultured on a shoot induction tissue culture medium. Explants were observed to thicken at the base in or just above the medium surface. Cut sections revealed that increased meristematic activity in the spongy parenchyma layer of the mesophyll coincided with the thickening and preceded the appearance of organized meristems at the epidermal level. Leaf primordia enlarged quickly and developed both glandular and septate trichomes at early stages. Well-developed stomata were also visible on leaf primordia indicating that differentiation from protoderm to epidermis occurs very quickly during leaf primordia development in African violet.

NEW HOSTS FOR GRAMINICOLOUS FUNGI IN VIRGINIA: 1989-1990. Curtis W. Roane and Martha K. Roane. Dept. of Plant Pathology, Physiology & Weed Science, VPI&SU, Blacksburg, Va., 24061. Study of fungi on grasses in Virginia has been confined mostly to cereals, turf and pasture species. In 1989-90 on about 140 grass specimens we identified about 85 fungi. Listed are some fungi previously known from Virginia and some new hosts for them. The list is cryptic whereby H=host, U=new host for United States, V=new host for Virginia, and P=previously known on a Virginia host. Colletotrichum graminicola, anthracnose cereals, 24H (16U,7V,1P); Ascochyta sorghi, 18H (11U, 7V), Phyllosticta sorghina 8H (8U); Puccinia recondita, the leaf rust, wheat, 6H (2U, 2V, 2P); Rhizoctonia solani (including R. cerealis) brown patch fungus of turf, 6H (1U, 2V, 3P); Curvularia lunata, leaf spot, 5H (SU); Phyllachora punctum, tar spot, panicgrasses, 4H (2U, 1V, 1P); Phomatospora dinemasporium, 4H (4U); Bipolaris cynodontis, leaf blotch (of Bermuda grass), 3H (2U, 1P); Puccinia coronata, crown rust fungus, 3H (2V, 1P); Stagonospora maculata, purple leaf spot, 3H (2U, 1P); S. arenaria, leaf blotch, 2H (1U, 1V); Cercosporidium graminis, leaf streak, 2H (1U, 1P); Puccinia graminis, black stem rust fungus, 2H (1U, 1V). This is only a partial list of fungi commonly occurring in Virginia whose host range has been extended. A complete summary will be published.

GRAMINICOLOUS FUNGI NEW TO VIRGINIA, 1989-1990. Martha K. Roane and Curtis W. Roane. Dept. Plant Pathology, Physiology and Weed Science, VPI & SU. Blacksburg, Va, 24060. In 1989-90 several fungi on grasses not previously reported in VA were collected. New to the US and VA on new hosts are Bipolaris leersiae, Chaetoseptoria sp., Colletotrichum caudatum, Drechslera bromi, Microdochium bolleyi, Phaeoseptoria festucae var. muhlenbergiae, Phaeosphaeria eustoma, P. fuckellii, P. luctuosa, P. nigrans, P. nodorum, Phloeospora graminearum, Phomatospora dinemasporium, Phyllachora vulgata, Phyllosticta anthoxella, P. healdii, P. helenae, P. minutispora, Ramularia graminicola, Septoria tandilensis, Spermospora subulata, Stagonospora foliicola and S. simplicior. New to VA but not to the US are Cercospora setariae, Drechslera dactylidis, Exserohilum monoceras, Mastigosporium rubricosum, Rhynchosporina tridentis, Rhynchosporium orthosporum, Stagonospora tridentis and Ustilago spermophora. A complete summary will be published.

PRELIMINARY INVESTIGATIONS OF THE LIFE HISTORY OF THE ENDANGERED PLANT SPECIES ARABIS SEROTINA STEELE (BRASSICACEAE). Garrie D. Rouse, Environmental Dept., Schnabel Engineering and Associates, Richmond, Va. 23220, & Cheryl A. Rouse*, Medical College of Va./Va. Commonwealth Univ., Richmond, Va. 23298. In July of 1988 the US Fish and Wildlife Service determined Arabis serotina to be a federally Endangered Species. As part of the recovery plan, a several year study of the life history of the plant has been initiated. Two hundred and forty three individuals of A. serotina, from six sites covering the range of the species, were tagged for long-term study and monitored over the 1990 field season. Data on growth, mortality, predation, seed output, etc., were collected to better define the life history of the species. The results from the first year of this multi-year study indicate a high rate attrition among rosettes (48%) and significant predation of bolting individuals by catepillars (Pieris sp.). The existence of a rhizomatous habit among several individuals of A. serotina was documented. Recommendations for future monitoring efforts will be presented.

PHOTOSYNTHETIC RESPONSES TO TEMPERATURE AND CO_2 IN HYBRIDS BETWEEN *FLAVERIA* SPECIES OF DIFFERING PHOTOSYNTHETIC TYPE. Tatia J Rowland*, RO Littlejohn, Dept. of Biol., Liberty Univ., Lynchburg, VA, 24506, MSB Ku* & GE Edwards*, Dept. of Bot., WA. St. Univ., Pullman, WA, 99164. Simultaneous measurements of apparent photosynthesis (A) and quantum yield of electrons transported through PSII (Φ_e, determined from Chl a fluorescence) were obtained for intact leaves of *F. floridana* (C_3-C_4 intermediate), *F. brownii* (C_4-like), and their reciprocal hybrids. Temperature optima for both A and Φ_e were close to 30C for *F. floridana*, 40C for *F. brownii*, and 35C for both hybrids. Comparison of A and PSII activity suggests an increase in the ratio of photorespiration (PR) to A with increasing temperature for all genotypes while O_2 inhibition of A suggests that levels of PR are highest in *F. floridana*, lowest in *F. brownii*, and intermediate for the hybrids. The intermediacy of the two hybrids with respect to PR is further substantiated through comparison of their carboxylation efficiencies and their ratios of CO_2 molecules fixed per elctron transported through PSII to those of the two parents. While very little photosynthetic differentiation was evident between the reciprocals, indicating limited effect of maternal inheritance, considerable intermediacy and hybrid vigor were noted as seen by the hybrids' ability to maintain rates of A equaling or exceeding those of both parents at their respective optimum temperatures. The results suggest that, in comparison to the C_3-C_4 parent, an increased expression of C_4 characteristics exists in the hybrids which accomplishes reduced PR and increased efficiency of directing energy derived from PSII toward carbon assimilation.

THE EFFECT OF CULTURE AGE ON THE ABILITY OF SINGLE CELLS OF EUGLENA GRACILIS TO SURVIVE PASSAGE. J.M. Rupe and J.R. Palisano, Dept. of Biology, Emory & Henry College, Emory, VA 24327. The unicellular green alga Euglena gracilis has a finite lifespan in vitro. This lifespan is characterized by a standard growth curve. Preliminary results will be presented which suggest that the stationary and exponential death phase of the growth curve occur independent of the depletion of nutrients and/or buildup of toxic wastes since conditioned medium is capable of supporting the growth of newly inoculated cells. When single cells from cultures of various ages were isolated on solid media and then transferred individually to various volumes of liquid media, the ability of the single cells to survive and multiply is inversely related to the age of the culture from which the cells are obtained. This loss of proliferative potential is independent of the volume of liquid medium in which the single cells are placed. Single cells isolated from 3- to 7-day-old cultures showed no reduction in their ability to multiply; however, cells from 1- and 2-month-old cultures showed a significant decrease in mitotic activity.

VEGETATION ANALYSIS OF FIVE APPALACHIAN BOGS. C. Neal Stewart, Jr., Dept. of Biol. VPI & SU, Blacksburg, Va. 24061. Five northern-type, *Sphagnum*-dominated, treeless, Appalachian bogs (elevation ~ 1000 m) were quantitatively analyzed to compare vegetation using the point-quarter method. The four West Virginia (Pocahontas County) bogs were similar to each other and different than the bog surveyed in Tennessee (Johnson County). The cranberry, *Vaccinium oxycoccos*, was found to be most important in the vegetation structure in W.V., whereas *Rubus hispidus* was determined to be most important in Tenn., followed by *Vaccinium macrocarpon*. In all the bogs surveyed, trailing growth habits are dominant in the vegetation structure. Important graminoid species in W.V. were *Rhynchospora alba* and *Eriophorum virginicum*. These two species were absent in Tenn. where the graminoid growth form was comprised of several codominant sedges and grasses. Edaphic factors, such as pH, and climate, as well as historical factors probably determine the vegetation types found. Bog size was not a factor in species composition diversity, or growth habit of vegetation. Comparisons were also made among other non-Appalachian northern peat bogs.

TEMPERATURE GROWTH RANGES ON POTATO-DEXTROSE AGAR OF REGIONAL ISOLATES OF THE DOGWOOD ANTHRACNOSE FUNGUS, Discula sp. R. J. Stipes and J. L. Ratliff, Dept. Plant Pathol., Physol. & Weed Sci., Va. Tech, Blacksburg 24061.
Since temperature, among other factors, seems to profoundly affect development of dogwood anthracnose (DA) caused by the Ascomycetous fungal pathogen, Discula, we monitored vegetative (linear) growth patterns of 8 isolates from GA, MD, NY, OR, VA & TN on Difco potato-dextrose agar at 7 temperatures (5, 10, 15, 20, 25, 28 & 32C). We herein present data recorded at the 7-day observation period following inoculation. All but 1 isolate (TN) grew some at 5C, and the maximum growth temperature was in the 20-25C range. No growth of any isolate occurred at 28 or 32C. The Oregon isolate from Cornus nuttallii behaved very comparably to all other eastern U.S.A. isolates from Cornus florida. The Discula growth pattern as shown in this study would tend to skew the "preference" of this fungus toward the lower end of the mesophile range. Even though one cannot confidently extrapolate these results to the field situation of disease development, sporulation parameters and pathogen survival, these data on vegetative growth strongly suggest that the disease (DA) may be more severe at the lower end of this temperature-growth testing range.

PROTEIN PROFILES ON ACRYLAMIDE GELS OF REGIONAL ISOLATES OF THE DOGWOOD ANTHRACNOSE FUNGUS, Discula sp. R. Jay Stipes, Jean L. Ratliff and Alice W. Way, Dept. Plant Pathol., Physiol. & Weed Sci., Va Tech, Blacksburg 24061. Only fragmentary data are now extant on certain taxonomic/morphologic aspects of the dogwood anthracnose Discula sp., now decimating dogwood (Cornus florida) populations in the Appalachians. Chemical fingerprinting provides a novel insight into the relatedness of different isolates/strains. We examined 4 regional isolates (DA4 from the Blue Ridge Parkway, Floyd, VA; DA5 from NY; DA6 from GA; and DA7=VA17B from VA). Cultures were grown on liquid potato-dextrose broth for 37 days at 25 C, at which time the mycelia were lyophilized. Protein extracts of mycelia were subjected to SDS-polyacrylamide gel electrophoresis. Coomassie Blue was used as the general stain for proteins sieved through a 12% gel via their molecular wts. About 20-25 bands were noted, mostly in the 26-66 KiloDalton range. Most isolates were remarkably similar, particularly DA4, DA5 & DA6, indicating genetic relatedness. This similarity also might indicate a single virulent pathovar population raging through the dogwood communities. A much more extensive sampling of proteins from diverse strains is now in progress which will provide a more comprehensive perspective of variation in the pathogen.

A NEW RACE OF *Bipolaris zeicola* FROM VIRGINIA. E. J. Traut and H. L. Warren. Dept. of Plant Pathology, Physiology and Weed Science. Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

Three races and a new pathotype (NP) of *Bipolaris zeicola* (= *Cochliobolus carbonum*) with differential pathogenicity on corn inbred lines have been described. During the summer of 1990, some corn plants in Whitethorne, VA showed foliar symptoms similar to those described for the new pathotype. The pathogen was morphologically similar to isolates of *B. zeicola* races or the pathotype. Fourteen corn inbred lines were evaluated for reaction to races 1, 2 and 3, the NP and the isolate from Whitethorne (WT) under greenhouse conditions. Seedlings were inoculated at the V4-V5 growth stage with a concentration of 10,000 conidia per ml. Lesion type and severity were assessed 2, 5, 7 and 12 days after inoculation. Disease severity was visually estimated on a 1-5 scale. Comparison of the reaction of this set of inbreds to the inoculated isolates shows that the WT isolate has a different genotype from the other three races and the pathotype from the Midwest. Five inbreds showed resistance to the WT isolate. Lesions incited by the WT isolate are oval, tan, and on some inbreds have concentric rings. Lesions of the WT and the new pathotype from the Midwest developed slowly compared to races 1, 2 and 3. However, both the WT and the new pathotype differ in pathogenicity.

AN ACER BARBATUM-RICH FOREST IN THE VIRGINIA COASTAL PLAIN. Donna M. E. Ware and Stewart Ware, Dept. of Biol., Col. of Wm. and Mary, Williamsburg, VA. Acer barbatum Michx. has been regarded as a potential co-dominant of Coastal Plain upland hardwood forests, but has not been found in such forests in recent studies in VA. It seems not to occur on Coastal Plain uplands, but in steep-slope ravines cut through to the calcareous Yorktown Formation underlying the area. Quantitative data from such ravine slope forests in Grove Creek watershed (James City Co.) showed that Fagus grandifolia and A. barbatum were overstory dominants, with Tilia americana a minor associate, and Cornus florida the understory dominant. Several species encountered in the Grove Creek ravines were at or near their northern range limit (e. g., A. barbatum, Bumelia lycioides, Viburnum rufidulum, Ponthieva racemosa, Verbesina virginica) or disjunct from further west (e. g., Quercus muehlenbergii, Magnolia tripetala, Cornus alternifolia, Stewartia ovata, Athyrium pycnocarpon, A. thelypteroides, and the Coastal Plain record Mitella diphylla).

GEL ELECTROPHORESIS PROFILES OF *Colletotrichum graminicola* ASSOCIATED WITH GRASS SPECIES. H. L. Warren, A. W. Way and C. T. Roane. Dept. of Plant Pathology, Physiology, and Weed Science. Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

Two gel electrophoresis methods were used to characterize isolates of *Colletotrichum graminicola* obtained from cultivated and grass species. Sodium dodecyl sulfate gel (stained with coomassie blue) patterns of soluble protein indicate that isolates of *C. graminicola* from corn, sorghum and grasses can be differentiated based on their host specificity. Isozymes, as performed with polyacrylamide further separated grass isolates into several distinct groups. Corn isolates showed less variability than all other isolates, while sorghum isolates were more variable, which is consistent with results from pathogenicity tests. Isozyme analysis, as performed with polyacrylamide gels can be a valuable tool in the study of genetic variation among fungal organisms.

VIRGINIA'S NATIVE BROME GRASSES, BROMUS SUBGENUS FESTUCARIA. Thomas F. Wieboldt, Massey Herbarium, Dept. of Biology, Va. Polytechnic Inst. and State Univ., Blacksburg, Va. 24061. Four species of native woodland brome grasses are recognized: Bromus ciliatus, B. kalmii, B. latiglumis, and B. pubescens. The confusing nomenclatural history of these taxa is reviewed. Attention is focused on the morphological distinctions between Bromus latiglumis and B. pubescens. Bromus latiglumis may be distinguished by its much larger size, numerous leaves with overlapping sheaths, its velvety leaf sheaths, and the presence of auricles on the collar. Its distribution is shown to be montane and associated with alluvial riparian habitats. A fifth taxon, Bromus nottowayanus, described by M.L. Fernald from the bottomlands of the Nottoway River is considered in some detail. The characters normally used to distinguish the species (number of veins in the glumes) is shown to be unreliable but other characters await further evaluation. Additionally, B. nottowayanus displays certain characters intermediate between B. pubescens and B. latiglumis but quantitative analysis shows discreet morphologies. The taxonomic status of Bromus nottowayanus, nevertheless, remains unresolved for the present.

PHYTOPLANKTON ASSEMBLAGES ASSOCIATED WITH A BLOOM OF PTYCHODISCUS BREVIS OFF THE NORTH CAROLINA COAST. Traycie L. West and H.G. Marshall, Dept. Biological Sciences, Old Dominion University, Norfolk, Va. 23529-0266. Between October 1987 and February 1988 a major red tide event occurred off the North Carolina coast causing significant financial losses to the local economy. This extended bloom was caused by the dinoflagellate Ptychodiscus brevis. The relationships during this bloom between other phytoplankton components and this species are being evaluated. Preliminary results indicate other dinoflagellates, diatoms (centrales and pennales species), and chlorophytes also had increased levels of abundance during the bloom period, whereas, cyanobacteria and cells within the picoplankton component have lower concentrations during this period. Other common dinoflagellates during the bloom included Ceratium spp., Prorocentrum spp. and Protoperidinium spp. The diatoms were dominated by neritic species. Cryptomonad populations showed no significant difference before or during the bloom period.

SMALL MAMMALS, HABITAT, AND THE FATE OF FALLEN FRUIT OF AN EXOTIC BUSH HONEYSUCKLE, LONICERA MAACKII. Charles E. Williams, The Nature Conservancy, 1110 Rose Hill Dr., Charlottesville, VA 22901, & Jonathan L. Ralley*, Sch. of Interdisciplinary Studies, Miami Univ., Oxford, OH 45056. Lonicera maackii (Rupr.) Maxim., the Amur or Mongolian honeysuckle, is an exotic invasive shrub that produces a superabundance of low quality, persistent, avian-dispersed fruits. We experimentally examined the role of small mammals as predators of L. maackii fruits in field and laboratory studies to determine: 1) if fruits are chemically defended against predation by small mammals; and 2) the extent of postdispersal fruit predation by small mammals in relation to habitat. Captive deer mice, Peromyscus maniculatus, readily fed on fruits and seeds of L. maackii thus the "persistent fruit defense hypothesis" was not supported. Rates of fruit removal/predation by small mammals (primarily P. maniculatus and P. leucopus) in the field did not differ significantly among forest interior, forest edge or wooded corridor habitats. Overall daily survival rates of fruits ranged from 84.1% to 89.8%

THE CURRENT STATUS AND DISTRIBUTION OF THE HOARY SCULLCAP, **SCUTELLARIA INCANA** BIEHLER IN VIRGINIA. Robert A. S. Wright, Central Virginia Biological Research Consortium, 5204 Riverside Drive, Richmond, Virginia 23225.

In 1921, Professor Jerome Grimes of William & Mary discovered **Scutellaria incana** at Matoaca Park in James City County. This plant was later collected there in 1939, 1968 and 1989. Grimes discovered another James City station on the headwaters of Mill Creek in 1921, and it appears to have been rediscovered by Dr. Donna Ware at William & Mary in 1990. In 1936 and again in 1938, John B. Lewis found the plant in two Amelia County locations. A collection made by Barbara and Alton Harvill in Prince Edward County in 1967 has also eluded rediscovery. The author found it in Powhatan County in 1986. To date, only three populations are extant in Virginia, and two are threatened by construction plans. The other population may be threatened in the near future by highway or subdivision development. This presentation highlights the current status, the known stations, threats to known populations, distribution and interesting taxonomy of a truly rare Virginia plant, **Scutellaria incana** Biehler, the hoary scullcap.

Chemistry

COORDINATED BF_4^- IN COPPER COMPLEXES: PACKING FORCES OR PERMANENT COORDINATION? Mahdi M. Abu-Omar* and W. W. Porterfield*, Dept. of Chemistry, Hampden-Sydney Col., Hampden-Sydney, VA 23943. The BF_4^- ion is in most instances a very poor ligand for transition metals, serving usually as an innocent counterion for cationic species. However, in 1988 two model compounds for copper blue proteins were reported having the copper atom ligated by two imidazole N atoms, two linking thioether S atoms, and a Cl^- counterion, but also by a BF_4^- counterion F atom (6-coordinate). Because a comparable ligand with remote CH_3 groups of no steric significance gave a 5-coordinate geometry without coordinating BF_4^-, it was suggested that packing forces within the crystal had forced BF_4^- coordination. However, we have established through ^{19}F NMR studies that the BF_4^- group remains coordinated in solution, indicating permanent coordination. To the extent that the compounds are true models for copper blue proteins, this indicates an interesting possibility that these proteins can coordinate extremely hard bases from their environment. Arguments are presented for electronic influences within the chelating ligand that might lead to the observed difference between the two compounds.

INFRARED SPECTRAL ANALYSIS: A NEURAL NETWORK APPLICATION IN UNDERGRADUATE INSTRUCTION. Nils W. Ahlgren and Frank A. Palocsay, Dept. of Chemistry, James Madison University, Harrisonburg, VA 22807. Recently, the release of inexpensive neural networking development systems have simplified the examination and prototyping of neural network applications in chemistry. Because neural nets have been particularly effective in applications involving pattern recognition, an infrared spectral analysis network was developed and evaluated. The results show that the chosen neural network shell system can be used to develop a network which effectively identifies infrared spectra. This network could serve as an educational tool in undergraduate instruction.

ROLE OF GYPSY MOTH DEFOLIATION IN THE ACIDIFICATION OF HEADWATER STREAMS. James D. Armstrong Jr., Daniel M. Downey, Dept. of Chem., James Madison University, Harrisonburg, Va. 22807. It is thought that there is a relation between Gypsy Moth defoliation and stream acidification. In the past it has been shown that regions which were clearcut showed stream acidification trends. Cedar Creek near Strasburg, Virginia, showed the same effects after the watershed had been infested by Gypsy Moths.

In order to conduct a thorough study of the impacts of Gypsy Moth defoliation, five streams which form the headwaters of Dry River were chosen. Selection criteria for the streams were based on the similarities in water chemistry, topographical relation to one another, acid sensitivity and the proposed Gypsy Moth impact on the region. Forest Pest Management personnel assessed the area in the summer of 1990 and found 55% defoliation from Gypsy Moths. Defoliation in spring and summer of 1991 is expected to be severe. The situation on these streams will be monitored through the next year in order to assess the affects of defoliation.

COMPUTER SIMULATION OF A LIPID BILAYER AS A SOLVENT. Amy E. Aussiker and Steven G. Desjardins, Dept. of Chem., Washington and Lee Univ., Lexington, VA 24450. A molecular dynamics simulation of a 2 x 16 decanoate bilayer with dissolved spherical solutes is performed to gauge the effect of solutes on bilayer structure. To simplify the simulation, the bilayer molecules are represented as freely jointed chains and the head groups are harmonically constrained in a planar arrangement under an applied force equivalent to 1 atm of pressure. The well known tilt of the lipid molecules within each monolayer is observed, and simulations with 2,4,8,12 and 16 solute particles indicate the extent of bilayer swelling, measured as the average distance between head group planes.

STRUCTURAL ASPECTS OF CHROMATE AND DICHROMATE COMPLEXES OF LANTHANIDE MACROCYCLES. F. Benetollo, G. Bombieri, P. Gilli, P. M. Harlow, A. Polo, L. M. Vallarino, Dept. of Chem., VA Commonwealth Univ., Richmond, VA 23284.

The $CrO_4^{=}$ ion may be expected to function as an anionic ligand in a $[MX_y]^{n+}$ complex only when the $\{MX_y\}$ moiety is either extremely stable or substitution-inert. The latter prerequisite is satisfied by the lanthanide(III) complexes $[M(CH_3COO)_2Cl{\cdot}nH_2O$, where M is La(III)-Lu(III), L is the six-nitrogen-donor ligand $C_{22}H_{26}N_6$, and n is 3-6. Reaction with potassium chromate in aqueous solution resulted in complete anion metathesis for all members of the series, but the stoichiometry and structure of the products depended on the size of the metal center. The larger lanthanides, La(III) to Nd(III), gave $ML(CrO_4)_{1.5}{\cdot}nH_2O$, containing only ionic chromate; the intermediate lanthanides, Sm(III) to Tb(III), gave the yellow $ML(CrO_4)_{1.5}{\cdot}nH_2O$, containing both ionic and coordinated chromate, and the brown $[M(CrO_4)(H_2O)L]_2(Cr_2O_7){\cdot}2H_2O$, the X-ray crystallographic analysis of which showed the presence of bidentate chelating chromate and ionic dichromate. Finally, the smaller lanthanides, Dy(III) to Lu(III), gave products containing both ionic and coordinated chromate.

THE SYNTHESIS AND CHARACTERIZATION OF IRON-MODIFIED POLYIMIDE FILMS. Joseph J. Bergmeister and Larry T. Taylor, Department of Chemistry, Virginia Tech, Blacksburg, VA 24061-0212. We have found that polyimide films containing an iron oxide microstructure can be prepared by casting and curing a homogeneous solution of a pre-polyimide and an iron complex. The formation of unique features in the films, such as surface layers and bulk particles were dependent upon the iron dopant used. Surface layers of iron oxide (up to 1500 Å) were formed when iron(III) chloride, I, was used as the dopant; however, submicron bulk particles of iron oxide were formed when iron (III) acetylacetonate, 2, was used as the dopant. The synthesis and characterization of various polyimides modified with 1 and 2 will be discussed.

Determination of the Absolute Rate Constant for Chlorine Atom Abstraction from N-Chloroimides by Alkyl Radicals, J. Blackert, J. M. Tanko, Department of Chemistry, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0212.

The absolute rate constant for chlorine atom transfer from N-chloroimides to alkyl radicals was measured utilizing the cyclopropylcarbinyl "clock" reaction. The rate constant (2.5×10^7 $M^{-1}s^{-1}$ at 17 °C) is ca. 1000 x smaller than observed for the analogous bromine atom transfer from N-bromoimides. These results are discussed in the context of the potential utility of N-bromoimides in organic synthesis.

POLARIZED LUMINESCENCE AND ABSORPTION SPECTRA OF Tb^{3+} AND Eu^{3+} IN TRIGONAL $Na_3[Ln(2,6\text{–pyridinedicarboxylate})_3]\cdot NaClO_4\cdot 10\ H_2O$. James P. Bolender, David H. Metcalf, and F.S. Richardson, Chemistry Department, University of Virginia, Charlottesville, Virginia, 22901.

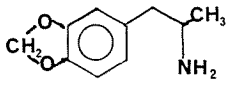
We have measured and analyzed the polarized orthoaxial luminescence and absorption spectra of Tb^{3+} and Eu^{3+} in single crystals of trigonal $Na_3[Ln(dpa)_3]\cdot NaClO_4\cdot 10\ H_2O$ (dpa = 2,6-pyridinedicarboxylate = the dianion of dipicolinic acid). Differential linear polarization (σ versus π) is measured in the orthoaxial luminescence and absorption spectra. A semiemperically derived energy level scheme is developed for the crystal field components of the Tb^{3+} (^7F_J (J = 0–6), $^5D_4$, $^5D_3$, $^5G_6$, $^5L_{10}$, $^5D_2$, $^5G_5$) and the Eu^{3+} (^7F_J (J = 0–6), ^5D_J (J = 0–3)) multiplets. (This work was supported by a grant from the U.S. National Science Foundation.)

THE DECOMPOSITION OF NICKEL NITRATE HEXAHYDRATE. Lori R. Brock, T. C. DeVore, Dept. of Chem., James Madison University, Harrisonburg, VA 22807. The thermal decomposition of nickel nitrate hexahydrate has been studied using rapid scan infrared spectroscopy. The evolved gases were monitored as a function of time to establish the decomposition rates and degradation mechanisms for the compound. Thermogravimetric analysis was also done to support the mechanisms postulated. The effects of sample size, crystal size, heating rate, and the addition of a carrier gas on the degradation of the nickel nitrate hexahydrate were also studied. Powdered $Ni(NO_3)_2.6H_2O$ was observed to decompose in four steps in flowing argon. In the first two steps, which occurred between 315 and 413 K, the hexahydrate water was lost forming the dihydrate. The third step largely involved the loss of the remaining two moles of water, to give the anhydrous nickel nitrate, and was completed by 498 K. The last observed transition lead to the formation of nickel oxide via the evolution of NO_2.

HEME PROTEIN ELECTRON TRANSFER REACTIONS. Edward Chen and Fred M. Hawkridge, Dept. of Chemistry, Va. Commonwealth University, Richmond, VA 23284. The direct electron transfer reactions of the heme protein, horse heart cytochrome c, has now been shown to occur at quasi-reversible rates at several pristine metal electrode surfaces. In this study the electron transfer reactions of cytochrome c has been examined at mercury electrodes. The aim of this study has been to delineate adsorption processes that have been widely reported for this highly hydrophobic metal/aqueous interface and the highly hydrophilic surface of this redox protein. The integrity of proteins solutions is believed to have had a central role in much of this work. Using a static mercury drop electrode the differential pulse polarographic responses have been determined as a function of drop life and cytochrome c concentration. The thermodynamic, kinetic and adsorption features of these reactions will be discussed.

SURFACE CHARACTERIZATION OF PLASMA-MODIFIED LaRC-TPI. J. W. Chin and J. P. Wightman, Chemistry Department, Center for Adhesive and Sealant Science, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. Surface modification with radio frequency(RF)-generated plasmas has been widely used in increase wettability and adhesion of polymer surfaces. The goal of this work is to utilize X-ray photoelectron spectroscopy (XPS), infrared reflection absorption spectroscopy (IR-RAS), contact angle analysis and ellipsometry to study the changes induced in the surface of LaRC-TPI, a thermoplastic polyimide, by oxygen, ammonia and argon plasmas. Upon exposure to plasma, significant changes in surface chemistry were seen to develop. All three plasmas caused an increase in the concentration of surface polar groups; contact angle analysis showed dramatic changes in surface wettability. Studies of the rate of polymer ablation indicated that surface chain scission was also occurring.

THE SYNTHESIS AND CHARACTERIZATION OF SOME NEW CENTRAL NERVOUS SYSTEM STIMULANTS. John Chubb and Roy L. Williams, Dept. of Chemistry/Biochemistry, Old Dominion University, Norfolk, VA 23529. This paper will describe the synthesis and characterization of several novel analogues of the 3,4-methylenedioxymethamphetamine parent molecule (1). Some other analogues (2,3) of the parent molecule have previously been shown to have considerable CNS stimulant properties. This research has sought to extend the potential reactivity of the parent system to more functional derivatives such as (4,5), which have been shown to exhibit some interesting CNS activity. The structure activity relationship of these new compounds to the parent systems will be discussed.



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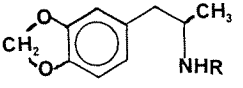

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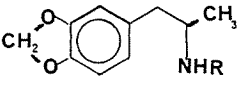


(4), R = CH_2CH_2Cl; (5), R = $CH_2CH_2COCH_3$

PHENOLIC NATURAL PRODUCTS FROM *SPONDIAS MOMBIN* . Kenneth E. Davis and Albert T. Sneden, Department of Chemistry, Virginia Commonwealth University, Richmond, Virginia 23284-2006 and Franklyn Avala Flores, Universidad Nacional de la Amazonia Peruana, Iquitos, Peru.

Spondias mombin (yellow mombin) is a member of the Anacardiaceae family of plants native to tropical parts of the Americas. In Peru, this plant, known as "ubos," is used by native Indians as an antiinflammatory and antidiarrhetic. Various *Spondias* species have been noted in the literature to contain pharmacologically active compounds. As part of our program to identify new, biologically active compounds from plants, an ethanolic extract of *S. mombin* has been investigated. The original extract demonstrated activity in the brine shrimp lethality assay, but subsequent fractions did not confirm this activity. However, the presence of phenolic constituents was detected by spraying the TLC plate of the extract and subsequent fractions with a ferric chloride solution. Several of these phenolic constituents have now been isolated using chromatographic techniques. The isolation and progress in determining the structures of the phenolic constituents will be discussed.

(Supported by a grant from the Jeffress Trust.)

THE SURFACE CHEMISTRY OF COMPOSITES. John G. Dillard, Jack C. Wells, and Bawyana Thompson, Department of Chemistry, Center for Adhesive and Sealant Science, Virginia Tech, Blacksburg, VA 24061-0212. The surface chemistry of adhesively bonded composite materials has been studied. Composite surfaces for non-treated and treated specimens were characterized as to topographical features using SEM and with regard to chemical functionality using XPS. The composite specimens were adhesively bonded after surface treatments including; no treatment, abrasion, application of a primer, and abrasion and application of a primer. The test specimen was a wedge sample. Crack growth in the specimens was followed as a function of time while the specimens were in contact with vapor from concentrated ammonium hydroxide, water, and methanol. The initial failure mode for primed samples was near surface delamination of the composite. Upon exposure of the primed specimens to methanol vapor, the failure mode occurred at the composite/primer interface. The results demonstrate that a weak interaction occurs at the composite-primer interface and that the interaction is degraded by reaction with methanol. Abraded, and abraded and primed specimens upon exposure to methanol failed by severe delamination of the composite. The mode of failure and the rate of failure depended on the surface treatment conditions and the chemical nature of the vapor to which the specimens were exposed.

NEW GADOLINIUM(III) RELAXATION RATE ENHANCERS FOR WATER PROTONS. Kathleen Kahler Fonda and Lidia M. Vallarino, Department of Chemistry, Virginia Commonwealth University, Richmond, VA 23284-2006.

Paramagnetic species lower the T_1 relaxation time of nuclei which interact with the paramagnetic material by providing a more effective pathway for spin-lattice (T_1) relaxation. This phenomenon has been exploited to produce enhanced images in magnetic resonance imaging. We report the results of T_1 measurements of water protons in the presence of $GdLX_3 \cdot nH_2O$, where L is the six-nitrogen macrocyclic ligand $C_{22}H_{26}N_6$ and X is acetate, chloride, or bromide. The complexes $GdLX_3 \cdot nH_2O$ contain a highly inert metal-macrocycle core which is not decomposed even in acidic or basic media. In the diacetate chloride complex, the acetate ions remain at least partly coordinated in solution, impeding the access of the water molecules to the metal and lowering the efficiency of the complex as a relaxation enhancer. In the trihalide complexes, which contain uncoordinated counterions, the quasi-planar structure of the metal-macrocycle moiety allows excellent access to the metal center and improved efficiency of the complex as a relaxation rate enhancer.

THERMAL DECOMPOSITION OF $Cu(NO_3)_2*3H_2O$

Chip Gaskins*, Lori Brock, T.C. DeVore, Dept. of Chem., James Madison University, Harrisonburg, Va. 22807

The thermal decomposition of trihydrated copper nitrate has been investigated using EGA-FTIR. It is a complex process proceeding through at least four intermediates before forming copper oxide. Nitric acid begins evolving at approximately 365 K. The absorbance of HNO_3 varies as a function of time. HNO_3 evolution increases as transition states are formed and starts to decrease as intermediates begin to form. Evolution of HNO_3 reaches a minimum when a stable intermediate is formed. An unknown copper species sublimes throughout the process. Water evolves at various points during the experiment, but is difficult to measure. Nitrogen dioxide begins to evolve at 470 K and increases as HNO_3 disappears until only copper oxide is formed.

CALCULATION OF VIBRATIONAL FREQUENCY OF CHLOROPHYLL a FROM ITS INTERMOLECULAR DISTANCE IN SOLUTION, FILM, AND CRYSTALLINE STATES

Colmano Germille, Dept. of Biomedical Sciences, VMRCVM, VPI & SU, Blacksburg VA, 24061-0442. The red absorbance peak of the chlorophyll a chromophore (color carrier) shifts its wavelength (frequency of vibration) position, from 665nm to 675nm and 745nm, depending on the intermolecular distance of its molecular packing in solution, film, and crystalline states. Using the molecular orientation of these states, and knowing the intermolecular packing distance in the three different states a model of the shift (coupled with quantum chemistry techniques), may be calculated and constructed. The knowledge of the physical parameters of chlorophyll a in different spatial orientation may explain the correlation of peak position of the red absorption for molecules in solution, film, and crystalline states. The assumption is that the intermolecular distance is inversely proportional to the molecular radius cubed.

EPR AND DNP STUDIES OF SILICA PHASE IMMOBILIZED NITROXIDE (SPIN) SAMPLES.

R.K. Gitti and H.C. Dorn, Chemistry Department, Virginia Tech, Blacksburg, VA 24061

DNP is a general method for increasing NMR sensitivity and stutying of weak intermolecular interactions. However the necessity of a low magnetic field (0.035-1.4T) for the effective polarization build up has limitted the static approach for studies of simple molecules with a single resonance line.

Recently, a flow transfer DNP method has been developed[1]. This approach provides an order of magnitude better NMR detector sensitivity and high chemical shift resolution which made possible measurements of selective DNP enhancements for different nuclei on the same molecule. Particularly attractive is the solid/liquid itermolecular transfer (SLIT) DNP technique which in addition to the above provides better transfer efficiency as well as avoids contamination of valuable samples with paramagnetic species. In the case of SLIT DNP approach the polarization is generated in a low magnetic field (0.33T) utilizing SPIN samples, then transfered (via flow) and detected in a high magnetic field (4.7T).

In this presentation, preparation and EPR characterization of novel SPIN systems suitable for SLIT DNP experiment will be described. Some ^1H and ^{13}C DNP enhancmets utilizing the above SPIN samples will be reported as well as SLIT DNP enhancements for enantiomeric pairs in the presence of a chiral environment (e.g. chiral spin labels immobilized on silica gel) will be discussed.

(Supported by Jeffres Research Foundation and Petroleum Research Foundation).

1. H.C. Dorn, R.K. Gitti, K.H. Tsai and T.E. Glass, *Chem.Phys.Letters, 155*, 227 (1989).

INTERMOLECULAR CHIRAL RECOGNITION PROBED BY ENANTIOSELECTIVE QUENCHING KINETICS. A MECHANISTIC MODEL FOR DISSYMMETRIC METAL COMPLEXES IN SOLUTION. Deborah P. Glover, F.S. Richardson, and David H. Metcalf, Chemistry Department, University of Virginia, Charlottesville, Virginia, 22901.

We have developed a mechanistic model for enantioselective excited- state quenching kinetics for systems in which quenching occurs via electronic energy-transfer processes within donor-acceptor encounter complexes in solution. This model is applied to systems in which the luminophore (L^*) and quenchers (Q) are dissymmetric metal coordination complexes and in which luminescence quenching rates are slow compared to translational and rotational diffusion rates. The rate parameters derived from enantioselective quenching measurements are expressed in terms of both electronic and stereoselective contributions to intermolecular chiral discrimination, and applications are illustrated for several lanthanide(luminophore)-transition metal(quencher) systems. (This work was supported by a grant from the U.S. National Science Foundation.)

PHYTOCHEMICAL STUDIES OF *HIMATANTHUS SUCUUBA* . Phillip W. Hathcock, Jr. and Albert T. Sneden, Department of Chemistry, Virginia Commonwealth University, Richmond, Virginia 23284-2006 and Franklyn Avala Flores, Universidad Nacional de la Amazonia Peruana, Iquitos, Peru.

Himatanthus sucuuba is a member of the Apocynaceae family of plants which grow as shrubby trees from Panama to the tropical regions of South America. In Peru, *H. sucuuba* ("bellaco caspi") is found in the Amazonian region and is used by native Indians as an anticancer and antirheumatic plant. As part of our program to identify new, biologically active compounds from plants, an ethanolic extract of *H. sucuuba* has been investigated. The original extract demonstrated insecticidal activity against *Drosophila* eggs, but did not show any antibacterial or antifungal activity. The use of the latex from *H. sucuuba* to treat warble fly infections by the Waorani Indians in South America has been documented, and the positive insecticidal activity prompted further investigation of this plant. Trituration of the original extract with dichloromethane resulted in the isolation of a white solid which was composed of several major constituents. Several of these constituents have now been isolated using chromatographic techniques. The isolation and progress in determining the structures of these compounds will be discussed. (Supported by a grant from the Jeffress Trust.)

XPS ANALYSIS OF REDUCED IRON MAGNETICALLY EXTRACTED FROM IRON FORTIFIED BREAKFAST CEREALS. C. L. Heisey, Dept. of Chem., Va. Polytechnic Inst. & State Univ., Blacksburg, Va. 24061, D. Burch, Science Dept., Chatham Hall, Chatham, Va. 24531, & J. P. Wightman, Dept. of Chem., Va. Polytechnic Inst. & State Univ., Blacksburg, Va. 24061. Reduced iron powder was magnetically extracted from commercially available iron fortified breakfast cereals. X-ray photoelectron spectroscopy (XPS) studies determined that the outermost 5 nm of the extracted iron particles contained primarily carbon and oxygen with a small amount of iron and nitrogen. Argon and oxygen plasmas were used to remove the outer layer of organic contamination from the iron powder and increase the percentage of iron in the surface. The binding energy of the Fe2p photopeaks indicated that the outermost layer of the extracted iron powder was oxidized. The range in the size of the iron particles was approximated from scanning electron microscope (SEM) photomicrographs.

PROTEOLYTIC ACTIVITY ASSOCIATED WITH THE WATER STRESS PROTEIN FROM THE CYANOBACTERIUM NOSTOC. Suzanne Hladun and Malcolm Potts*, Dept. of Biochemistry and Nutrition, Va. Tech, Blacksburg, VA 24061. Water stress protein-39 (WSP-39) has been isolated from the cyanobacterium Nostoc which has the unique ability to withstand long periods of dessication without loss of viability. High levels of WSP-39 are found only in dried colonies with rapid turnover of the protein occurring during the earliest stages of rehydration. Protease inhibitor studies suggest the presence of an extremely active, specific serine protease that is responsible for the observed degradation. Electron microscopy studies localize WSP-39 to the carbohydrate sheath material immediately outside the cell suggesting that WSP-39 is a glycoprotein. Blots stained for both glycoproteins and WSP-39 indicate that observed high molecular weight complexes are a glycosylated form of WSP-39. A possible model for WSP-39's role in protecting the cell during dessication may be one in which WSP-39 acts as a water barrier to prevent loss of significant amounts of water during periods of drought.

GENOMIC DNA FRACTIONS FROM CYANOBACTERIUM Nostoc commune DIFFER IN BUOYANT DENSITY. Vinita S. Joardar and Malcolm Potts, Dept. of Biochemistry and Nutrition, Va Polytechnic Inst. and State Univ., Blacksburg, VA 24061. The filamentous, heterocystous cyanobacterium Nostoc commune is tolerant to desiccation. Genomic DNA preparations from desiccated and rehydrated colonies of Nostoc commune have been found to contain two distinct fractions of DNA. These two fractions differ in their buoyant density and can be separated by cesium chloride ultracentrifugation. Fraction I DNA has higher buoyant density, is not detectably methylated and is associated with proteoglycan. Fraction II DNA has lower buoyant density, is highly methylated and does not have proteoglycan associated with it. This study investigates the nature of the two DNA fractions.

THE EFFECT OF POLYMER TYPE AND DOSAGE ON COLOR REMOVAL FROM TEXTILE DYE WASTE. Mark C. Joy & David M. Johnson, Life Science Div., Ferrum Col., Ferrum, Va. 24088. Using two types of a cationic polymer, the effects of polymer dosage on color removal from textile dye waste was monitored in three-hour intervals over a four-day period. Color was measured using the A.D.M.I. (American Dye Manufacturing Institute) Method. Effects of percent color removal in samples dosed with three levels of polymer were compared to the untreated sample. The percent color removal was correlated to residual dissolved solids. Also, the absorption spectrum (visible) was recorded for treated and untreated samples to determine the spectral region(s) affected by treatment. Results indicate significant reductions in color can be obtained.

THE ACTIVATION MECHANISM OF MYOSIN LIGHT CHAIN KINASE. Peter J. Kennelly*, Melissa Starovasnik#, James Lorenzen#, Jie Leng*, Petra Marchand*, and Edwin G. Krebs#, *Department of Biochemistry and Nutrition, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061 and #Department of Biochemistry, University of Washington, Seattle, WA 98195. Myosin light chain kinase[MLCK] is a protein kinase whose activity is absolutely dependent upon the binding of the calcium receptor protein calmodulin [CaM] for expression of its catalytic activity. We have proposed that the activity of MLCK is regulated by an autoinhibitory mechanism in which the CaM-binding domain of the protein is in fact bifunctional, with its second function being to act as an myosin light chain substrate binding site-directed inhibitor of enzyme activity when CaM is absent. Three lines of evidence support this assertion. First, synthetic peptides modelled after the CaM binding domain were CaM-controlled inhibitors of enzyme activity. Second, CaM-binding dramatically decreased the thermal stability of MLCK. However, the binding of these model peptides to the enzyme restored stability in a manner analogous to removing CaM. Third, affinity-labelling studies using the nucleotide analog 5'fluorosulfonylbenzoyl adenosine revealled that the MgATP substrate binding site on the enzyme is left essentially unaffected by the association and dissociation of CaM. Thus compound reacted with both MLCK and its CaM complex, and did so with nearly identical kinetic behavior.

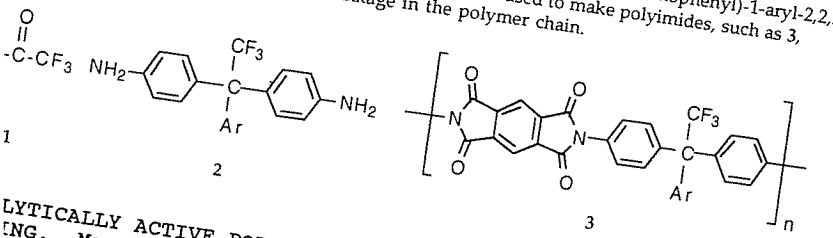
THE MILK LIPID SECRETION PROCESS IN MAMMARY EPITHELIAL CELLS. Brigitte H. Keon and T. W. Keenan, Biochemistry Department, Virginia Tech, Blacksburg, VA 24061. A model has been proposed for the mechanism of milk lipid globule (MLG) secretion from mammary epithelial cells (EC) of lactating mammals. Morphological and Biochemical data support an endoplasmic reticular (ER) origion of precursor microlipid droplets (μLD). A cell-free (CF) system has been developed for the formation and release of μLD upon incubation of ER in CF mixture. CF μLD are similar in morphology and lipid composition to in situ μLD. ER release of μLD is critically dependent on mammary cytosol (CYT), is time and temperature dependent, and proportional to [CYT]. MLG secretion appears to occur at the apical plasma membrane (PM) of EC. Preliminary data from reducible cross-linking studies suggest an affinity between PM and LD. Addition of dithiothreitol (DTT) reduced LD association with hPM by 42%. CYT prevented LD association to PM. Studies are underway to further define the role of CYT and PM components in the secretion of MLG from EC.

STUDIES ON FLUORESCENT MATERIALS IN HIGHLY ORGANIZED MEDIA. Maria D. Lee*, & Benjamin A. DeGraff*, Department of Chemistry, James Madison University, Harrisonburg, Virginia 22807. Biological membranes are a subject of current and intensive investigation, and emission anisotropy techniques are recent innovations for membrane study. Liquid crystals can provide a suitable model for a number of aspects of membrane organization. I have employed liquid crystals as a membrane model and designed/constructed a system for emission anisotropy studies. This system has been used to measure polarization parameters of luminescent probes in liquid crystal hosts with a goal of modeling biological membrane structure. By applying the technology developed for the liquid crystal system, anisotropy data from actual membrane media will be obtained and interpreted.

THE EFFECTS OF PHOSPHATE ON HUMIC ACIDS ADSORPTION ON VARIOUS SUBSTRATES. Wing H. Leung & Marie-Rose N. Samba, Dept. of Chemistry, Hampton University, Hampton, Va. 23668. The adsorption of humic acids on various substrates was studied in the presence and absence of phosphate in aqueous solutions. The filtrates were analysed with UV/Vis spectrophotometer for humic acids. The data were analysed using the Langmuir as well as Freundlich equation. The results showed that phosphate inhibit the adsorption on hydrous oxides, while the adsorption of humic acids was increased on activated carbon in the presence of phosphate. The nature of substrates and the pH values of solutions both demonstrated decisive effects on adsorption of humic acids.

NEW MONOMERS AND CONDENSATION POLYIMIDES CONTAINING A PHENYLTRIFLUORO-ETHYLIDENE LINKAGE. Timothy H. Meeks, Cheryl L. Davis, Lisa M. Reichenbach, and Roy F. Gratz, Dept. of Chemistry and Geology, Mary Washington College, Fredericksburg, VA 22401-5358.

he synthesis of several new aryl trifluoromethyl ketones, 1, and 1,1-bis(4-aminophenyl)-1-aryl-2,2,2-fluoroethanes, 2, will be discussed. The diamines, 2, will be used to make polyimides, such as 3, ntaining the phenyltrifluoroethylidene linkage in the polymer chain.



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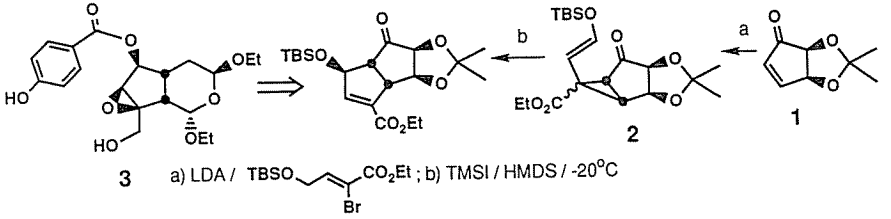
LYTICALLY ACTIVE POLYMERS FOR USE IN ELECTRODELESS COPPER NG. Manette A. Merritt, Donna S. Amenta, Benjamin A. DeGraff, ohn A. Mosbo, Dept. of Chem., James Madison Univ., sonburg, VA 22807. Strongly adhering, high-resolution (e.g., line) copper plating is advantageous in the design of ure electronic circuits. It was the goal of this project to plastic surface with a thin film (monolayer) of a polymer ning bound catalytic sites that could be activated ively to promote copper plating. Thus, the preparation of a containing chemically anchored transition metals such as um were undertaken. Several approaches were used. The f these involved chemical transformations directly on a rene backbone. The materials so obtained were not tory for our purposes; consequently, alternative synthetic es involving the construction of the metal bound polymers omers were sought. The reaction sequences from all of proaches, as well as the subsequent studies, will be d.

SYNTHESIS OF ß-ALKYLPYRIDINES AND ß-(ω -ALKENYL)PYRIDINES. Matt and Wayne M. Stalick, Department of Chemistry, George Mason Fairfax, VA 22030. Alkylpyridines have been identified as major of oil shale and lower rank bituminous and lignite coals. In velop a better understanding of the decomposition pathways of these a study of the thermolysis reactions of ß-alkylpyridines has been our research group. During the breakdown of long chain alkyl- mixture of shorter alkyl- and alkenylpyridines are produced. To cterize the products and to examine their breakdown parameters, it to synthesize some of these breakdown products. The synthesis lpyridines had been acheived using a modified Brown and Murphey this procedure is now extended to include the ß-alkenylpyridines interesting observation during this synthesis is that the amount lation vs dialkenylation seems to depend upon the distance of the om the aromatic ring. This effect along with the yields and the n of the products of these reactions are presented.

LOW TEMPERATURE REARRANGEMENT OF VINYLCYCLOPROPANES TO CYCLOPENTENES. APPLICATION TO THE ENANTIOSPECIFIC SYNTHESIS OF (-) - SPECIONIN, Tomas Hudlicky, Michael Natchus, Alison Fleming, Nina Heard, Department of Chemistry, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

Nonpyrolytic conditions suitable for the vinylcyclopropane / cyclopentene rearrangement for compoundsof type 2 have been investigated and applied in the enantiospecific synthesis of (-) - Specionin 3 from 1. The progress of the total synthesis of 3 will be presented.



HETEROBIMETALLIC DIPHOSPHINE COMPLEXES: SYNTHESIS, CHARACTERIZATION AND REACTIONS. Lori Nixon, Michelle M. Setzer and Serge Schreiner, Dept. of Chem., Randolph-Macon Col., Ashland, VA. 23005. Bimetallic transition metal complexes have great potential for the development of multicentered catalysts since both metal centers are accessible to bind small molecules. In order to determine the potential benefits of cooperative bimetallic activation, the synthesis of homo- and heterobimetallic complexes has been explored. Low-valent complexes of the MM'(μ-dppm)$_2$ series (M = Pd; M' = Ni, Pd; dppm = bis(diphenylphosphinomethane) have been synthesized and characterized. These complexes have a common molecular framework, but differ in the metal's oxidation state and degree of coordinative saturation. The synthetic procedures leading to these complexes as well as their characterizations will be detailed.

SEARCH FOR MORE EFFICIENT ZERO-VALENT PALLADIUM CATALYSTS THROUGH VARIATION OF THE ELECTRONIC AND STERIC PROPERTIES OF PHOSPHINE LIGANDS. Godson C. Nwokogu and Daniel Owusu*, Department of Chemistry, Hampton University, Hampton, VA 23668.

The rate determining step in useful palladium(0)-catalyzed C-C bond forming reactions is the oxidative addition of the substrate to a Palladium(0)-complex. In this step, the Pd-atom is acting as a nucleophile. Increasing the nucleophilicity at Pd in the complex through more electron-rich ligands may, therefore, lead to more efficient catalysts. In order to test this, we have prepared one new and one known tris(trimethoxyphenyl)phosphine and a known tris(dimethoxyphenyl)phosphine. These highly nucleophilic(basic) and bulky phosphines are to be compared with standard ligands such as triphenylphosphine in Pd-catalyzed C-C bond forming reactions.

Our efforts in preparing the triarylphosphines and preliminary results from their evaluation as ligands in Pd(0)-catalyzed reactions will be presented.

THE SYNTHESIS OF 8-AZIDO-S-ADENOSYLMETHIONINE AND ITS USE AS A PHOTOAFFINITY LABEL OF A METHYLTRANSFERASE. Keith A. Oxenrider and Thomas O. Sitz, Dept. of Biochem., Virginia Tech, Blacksburg, VA 24061-0308. The guanine-7-methyltransferase that methylates the "cap" structure in eucaryotic mRNA is very important in gene expression. If the 7-position of the guanine is not methylated in the "cap" structure, processing and translation of the mRNA into protein is dramatically restricted. We have defined three domains in the active site of this methyltransferase, the AdoMet binding region, the "cap" region, and the RNA binding domain. We have synthesized 8-azido-S-adenosylmethionine (8-azido-AdoMet) as a photoaffinity label using S-adenosylmethionine synthetase isolated from rabbit liver. The product, 8-azido-AdoMet, was isolated on a phosphocellulose column with a yield of 22%. The 8-azido-AdoMet had a characteristic UV adsorption spectra and showed rapid photolysis with a germicidal UV lamp. The 8-azido-AdoMet reacted with dithiol reagents used to stabilize the methyltransferase, but did not react as rapidly with mono-thiol reagents. Preliminary experiments showed that this azido compound could inhibit the guanine-7-methyltransferase.

MULTICOMPONENT CALIBRATION AND ANALYSIS IN LIQUID CHROMATOGRAPHY. Russell B. Poe, Todd L. Cecil, Sarah C. Rutan, Dept. of Chem., Va. Commonwealth Univ., Richmond, Va. 23284. Photodiode array detectors have been used to improve the detection capabilities in liquid chromatography. In this work, different methods are investigated to improve the quantitative results obtained from liquid chromatography using full spectrum fluorescence detection. The advantage of multiple wavelength detectors compared to single wavelength detectors is that multiwavelength information can be used to resolve and quantitate overlapping peaks. Different approaches such as multiple linear regression, Kalman filtering, and rank annihilation have been investigated for multicomponent calibration using fluorescence detection in liquid chromatography.

COMPARATIVE ANALYSES OF Nd^{3+} ($4f^3$) ENERGY-LEVEL STRUCTURES IN VARIOUS CRYSTALLINE HOSTS. John R. Quagliano, and F.S. Richardson, Dept. of Chemistry, Univ. of Virginia, Charlottesville, VA., 22901 (USA) and M. F. Reid*, Dept. of Physics, Univ. of Hong Kong, (Hong Kong). We have performed an in- depth analysis of the energy-level structures in seven Nd^{3+} ($4f^3$) crystal systems: $[Nd(H_2O)_9] \cdot 3CF_3SO_3$, $Nd^{3+}:Cs_2NaGdCl_6$, four Nd^{3+}-doped garnets ($Nd^{3+}:A_3B_5O_{12}$), and $Nd^{3+}:CsCdBr_3$. A model Hamiltonian employing 20 free-ion operators and the appropriate one-electron crystal-field interaction operators was diagonalized within the full 364 $SLJM_J$ basis of the f^3 electronic configuration. Ample spectroscopic experimental data allowed us to use least squares fitting routines to produce a crystal-field energy-level structure for Nd^{3+} in each host. Particular attention is given in this report to trends in the values of the free-ion parameters among the seven hosts. Although similar free-ion values are expected, the atomic (ionic) radius and the charge of the coordinating species can lead to changes in the extent of free-ion interactions. The effects of specific two-body *correlation* crystal-field operators (originally proposed by Judd and later studied by Reid) will also be discussed. (Work was performed with support from the National Science Foundation.)

MATHEMATICAL AND INTUITIVE INTERPRETATIONS OF THE FOURIER TRANSFORMATION. C. C. Sauer, L. M. Rieck, R. J. Gentile and J. J. Leary: Department of Chemistry, James Madison University, Harrisonburg, VA 22807.

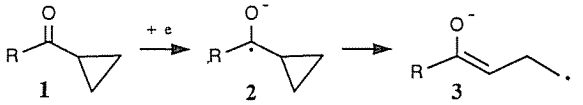
From the chemist's prospective, applications based upon the work of Jean Fourier (1768-1830) remained dormant until 1965, when Cooley and Tukey published one of the first fast Fourier transform algorithms (FFT). The availability of both FFT algorithms and powerful computers has led to the nearly explosive growth of analytical instrumentation that utilizes Fourier data reduction techniques (e.g. FT-IR, FT-NMR, FT-MS, FT-Raman, etc.). This presentation will focus on both intuitive and mathematical aspects of the Fourier transformation. In general, the functions to be transformed will be simple sines, cosines and their composites. Among the topics that will be discussed are: interference, frequency limits, symmetry, periodicity and the effect of displacing the function.

PHOTOCHEMICAL FORMATION OF THE DIPHENYL METHYL RADICAL WITH SUBSEQUENT OXIDATION BY METAL IONS. Morgan S. Sibbald and B. A. DeGraff, James Madison Univ., Harrisonburg, Va. 22807. Steady illumination ultraviolet photolysis of the s-tetraphenyl acetone molecule causes a decarbonylation reaction with the formation of two diphenyl methyl radicals. In the presence of certain metal ions, the radical can be oxidized to form the diphenyl methyl carbocation and a reduced metal, or possibly an organometallic species. The carbocation or organometallic species immediately reacts with the nucleophilic solvent methanol to produce an ether. Data and its interpretation characterizing the ketone's photochemistry, as well as the radical's fate both in the absence and presence of metal ions will be presented.

THE SYNTHESIS OF 4'-ISOCYANO-BENZO-15-CROWN-5. Elizabeth A. Smith, Abbey D. Heath, Donna S. Amenta, John A. Mosbo, Dept. of Chem., James Madison Univ., Harrisonburg, VA 22807. Through a series of synthetic steps the previously unreported title crown ether was prepared. Using literature procedures, nitration of the commercially available benzo-15-crown-5 provided the 4'-nitro crown ether, which was subsequently hydrogenated to yield 4'-amino crown ether. The previously unreported formanilide derivative was then synthesized utilizing acetic formic anhydride. This compound was dehydrated with a phosphine, carbon tetrachloride, and triethylamine to yield the target molecule. Details of the latter two synthetic steps and initial attempts to prepare platinum complexes of the isocyanide ligand will be described.

ELECTRON TRANSFER PROBES: REARRANGEMENTS OF ARYL CYCLOPROPYL KETYL ANIONS. James M. Tanko and Ray E. Drumright, Department of Chemistry, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0212.

Cyclopropyl-containing substrages (e.g., 1) have often been employed as diagnostic probes for single electron transfer in organic chemical reactions. The implicit assumption in such studies is that the detection of rearranged (ring-opened) product(s) can be ascribed to the intermediacy of a cyclopropyl ketyl anion radical (2 → 3):



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Results will be presented which demonstrate while aryl cyclopropyl ketyl anions do ring open, the process is reversible.

SUBSTITUENT EFFECTS ON THE GEOMETRY OF THE CYCLOOCTATETRAENE RING. Carl Trindle, Chemistry Department, University of Virginia, Charlottesville, VA 22903 and Troy Wolfskill*, Chemistry Department. Lycoming College, Williamsport PA 17701.

Cyclooctatetraene can achieve a variety of geometries: tub, crown, chaise, and octagonal or distorted planar forms, depending on the system's charge and spin multiplicity. Our *ab initio* computations, which produce optimum geometries, relative energetics, and vibrational frequencies, provide a coherent story of the influences of charge and spin, consistent with a Walsh analysis.

Since acceptor and donor substituents may alter the net charge on a cyclooctatetraene ring, such substituents might affect the geometry of the ring. We used the AM1 model for the wave function and electronic energy to evaluate the impact of substituents on charge distribution in the ring, and on the inversion barrier. Qualitative perturbation-molecular-orbital analysis suggests that substituents would force charge alternation in the ring, reduce bond-length alternation, and lower the inversion barrier. These predictions were borne out for a model donor ($-CH_2$ anion) and a model acceptor ($-CH_2$ cation). However more easily accessible substituents, the donor methoxy and the acceptor formyl, had minor effects on the inversion barrier. Multiple acceptor or donor substution and push-pull substituents exaggerated the charge alternation, but had little impact on inversion barriers. Fused-ring derivatives, such as the bis-cyclopenta-cyclooctatetraenes, suffered less of the bias arising from sigma-system strain toward a puckered singlet cyclooctatetraene ring, and in these systems electron donors were particularly effective in flattening the ring.

ANALYTICAL APPLICATIONS OF CHITIN/CHITOSAN, I.T. URASA AND JULIO C. ARCE, Department of Chemistry, Hampton University, Hampton, VA.23668.

Chitin, a polysaccharide, is biomass produced by marine animals, insects, and fungi. Biomass materials are known to accumulate metal ions by the process of biosorption in which chemical functional groups found in the cell wall biopolymers interact with the metal ions. Binding sites include amines, imidazoles, amides, hydroxyls, thiols, phosphates, and carboxylates. In some cases, covalent bonding is involved, making these materials suitable as complexing agents.

Chitosan is a form of chitin in which the acetylated amino groups have been converted into simple amino sites by reaction with hot alkali. This enhances the reactivity of the polymer towards metal ions.

However, very few reports have appeared in the literature showing how these very prevalent biomass materials can be effectively used in environmental problems. Our work has shown that these materials can be tailored towards the immobilization of priority pollutants, such as lead, in natural waters, soils, and sediments.

LIMESTONE TREATMENT OF ACIDIFIED STREAMS. Jeffrey D. Waqman and Dan Downey, James Madison University, Harrisonburg, VA 22807. The goal of this study is to evaluate the mitigation of the acidification of streamwater through single-point application of limestone. Acid rain is primarily formed when nitrogen oxides (NO_x) and sulfur oxides (SO_x) emitted from the burning of fossil fuels react in the atmosphere to form Nitric and Sulfuric acids, respectively. These acids return to earth where they enter streams through rain runoff and underground water displacement. The sulfate ion reduces the stream's buffering capacity by replacing the natural carbonate and bicarbonate. Limestone is calcium carbonate ($CaCO_3$) which dissolves sufficiently in streams to provide supplemental carbonate ions to boost buffering capacity. The effectiveness of the treatment has been found to be dependent on several parameters including the mass, particle size, and purity of the limestone, the stream gradient, flowrate and existing water quality and the total acid loading in the watershed.

DIRECT PYROLYSIS/FTIR INVESTIGATION OF THE DECOMPOSITION OF POLYMERS Michael T. Waroblak* and T.C. DeVore, Dept. of Chemistry, James Madison University, Harrisonburg, VA. 22807

Rapid scan Fourier Transform Infrared Spectroscopy is being used in conjunction with vacuum pyrolysis to investigate the dynamics of the thermal decomposition of polyvinyl chloride (PVC), polytetrafluoroethene (PTFE), polystyrene (PS), natural rubber poly(cis-isoprene), and ethene-vinylacetate (ETVA) copolymers. The DTA-FTIR software was used to investigate the initial decomposition of each polymer. PTFE and PS unzip to give their respective monomers (although PS also gives segmers). Natural rubber displays depolymerization and cycization mechanisms. PVC and ETVA give HCl and acetic acid respectively. ETVA copolymers provided valuable information regarding secondary pyrolysis mechanisms.

INFRARED ANALYSIS OF ULTRA THIN POLYMERIC FILMS ON METAL SUBSTRATES. H. F. Webster, and J. P. Wightman, Department of Chemistry, Virginia Tech, Blacksburg, VA 24061-0212. An understanding of the specific chemical and physical forces at work in the interphase region between adhesive and adherend is crucial in the understanding of the bond strength and durability in adhesive systems. Due to the nature of most adhesive systems, however, direct analysis of this interphase region is usually hampered by the geometry of the test system, and chemical analysis restricted to post fracture analysis. Analysis of thin polymeric films (< 100 nm), may provide a means to simulate and probe the interphase region under a variety of environmental conditions. This work focuses on the analysis of thin polymer films on metal substrates using the techniques of Fourier transform reflection-absorption infrared spectroscopy (FT-RAIRS), X-ray photoelectron spectroscopy (XPS) and ellipsometry. [Research supported in part by the Adhesive and Sealant Council, Ford Motor Co. and the Phillips Petroleum Co.]

CARBENE STUDIES OF BICYCLICS. George S. Whitney, Michael Sebesta, and William Brinkman, Department of Chemistry, Washington & Lee Univ., Lexington VA 24450. The toluenesulfonyl hydrazone derivative of the bicyclic ketone Fenchone is difficult to make because of steric hindrance. We have made it and decomposed it with base to extend our studies of carbene-to-tricyclene type molecules.

PHYSICAL STUDY OF CROSSLINKED POLYIMIDES. Carl A.Williams , Dept. of Chem, VPI, Blacksburg, Va. 24060, and T.C.Ward, Dept. of Chem, VPI, Blacksburg, Va. 24060. The importance of this research lies in the fact that adhesives provide economical advantages over conventional fastening techniques. Insite into the physical properties of these adhesives would yield valuable knowledge in determining the possible uses for these materials. The type of adhesives that were studied were lightly crosslinked polyimides that were formed by reacting maleated polypropylene with a couple different types of aliphatic diamines. Thermal analysis and other polymer characterization techniques were performed on the resulting polymers and these test proved that a crosslinked systems did exist. The future research will focus on the mechanical testing of the adhesive bond using various combinations of metal and composite substrates. (Supported by CASS Fellowship VPI)

THE SEARCH FOR PROCYANIDINOLS IN VIRGINIA WINES. Roy L. Williams, Dept. of Chemistry/Biochemistry, Old Dominion University, Norfolk, VA 23529, & Jacques Recht, Ingleside Plantation Vineyards, Oak Grove, VA. A group of polyphenolics known as the procyanidinols have been shown to exist in relatively high concentrations in various components of grapes and in finished wines. These compounds have been the focus of considerable research in Europe and now at Old Dominion University as a result of their unique biological activity. This paper will describe our efforts in the analysis and identification of these unique compounds by HPLC and describe our results of the analysis of a variety of red wines from Virginia with regard to their procyanidinol content.

DETERMINATION OF ORTHO-PHOSPHATE LEVELS IN NATURAL WATER SAMPLES USING AN AUTOMATED ROBOTICS ANALYSIS SYSTEM. Deirdre A. Zarganis, Michael A. Pleva and F. A. Settle*, Dept. of Chemistry, Washington & Lee Univ., Lexington, VA 24450. *Virginia Military Institute. The purpose of this research was to create an automated system that will correctly predict the concentration of orthophosphate in water samples. By automating the analytical method, we hope to increase the reliability of the data by minimizing the involvement of the analyst in the performance of the routine tasks required by the analysis. In the analysis standard reagent grade ammonium molybdate is added to the water sample to convert any orthophosphate to molybdophosphoric acid. Standard reagent grade stannous chloride dissolved in HCl is then added to reduce the colorless molybdophosphoric acid to an intensely colored molybdum blue. The physical property of color is then related to the concentration of phosphate by a Beer's law calibration curve at a wavelength of 690 nm. The system was proven to obey Beer's law, with a linear fit justified for the data. While the intercepts vary slightly, the slopes do not change. The automated analysis for orthophosphate in water samples by the stannous chloride method thus far can predict the concentration of phosphate with less than ten % error.

METABOLIC C-FORMYLATION OF THE IMINIUM ION METABOLITE DERIVED FROM PHENCYCLIDINE. Zhiyang Zhao, Louis Y. Leung,* Anthony Trevor,* and Neal Castagnoli, Jr., Dept. of Chemistry, Virginia Tech, Blacksburg, VA, 24061 and *Dept. of Pharmacology, University of California, San Francisco, CA 94143. The fate of the 1-(1-phenylcyclohexyl)-2,3,4,5-tetrahydropyridinium species, a principal metabolite derived from the psychosis inducing agent phencyclidine [1-(1-phenylcyclohexyl)piperidine, PCP], has been examined in brain subcellular fractions. A metabolite isolated from these incubation mixtures displayed on HPLC-diode array analysis a chromophore with λ_{max} 302 nm and on probe EIMS analysis an exact mass of 269.3900 corresponding to an empirical formula of $C_{18}H_{23}NO$ which in turn is equivalent to the addition of CO to the substrate molecule. These data prompted us to propose 1-(1-phenycyclohexyl)-5-formyl-1,2,3,4-tetrahydro-pyridine as a likely structure for the metabolite. The synthesis of this aminoenal was achieved by treatment of 1-(1-phenycyclohexyl)-2,3,4,5--tetrahydropyridine with N-formylimidazole. The GCMS characteristics of the fully characterized synthetic standard were identical to those of the metabolite. These results suggest that enamines may undergo metabolic C-formylation presumably via a transformylation process involving N^5-formyltetrahydrofolic acid (folinic acid) and/or the corresponding N^{10} formyltetrahydrofolic acid.

Computer Sciences

A SIMPLE STOCHASTIC MODEL FOR COMPUTER TERMINAL AVAILABILITY. Robert G. Brookshire & Scott P. Stevens, Dept. of Information & Decision Sciences, and Stinson H. Lenkerd, Academic Computing Services, James Madison Univ., Harrisonburg, VA 22807. Although queueing models have been widely applied in the analysis of computer performance and in the provision of services to individuals by multiple servers, these models have rarely been applied to the provision of computing services to individuals. We develop a queueing model based on the Erlang function for the availability of computer terminals in an academic computing laboratory. This model has the advantages of providing estimates of the numbers of computer users unable to obtain services, and of being comparable to standard performance measures for communications equipment. It also generates measures of resource availability which may be analyzed dynamically. Examples of the use of this model are provided.

GRAPHICS ON A NeXT WORKSTATION. Maria H. Lam, Department of Computer Science, Hampton Univ., Hampton, VA 23668. Four years ago the NeXT Inc. introduced the NeXT workstation. The NeXT environment is different from that of the most microcomputers in that it adopts the object-oriented concepts. The underlying language is Objective-C which is an extension of the C language. It also provides users with powerful software such as the Interface Builder such that elegant application interface can be developed by using little more than a mouse or simple programming. Therefore one can rapidly generate a graphical front-end for his/her application. We use a NeXT workstation to develop a 3D map of the world. By specifying the latitude and longitude of a viewing point, a user can view the world from any point with hidden lines removed. The program is written in object-oriented ForTran. The experience of producing this map will be discussed. This work is supported by Naval Surface Warfare Center under contract N60921-89-R-A149.

BINARY SEARCH IN MULTIPROCESSOR MODELS. Ernest L. Oliver and Dr. Pradip P. Dey, Dept. of Computer Science, Hampton Univ., Hampton, Va. 23668. Since searching is such a common activity in the computing sciences, it is desirable to find an efficient method for performing it. If the space to be searched is ordered and relatively large, the binary search is an ideal search method. The high performance of the binary search can be attributed to the halving of the search space each time a comparison is made. This is accomplished by repeatedly locating the middle element and determining if it is larger or smaller than the element being searched for. To search a list, it takes $\log_2 n$ time, where n is the size of the list. By parallelizing the binary search, several elements in the list can be searched for simultaneously. Ideally, in the parallelized procedure, the shared memory multiprocessor architecture (MIMD) can search for p elements in $\log_2 n$ time, where p is the number of availabe processors. Investigating and developing efficient algorithms to be implemented in multiprocessor models is the focus of this research.

PREVENTING MICROCOMPUTER VIRUSES IN PUBLIC-ACCESS FACILITIES. Anthony D. Townsend, Academic Computing Center, University of Virginia, Charlottesville, VA 22903. Coordinators of academic microcomputer facilities have to deal with an increasing threat of both Macintosh and PC viruses. This presentation will examine some of ways to prevent them in public access rooms. This will also include a brief look at the major types of viral infections, offer ways to detect them, and also look at different methods of eradication.

TREE COMPACTION. Lennore L. Vinnie, and Dr. Larry Morell, Dept. of Computer Science, Hampton Univ., Hampton, Va. 23668. Tree structures are fundamental to the study of Computer Science. They are used for structuring data bases and file systems. Information from programs can be stored in the form of a tree. This type of tree is called a parse tree. One reason for storing a program in the form of a parse tree is to provide greater editing capabilities, for example, positioning at the next statement, finding an identifier's declaration, and pretty printing the program. However, a major disadvantage of a parse tree is the enormous amount of space it requires. Therefore, some technique is necessary to compact the parse tree without sacrificing its benefits. Investigating and implementing such methods to compact parse trees is the focus of this research.

Education

THE DESIGN AND EVALUATION OF A PROJECT 2061 MODEL SECONDARY MAGNET SCHOOL. Michael L. Bentley. Southwest Virginia Governor's School, 304 Harvey Street, Radford, Va 24141. To meet the educational needs of academically talented students and to replenish the country's dwindling pool of scientists and engineers, secondary magnet schools for science and technology have proliferated throughout the country. The more recent schools have been influenced by Science for All Americans (1989), the project 2061 study of the American Association for the Advancement of Science. In 1990, a regional secondary magnet school was created in southwestern Virginia as 1 Project 2061 model to serve eight school districts. The school's program and features, as well as the evaluation plan, will be discussed.

ORGANIC CHEMISTRY FOR DAILY LIFE: A UNIT FOR THE HIGH SCHOOL COURSE. Jennifer C. Bullock and Thomas G. Teates, Virginia Tech, Blacksburg, Va. 24061. In recent years new pharmaceutical and polymer products have been put on the market at an exponential rate. At the same time there has also been a decrease in the number of students interested in scientific careers. We have designed a program to expose students to the basics of organic chemistry using examples from polymer and pharmaceutial products for relevance. The two basic goals of the program are to stimulate interest in chemistry by use of relevant topics and to give students information which will allow them to make informed consumer decisions. Plans are underway for field testing the program and will be discussed in the presentation.

USE OF THE LASER MODEL IN PRESERVICE SCIENCE TEACHER EDUCATION. George E. Glasson and Rosary V. Lalik, Div. of Curriculum & Instruction, Va. Polytechnic Inst. & State Univ., Blacksburg, Va. 24061. The LASER Model is an instructional framework for engaging students in the reciprocal use of language and action in science classrooms. The model has three instructional phases: exploration, clarification and elaboration. Preservice elementary and middle school teachers were engaged in using the model during science methods courses by investigating the topics of reflection and refraction of light. These teachers subsequently planned, taught and videotaped instruction using this model in their field student teaching placements. They examined their own teaching by analyzing the videotaped instruction, designing portfolios and writing about their experiences. Informal analysis of these prospective teachers' work indicated that they developed more confidence in their abilities to be successful science teachers and an increased interest in learning science content. (Supported by the Reading to Learn Program of the Virginia Department of Education).

A VYGOTSKIAN PERSPECTIVE ON THE USE OF DIALOGUE IN THE SCIENCE CLASSROOMS. Rosary V. Lalik and George E. Glasson , Div. of Curriculum & Instruction, Va. Polytechnic Inst. & State Univ., Blacksburg, Va. 24061. The presentation focused on the Vygotskian tradition in psychology and its implications for science education. Vygotskians emphasize the interplay between speech and action in the development of internal psychological functions and the notion of an externalized form of mind, known as the construction zone. In this zone, learners bring their unique cultural histories and, with the assistance of others, combine dialogue and action to accomplish purposeful activity. This theoretical perspective is particularly useful to science educators because it provides a basis for attracting and supporting the participation in science of minority and female populations. (Supported by the Reading to Learn Program of the Virginia Department of Education).

PHILOSOPHY AND BEHAVIOR: CONFLICT IN ACADEME. Bernard H. Levin, Blue Ridge Community College, Weyers Cave, Va. 24486, & Darrel A. Clowes, College of Education, Virginia Tech, Blacksburg, Va. 24061. Complaints about our system of education, including higher education, have nearly overwhelmed existing intra-institutional processes and made them increasingly vulnerable to external political forces. The wide-spread belief that nothing is right in education has resulted in testing for minimum competencies, for pre-post changes, and even for "thinking skills." Throughout our mensuration spasms, operationalized skills are the focus, rather than more global cognitive processes. Higher education continues in a positivist mode of thought while the intellectual world has left this mode, moved into modernism and now is tentatively approaching post-modernism. This cultural lag is an explanation for the frustration we experience with current policy on student educational outcomes assessment.

USING COMPUTERS FOR DATA ACQUISITION AND ANALYSIS IN THE PHYSIOLOGY TEACHING LABORATORY. Mark M. Mast, Kenton K. Brubaker, A. Clair Mellinger, and Roman J. Miller, Dept. of Biol., Eastern Mennonite Col., Harrisonburg, VA 22801. In an attempt to modernize, upgrade, and revitalize physiological laboratory instruction, we have recently installed nine IBM-compatible computer workstations (Hyundai super 386C, 20 mHz, 80387 math coprocessor, VGA color monitor, 40 mb hard disk) interfaced to physiograph recording systems (Minigraph, Lafayette). Lab Tech Notebook (LTNB), our data acquistion program, obtains data through an eight channel analog-to-digital board (DAS-8PGA, MetraByte). LTNB is compatible with our major software package, Microsoft Works, which integrates word processing, spreadsheet, graphics, and database components. As an example of the system's capabilities, we have recently programmed it to analyze a typical frog heart ventricular myogram obtained via a force transducer. Data, received at a rate of 100 Hz by LTNB, are displayed in several ways on the computer monitor in real time fashion as: (1) graphic representations of the ventricle contraction waves, (2) numerical displays of the current contraction rate (beats/min) and (3) quantifications of the areas under the contraction curves (area/min and area/contraction). Display data are simultaneously recorded in a data file on the computer's hard disk. Selected portions of this data file can be easily transferred into Microsoft Works for further analysis and for permanent charting. This system readily allows for visual and quantitative assessments of influencial factors, such as temperature or drugs, that alter heart rate or contractile strength. While the overall system is complex and powerful, it is user-friendly enough to allow undergraduates to learn how to operate and even program it. (Research funded by Grant #USE-9051156, National Science Foundation and D.B. Suter Endowment for Biology.)

A CONCEPT WHEEL: A TOOL FOR CURRICULUM AND INSTRUCTIONAL DESIGN John W. Mclaughlin, College of Education, Div. of Curriculum and Instr., VA Polytechnic Inst. and State Univ., Blacksburg, VA 24061-0313. Science education and science curriculum have been obsolete for many generations. Recently, reform in curriculum and instruction in science education has emphasized conceptual and hands-on learning, the development of critical thinking skills and an encouraged study of science in our society. Educators who are encouraged to implement these elements in their curriculum and instructional planning, and who have been departmentalized for many years, may find it difficult to make all of the conceptual connections in the curriculum. Expanding on the concept mapping theory by J. Novak, Cornell University, the construction of a conceptual wheel lesson plan allows teachers and students to make visual interconnections between specific curriculum concepts while allowing for the further development of critical thinking skills via creative instruction.

CONCEPT MAPPING: THE HYPERCARD APPROACH Manette Monroe, Virginia Polytechnic Institute & State University, Blacksburg, VA 24060. Concept mapping is a learning tool to help students develop higher-order thinking skills. The recommendations encompased within Project 2061 are uniquely suited to application of concept-mapping techniques. Relationships and understanding are emphasized over simple memorization of a large number of facts. A program utilizing Hypercard on the MacIntosh computer was created as an alternative approach to concept mapping. Animation and graphical representation were employed to help students better understand the conceptual information in a "user-friendly" atmosphere.

THE USE OF HYPERCARD TO FACILITATE LEARNING WITH THE LASER MODEL. Edgar D.Morris, Jr., Div. of Curriculum & Instruction, Va. Tech., Blacksburg, Va. 24061-0313. HyperCard is a computer software that provides its users with a way of expressing themselves textually but with the added dimensions of sound and animation. With one of the major components of George Glasson's and Rosary Lalik's Language and Action in Science Education Reflections (LASER) model being that through language students can represent their point of view, it would seem that Hypercard would be a useful language tool for this endeavor. This study provided an eighth grade physical science class with a Macintosh Classic and Hypercard 2.0 software for the purpose of allowing these students and their teacher an opportunity to use Hypercard in conjunction with the LASER model to see if indeed that Hypercard could aid in facilitating student learning by providing the student with tools to extend their communication of ideas. The results were that both the teacher and students alike found ways of using the Hypercard software for communicating their ideas to others.

A TWO-WEEK SUMMER SCIENCE AND TECHNOLOGY ATTITUDE BOOST FOR NINTH GRADERS. Alvin M. Pettus, Secondary Education, Library Science and Educational Leadership, James Madison University, Harrisonburg, VA 22807 & Paul Clifford*, Thomas Harrison Middle School, Harrisonburg, VA 22801. Twenty ninth grade students in the Better Information Project attended a two-week Pre-College Awareness session at James Madison University during the Summer of 1990. In addition to addressing the overall purpose of the program as defined by the State Council of Higher Education in Virginia, the program at JMU emphasized learning and enrichment activities related to science, mathematics, and technology. The activities were designed to develop positive attitudes and perceptions about studying science and mathematics in schools and applying science and technology to solve problems in the future. Topics for the enrichment activities included, "DNA: The Stuff of Life," "The Wonders of Liquid Nitrogen," "Investigations of Separations," "The Summer Sky," and "Graphs As Math Models." Positive changes were detected in student participants' attitudes toward studying science and mathematics personally and toward the value of science and mathematics study for others.

INSERVICE PROGRAMS FOR PHYSICS TEACHERS: ANTICIPATED NEEDS AND REAL EXPERIENCES. Thomas G. Teates, Div. of Curriculum & Instruction, & Dale D. Long, Dept. of Physics, VA Polytechnic Inst. & St. Univ., Blacksburg, VA 24061-0313. During a two year period 45 physics and physical science teachers participated in a summer and academic year program designed to provide a thorough knowledge of physics fundamentals, preparation for extensive use of hands-on activities for labs and effective demonstrations, experience with multiple uses of microcomputers and interface devices, knowledge of an array of practical applications of physics in everyday situations, and preparation to lead workshops in their local schools. The authors have been impressed with the many accomplishments of participants and the changes for better science instruction for students and with the difficulty of changing some of the traditional practices and constraints that are imbedded in the school culture and which interfere with the improvement in the quality of instruction. Pleasant surprises and disappointments in the observed teaching situations and practices of participants suggest that positive change is possible but comes slowly and depends on multiple factors at the local level.

HANDS-ON ORGANIC MECHANISMS. George S. Whitney, Department of Chemistry, Washington & Lee Univ., Lexington VA 24450. Ways of getting students to learn mechanisms are often frustrating, if not futile. This illustrates a method of involving several students to illustrate acyl mechanisms using hands and arms as electron bonds. I'll discuss whether the amount learning equals the amusement value.

Engineering *(Business Meeting Only)*

Environmental Sciences

LABORATORY ANALYSIS OF SOIL CONDITIONS IN CONSTRUCTED WETLANDS IN VIRGINIA. Robert B. Atkinson, Paul R. Benzing, and J. Cairns, Jr. Ctr. for Env. and Haz. Mat. Studies, Va. Polytechnic Inst. Under section 404 of the Clean Water Act, approximatedly 40 ha of mitigation sites for forested wetlands have been created and more are planned through 1995. Naturally occurring forested wetlands perform a variety of functions, some of which are related to anaerobic soil conditions. A laboratory study was conducted to determine potential for oxygen depletion and carbon dioxide formation under flooded conditions. Soil samples were taken from constructed wetland, adjacent reference wetland, an adjacent upland, and were paired with sample locations for field analysis of soil redox potential. Soil cores were placed in quart mason jars, covered with distilled water to leave a six cm head space, and sealed. Gas samples were taken weekly and carbon dioxide and methane concentrations were determined using a thermal gas chromatograph. Carbon dioxide production was highest in natural wetland soils and lowest in constructed wetland soils. Indications of methane production were limited to natural wetlands.

FIELD ANALYSIS OF SOIL WATER IN CONSTRUCTED FRESHWATER WETLANDS IN VIRGINIA. Robert B. Atkinson, David S. Barber, and J. Cairns, Jr., Univ. Ctr. for Env. and Haz. Mat. Studies, Va. Polytechnic Inst. In accord with Section 404 of the Clean Water Act, the Virginia Department of Transportation (VDOT) has constructed approximately 40 ha of palustrine forested wetlands. The study site is a 1.5 ha wetland constructed in 1987 in Petersburg, Va. Field investigation of redox potential was designed to compare constructed wetland, adjacent uplands, and an adjacent reference wetland. Redox potentials were measured below water table using platinum electrodes, a saturated calomel reference electrode, and a field meter. Platinum electrodes were constructed by soldering 30 cm of 20 gauge insulated copper wire to 1.3 cm of 20 gauge platinum wire, inserted into a pointed glass tube, and sealed at both ends. Preliminary results indicate significantly higher redox potentials in constructed wetland soils.

THE DEVELOPMENT OF CHEMICAL-DIFFUSING SUBSTRATES FOR IN SITU PERIPHYTON COMMUNITY SURVEYS. Matthew Arnegard, Paul V. McCormick, & John Cairns, Jr., Dept. of Biol., Va. Polytechnic Inst., Blacksburg, Va. 24061. Investigators studying the effects of chemical stress on ecosystems are often faced with a choice between laboratory tests, which tend to lack environmental realism, and field assessments, which lack control and replicability. An in situ experimental method for predicting environmental hazard is discussed which measures impacts on periphyton communities. A chemical stressor contained in a plastic flask diffuses through a porous clay surface and into the periphyton community developing on the outer surface. Initial laboratory trials using various classes of chemicals (e.g., acids, metals) indicate that reasonably predictable rates of diffusion are achieved. This method allows for much of the control and replicability of laboratory tests to be obtained under ambient environmental conditions.

SEDIMENTOLOGY AND STRATIGRAPHY OF SAND SHOALS ON THE VIRGINIA INNER SHELF. Margaret Christina Calvert, Dept. of Environmental Science, Lynchburg College, 1501 Lakeside Drive, Lynchburg, Va. 24501. This study was conducted as a portion of a ten week internship with the Virginia Institute of Marine Science. The purpose was to gain a better understanding of quaternery history of the continental shelf. Vibracore samples were correlated with seismic reflection records to determine shoal morphology.

ACTIVITIES DURING AN ENVIRONMENTAL SCIENCE INTERNSHIP. Ryan Cilsick, Dept. of Biology, P.O. Box 2121, Lynchburg Col., Lynchburg, VA, 24501. Internship was conducted over the summer of 1990. Summary and description of duties of a Natural History Intern for the Nature Center and Planetarium of Lee County, Ft. Myers, FL. Some of the tasks involved were teaching on elementary level, caretaking of wildlife, (rattlesnakes, bald eagles, alligators, etc) leading fieldtrips, presentations, and guided tours.

COUNTY NATURAL AREAS INVENTORIES IN VIRGINIA. Christopher A. Clampitt, Dept. of Conservation and Recreation, Division of Natural Heritage, 203 Governor St. Suite 402, Richmond, VA 23219. The Division of Natural Heritage is the Commonwealth's principal manager of information on rare, threatened and endangered species and unique or exemplary natural communities (natural heritage resources). The Division has instituted county natural areas inventories to 1) systematically identify natural heritage resources and 2) build partnerships with localities that will lead to greater protection of these resources at the local level. Natural areas inventories are conducted in the following steps: 1) collate existing information from museum collections and literature; 2) review maps and aerial photographs; 3) interview local experts; 4) aerial reconnaissance; 5) field surveys of potential natural areas; and 6) preparation of site reports that include protection recommendations. Efforts are underway to expand joint state/local protection activities and to explore the development of natural heritage resources GIS layers for localities.

A COMPARISON OF GROWTH AND PHOTOSYNTHETIC RATES OF THREE CYANOBACTERIAL SPECIES FROM THE TIDAL FRESHWATER POTOMAC RIVER. James F. Coles, Dept. of Biology, George Mason Univ., Fairfax, Va. 22030. Frequently throughout the 1980's, seasonal blooms of cyanobacteria (blue-green algae) occurred at nuisance levels at the Gunston Cove region of the Potomac River near Washington, D.C. The species which has been most dominant and consequently responsible for the blooms is Microcystia aeruginosa. This species, and two other cyanobacteria, Merismopedia and Oscillatoria, were isolated from Potomac River water samples and grown in artificially enriched media which simulates eutrophic conditions. Using the ^{14}C Tracer technique, photosynthetic rate curves for each species were determined at the temperatures of 15^0, 20^0, 25^0, 30^0 Celsius. A consistent trend in the curves of all three species suggests that photo-inhibition tends to occur at lower light intensities at lower temperatures. Additionally, growth rates of the three species were determined at each of the four temperatures by measuring chlorophyll-a concentration over time. By comparing the changes in cell density with that of chlorophyll concentration of Microcystis, it was observed that the chlorophyll content per cell increases when the culture is grown at higher temperatures, suggesting that chlorophyll concentration as a measure of biomass is temperature dependant.

DETERMINING COMMUNITY STRUCTURE SIMULARITIES BY STUDYING SPECIES DIVERSITY IN SHALLOW WATER AREAS ON LAKE GASTON. Chad R. Coley, Dept. of Biol., Lynchburg College, Lynchburg, Va. 24501. A species diversity study was conducted on Lake Gaston in the summer of 1990 to correctly identify species located there and to conclude community simularities. Ten different areas were observed: five lentic and five lotic environments. Each area was visited at dawn and at dusk to draw time variations of fish species. A relative abundance graph was constructed showing abundance or rarity of each species collected. A pie distribution table assorted nine fish families to percentage groups representing the entire catch. Simpson's Index with other indices were used to measure diversity for community structure. Community simularities were evident among lentic and lotic envirns. Species were found to be more evenly distributed in still water where running water areas were conservative in species represented. Predacious species were found more evident at dusk. The minnow and perch families were the dominant representatives while other bait fish were also seen to be rather abundant.

EVALUATION OF AN ION SELECTIVE ELECTRODE FOR THE DETERMINATION OF CUPRIC ION IN FRESHWATER. Claudia Hamblin-Katnik, Dept. of Biol., George Mason Univ.,Fairfax, VA. 22030. The cupric ion selective electrode (Orion 94-29) can be utilized to measure cupric ion content within fresh waters with some limitations. To achieve valid measurements, particularly at ionic concentrations of less than 10^{-5}, control of many parameters must be rigorously maintained throughout the sample preparation and measurement process. Parameters which must be considered are electrode cleanliness, equilibration, constant ionic strength, pH, temperature, sample volume, light, continuous stirring, use of metal-ion buffers, electrode placement during measurement, preconditioning and calibration. If constancy is not maintained in all areas a true Nernstian response can not be achieved.

A COMPARATIVE ECOFLORISTIC ANALYSIS OF THREE HIGH ELEVATION SPRINGS IN THE CENTRAL VIRGINIA BLUE RIDGE MOUNTAINS. Catherine G. Hnat, Teresa M. Nuckols, Terry L. Parrotte, Dept. of Biol., Lynchburg College, Lynchburg, Va. 24501. The first phase of a study of three high elevation springs in the central Virginia Blue Ridge Mountains-Wiggins spring 3160 ft., Armstrong spring 3580 ft., Lovingston spring 3690 ft.-has shown dissolved oxygen levels at 10 mg/L to 12 mg/L and Ph levels averaging from 4.6 to 5.0. Continuing phases of this study will help to determine how these and other ecological characteristics, rather than just the high elevations, influence the floristic differences found at these springs.

COMPARISON OF FLORIDA AND NORTHERN SUBSPECIES OF LARGEMOUTH BASS IN BRIERY CREEK LAKE, VIRGINIA. Randall S. Hoover, John J. Ney, and Eric M. Hallerman.* Dept. of Fisheries and Wildlife Sciences, Va. Polytechnic Inst. and State Univ., Blacksburg, VA 24061.

Briery Creek Lake, a 342-ha reservoir in south central Virginia, was stocked with both Florida and northern subspecies of largemouth bass following impoundment in 1986 and again in 1987. Both subspecies werestocked concurrently to permit evaluation of the potential of Florida bass to provide a trophy fishery in Virginia. We compared population composition, condition factor (a weight versus length metric), and growth rate for the 1987, 1988, and 1989 year classes of northern (N) and Florida (FL) bass and their hybrid progeny (F_1 and F_x). Geneotypes were differentiated in more than 400 bass by enzyme electrophoresis at four loci (A at-B, Gal-B, Idh-B, and Sod-A) which served as genetic markers.

Composition of all three year classes was dominated by hybrids (average of 73% F_1 and 13% F_x fish), indicating probable genetic impurity in parental stocks. Florida bass and F_1 hybrid had consistently higher condition factors than did northern bass. However, growth rates as estimated from length at capture did not differ significantly among the four groups.

SPATIAL, SEASONAL, AND INTERANNUAL PATTERNS IN PHYTOPLANKTON DENSITY AND TAXONOMIC COMPOSITION IN THE TIDAL FRESHWATER POTOMAC RIVER. R. Christian Jones, Claire Buchanan, and Victoria Andrele, Dept. of Biology, George Mason University, Fairfax, VA 22030. Phytoplankton were enumerated by species on samples collected on a biweekly to monthly basis over 6 years from 11-13 sites on the tidal freshwater Potomac River. Cell densities were analyzed by analysis of variance examining spatial, seasonal, and interannual variability. Phytoplankton densities were higher in the two embayment areas than in the river mainstem. A nearly exponential increase in phytoplankton was observed from March through August with a rapid decline in September and October. This pattern differed significantly among years resulting in a significant month-year interaction. Differences among years was also significant with the two lowest years correlating with low water residence times. Loss processes, particularly flushing, seemed to be generally more important than growth processes in explaining seaonal and interannual variation. Both growth and loss factors contributed to spatial variation. Diatoms were dominant in spring and various cyanobacterial species were most important in summer.

WHAT CAN THE VIRGINIA MUSEUM OF NATURAL HISTORY AT VPI&SU OFFER TO STUDENTS, TEACHERS, SCIENTISTS AND THE PUBLIC. Michael Kosztarab, Virginia Museum of Natural History, 428 N. Main St. Blacksburg, VA, 24061-0542. This young museum houses the oldest (initiated in 1888) and largest (ca. 920,000 specimens) natural history collections in the Commonwealth. Only the four zoological collections are housed in the new museum building. The three botanical collections as well as the paleontological and geological collections are in the Departments of Biology and Geology (Derring Hall) respectively.

Our first exhibits "Diversity Endangered" and "Mammals of North America" were very well received by the public. They averaged 1,000 visitors monthly during the first two months, and now are being moved to the main museum in Martinsville. Our newest exhibit, "Wildlife Endangered" includes color photographs on Virginia wildlife by Lynda Richardson of Richmond. A public lecture and field trip series was initiated with such topics as "How Birds Survive the Winter," and "Bats," with more to come. Our museum scientists are available to provide slide-illustrated talks for organizations and schools, and during the past ten years they have produced 418 publications and supervised 67 graduate students.

SMALL MAMMAL OCCURRENCE AND HABITAT ASSOCIATIONS IN A SUBURBAN ENVIRONMENT. Jill H. Kruper & T. L. Derting, Dept. of Biology, Hollins Col., Roanoke, Va. 24020. Within a suburban setting a large amount of human disturbance occurs which affects habitat availability and its characteristics. Consequently, the animal diversity within such areas is reduced. Identification of habitat characteristics that are essential to small mammal existence could improve landscape management practices which promote species retention. In this study, small mammal species occurrence was determined in disturbed (mown) and undisturbed field and wooded habitats in a suburban area. Habitat variables measured were vertical and ground cover, vegetation composition, and soil characteristics. Animal abundance and species richness was greater in the undisturbed field (85 animals, 5 sps.) than in the disturbed field (9 animals, 2 sps.). Occurrence was highest in areas with greatest vertical (< 0.5 m) and ground cover. In wooded areas, species richness and abundance decreased as disturbance increased (66 individuals, 5 sps. to 2 individuals, 1 sps.). Animal occurrence was positively associated with % vertical cover (> 0.5 m), litter depth, and plant sps. diversity. Thus, emphasis on the preservation of vegetative cover may be of key importance to enhancing small mammal species diversity in suburban areas.

A THREE MONTH STUDY OF FECAL COLIFORM LEVELS FROM THREE AREAS OF SMITH MOUNTAIN LAKE, VIRGINIA. Stuart R. Lynde & O. O. Stenroos Ph.D., Dept. of Biol., Lynchburg College, Lynchburg, Va. 24501. A three month fecal coliform study during the summer of 1990, consisting of biweekly samplings of lake water at Smith Mountain Lake, Virginia revealed levels of contamination below the fecal standard. Studies indicated an overall correlation to rainfall possibly resulting in drainage of coliforms from the soil. Limited direct sewage input into the system was also noticed, possibly the result of boat spillage. The contamination seemed to be widely distributed throughout the lake, as demonstrated by comparable fecal coliform levels from three distinct locations. These levels, however, were directly linked to the increased summer human population and either greatly declined or disappeared after the Labor Day weekend, corresponding to the decline in human population surrounding and using the lake. (Supported by the Smith Mountain Lake Association.)

TREATMENT OF RADON RICH WELL WATER. Douglas Mose, George Mushrush and Charles Chrosniak, Center of Basic and Applied Science, George Mason University, Fairfax, VA 22030. Private wells supply potable water to about 25% of the homes in northern Virginia, and almost all water wells contain radon, a carcinogenic radionuclide derived from uranium in rocks and soil. The average Virginia well provides about 2000-3000 pCi/l of dissolved radon; the U.S. Environmental Protection Agency has proposed that 300 pCi/l should be the allowed maximum for public water supplies. To estimate the ability of activated charcoal to remove radon from private well water, a home supplied by a water well carrying @4000 pCi/l was studied. Following 1 year of water measurements, an in-line tank containing 1 cubic foot of activated charcoal was installed, and a subsequent 6 month interval of radon measurements on untreated and on treated water was conducted. Although removal rates of more than 90% have been reported, this study home showed a 60-70% radiation removal in the tank. A high percentage removal rate was reached in less than a month after installation, and was maintained for about 4 months, but the removal rate declined to about 50% by the end of the testing interval. Additional studies are being conducted to determine the effect of using different charcoal volumes, different charcoal types; also being studied is the gamma emission of the charcoal tank.

RESEARCH IN PERCEPTIONS OF GLOBAL CLIMATE CHANGE. Katherine E. Spencer, Dept. of Biology, Lynchburg Col., Lynchburg, VA 24501. This project deals with research on global climate trends which have been observed in the twentieth century. Issues of global warming, global cooling, and causes will be addressed. The effects of global warming on the Earth's ecosystems and the well-being of humans will be examined. Causal agents of global warming will be analyzed in terms of their impact on other environmental issues, such as ozone depletion and human health. Results will address possible approaches to these issues in the future.

A SIX MONTH INVESTIGATION AND ANALYSIS OF THE WATER QUALITY OF COLLEGE LAKE. Greg Ware, and Ryan Cilsick, Dept. of Biol., Lynchburg Col., Lynchburg, VA 24501. This project deals with the collection and analysis of "grab" water samples from four specific locations on the shores of Lynchburg College Lake determining its water quality. The observations and the data obtained through a well planned and executed monitoring program will provide interesting information to Lynchburg College Officials and to those individuals interested in proper sampling techniques and analytical methods performed. Over a period of six months water was collected on a weekly basis and analyzed for the contamination of volatile organic compounds by gas chromatography, pH, specific conductance, fecal coliform, total organic carbon, chemical oxygen demand, temperature, suspended solids, and various metals by atomic absorption spectroscopy (AA). Results will be discussed determining the possible sources of detected contamination and indicating the threat these contaminates could have on the college lake ecosystems.

Geology

EXPERIMENTAL PARTIAL MELTING OF PEDLAR CHARNOCKITES, VIRGINIA BLUE RIDGE. J. S. Beard, Virginia Museum of Natural History, Martinsville, VA 24112; G.E. Lofgren, SN2, NASA/JSC, Houston, TX 77058; A. K. Sinha, Department of Geological Sciences, VPI/SU, Blacksburg, VA 24061. Several charnockitic gneisses from the Pedlar Massif of the central Virginia Blue Ridge were experimentally partially melted (P=700 MPa, T=850-950°C, NNO<fO_2<HM) and, with one exception, yielded substantial (24-58%) melt by 900°C. The low-temperature melts of charnockitic gneisses are peraluminous and granitic (Na2O/K2O=.36-.55; SiO2=73-75%). With increasing temperature, the melts become less granitic and are enriched in Fe, Ti and P. The melts coexist with the solid phase assemblage ksp-mt-il-opx-apat±qtz±anorthoclase. Subhedral to euhedral apatite that is in apparent textural equilibrium with the liquid is present in nearly every charge (usually 0.3 to 1.0% by weight). Apatite is strongly enriched in REE and Y. In the subsolidus assemblage of the charnockites, an average of 20-30% of the total La and Ce, over 50% of the Nd and nearly 80% of Y is contained in the apatite. At the same time, Eu is presumably strongly partitioned into restitic potassium feldspar. This implies that granitic melts derived from charnockitic Grenville basement will have steep, strongly LREE-enriched patterns with large negative Eu anomalies. Models based on the measured REE contents of apatite and charnockite and on the high-temperature melting and phase relations of the charnockites can reproduce many aspects of the major element and REE chemistry of some late Proterozoic subalkaline granites, suggesting a major role for melting of charnockitic crust in the petrogenesis of these granites.

POTENTIAL CHEMICAL STABILIZATION OF A SOIL FROM CATAWBA MOUNTAIN, VIRGINIA. David A. Hubbard, Jr.*, Va. Div. Mineral Resources, P.O. Box 3667, Charlottesville, VA 22903, James D. Behmer, Civil Engn., Univ. Va., Robin Grossman*, Civil Engn., Univ. Va., H. Gordon Larew*, Civil Engn., Thornton Hall, Univ. Va., Charlottesville, VA 22903. Numerous landslides exist along the flanks of Tinker Mountain and its southern extension Catawba Mountain. The landslide prone soils are developed on interbedded limestone and shale of Late Ordovician-age. Soil sampled from Catawba Mountain was classified as MH, for engineering purposes. The physical and mechanical soil properties are influenced by the clay mineralogy, characterized as a illitic-chloritic mixture. The soil was chemically treated with one of three chloride salts or lime to evaluate its mechanical response for potential stabilization. Both $CaCl_2$ and lime were found to enhance shear strength for four- and 28-day cured samples. Unfortunately, these test results conflict with test data from an engineering study at the lithologically and pedologically similar Hollins landslide site on Tinker Mountain. Variability in the composition and properties of illite soils indicate the importance of site specific characterization and stabilization studies for engineering solutions to landslide hazards.

CORRELATION OF WELL LOGS FROM THE SUBSURFACE OF WEST VIRGINIA USING RELATIVE SEA-LEVEL CURVES. Brett T. Brodersen, Richard J. Diecchio, George Mason Univ., Fairfax, Va. 22030. Relative sea-level curves were generated from gamma-ray and neutron logs for three deep wells in West Virginia, penetrating Mississippian to Cambrian strata. Deflections on the logs were interpreted as sandstone-shale or limestone-shale couplets. Sea-level curves were generated from these data using a technique similar to the method used to generate Fischer plots. In an attempt to evaluate this technique, these plots were compared to one another as well as to other published sea-level curves.

Major sea-level lowstands and highstands were correlated from well to well. Sea-level lowstands associated with the top and bottom of the Tippecanoe Sequence are discernable along with the a major lowstand at the end of the Ordovician. Third-order cycles throughout the Devonian, Silurian, and Ordovician are also discernable from the relative sea-level curves and many of these coincide with cycles recognized by other workers.

CATION EXCHANGE BETWEEN SEDIMENTS OF THE KIAMICHI FORMATION AND SALINE WATERS OF DOUBLE LAKE, WEST TEXAS. Terry Councell, Dept. of Geog., George Mason Univ., Fairfax, Va. 22030 and Warren Wood*, U.S. Geological Survey, Reston, Va. 22092. Double Lake is a saline lake situated on top of Cretaceous sediments of the Kiamichi Formation on the Southern High Plains of Texas. Observation wells were installed along the regional ground water flow gradient. One well just up-gradient of the lake (CE-1) contains anomalously high values of Ca and Mg. Two processes could explain these findings: cation exchange between Na in the lake water and Ca and Mg in the clays; and dedolomitization of deeper sediments. To test the hypothesis, sediment samples from vertical sections were analyzed for exchangeable cations. Well CE-1 penetrates the fresh/saline water mixing zone. Analysis of exchangeable cations in sediments from the freshwater section of CE-1 showed low Na values, similar to results of sediments upgradient of the lake. This evidence, combined with anomalously high Ca and Mg values in the water, suggest that cation exchange is occurring in Kiamichi sediments, whereby Ca and Mg are being liberated from clays by cation-exchange with Na in the water.

REPTILE LINEAGES ACROSS THE TRIASSIC-JURASSIC BOUNDARY OF VIRGINIA. **Nicholas C. Fraser, Virginia Museum of Natural History, Martinsville, VA 24112.** **The end of the Triassic was a key period in the evolution of terrestrial vertebrates. The first crocodiles, chelonians, sphenodontians, modern amphibian taxa, mammals and possibly also the earliest birds are known from Middle to Late Triassic sediments. In addition the first dinosaurs and pterosaurs also date back to this time interval. At this time Virginia lay at the heart of the supercontinent Pangaea, joined to what is today North Africa. Major mass extinctions are thought to have occurred at the end of the Triassic, but the exact nature and timing of these is disputed. Recent research on Triassic sediments in Virginia has centered on extensive new fossil reptiles. The new evidence indicates that there was a major mass extinction at the close of the Norian stage. There is also some indication that certain early Mesozoic tetrapods are useful biostratigraphically.**

THE JAMES MADISON UNIVERSITY MINERAL MUSEUM. Lance E. Kearns, Dept. of Geol./Geog., JMU, Harrisonburg, Va. 22807. The Mineral Museum which was initiated in 1976 is located on the top floor of Miller Hall. The collection presently displays over 700 specimens. The growth of the collection has been attributed to major donations by the Univ. of Del. and Bryn Mawr College in the late 1970s along with extensive private donations from mineral collectors, mineral dealers, and private individuals. The museum displays a systematic collection, an oversized specimen display, a suite of minerals from Elmwood, Tenn., a fluorescent mineral display from Franklin, N.J., and the recently endowed R.S. Mitchell Memorial Virginia Mineral collection.

GEOLOGY OF SMITH MOUNTAIN LAKE STATE PARK. W.S. Henika, Va. Div. of Mineral Resources, Dept. of Geol. Sci., Va. Polytechnic Inst. and State Univ., Blacksburg, Va. 24061. The Smith Mountain Lake State Park is in the southwestern Virginia Piedmont along the southeastern flank of the Blue Ridge anticlinorium. The area is one of intensely deformed metamorphic rocks of volcanic, sedimentary and igneous origins and is located about 5 miles southwest of the Bowens Creek wrench fault zone. The northwestern portion of the park is underlain by a layered biotite-hornblende gneiss unit (Moneta Gneiss/Ash Fm.) whereas southeast of the central boat launching area is a metagreywacke gneiss unit with thin actinolite schist, graphitic mica schist, calcareous gneiss and quartzite interbeds (Lynchburg Fm./Alligator Back Fm.). A large mafic/ultramafic pluton is along the southeastern park boundary. Map distribution of rock types shows regionally significant fold structures and controls important engineering properties of residual soil profiles affecting septic tank/drain field system locations and shore line erodability in the park area. Copyright Commonwealth of Virginia, 1991.

THE EFFECTS OF GROUNDWATER LEACHING ON FOSSIL PRESERVATION IN THE YORKTOWN FM. J. D. Herman, Dept. of Geol., James Madison Univ., Harrisonburg, Va. 22807. Patterns of fossil diagenesis caused by groundwater leaching provide insight into how shells are altered in unconsolidated terrigenous sediments on the Virginia coastal plain. The vertical and lateral distribution of diagenetic states was mapped in an outcrop of the Yorktown Formation (Upper Pliocene). At one end, a paleostream channel was incised during the Pleistocene and filled with sediments of the Shirley Formation. Groundwater movement, controlled by the presence of the paleochannel, caused patterns of fossil and sediment diagenesis.

Acidic groundwater caused diagenetic alteration or complete dissolution of fossils, and precipitated fine-grained iron oxyhydroxides. All carbonate material in the vicinity of the paleochannel was completely dissolved away, although ghosts of fossils remain. Away from the paleochannel, calcitic and aragonitic shells are found in parallel zones of alteration that dip toward the paleochannel and cut across original horizontal sedimentologic and fossiliferous layers. Groundwater leaching also produced a diagenetic stratification of the sediment, resulting in mineralogic and color changes.

The preservation of both aragonitic and calcitic shells was affected. Original aragonitic shells are found as chalky, unrecrystallized specimens, as neomorphosed shells, or are completely dissolved away. Original calcitic shells are either unaltered or chalky. Chalky shells range from relatively hard to soft and pasty, and SEM photos suggest that chalkiness is caused by dissolution of shell material and not simply loss of organic matrix. The presence of chalky aragonitic and calcitic shells indicate that chalky textures are, to some degree, independent of mineralogy and microstructure.

THE USE OF AQUIFER HYDROLOGY, CLIMATOLOGICAL VARIABLES, AND ESTUARINE SALINITY TO PREDICT SALTWATER INTRUSION INTO THE NORTHWEST RIVER NEAR CHESAPEAKE, VIRGINIA. Vaughan Mairs and H.G. Goodell, Dept. Environmental Sciences, University of Virginia, Charlottesville, VA 22903. The City of Chesapeake draws up to 10 MGD of water for domestic purposes from the Northwest River, a tributary of Currituck Sound. The river receives its base flow from the near surface aquifer of the Lynnhaven member of the Tabb Formation. In times of deficient precipitation the water table falls, the river discharge declines, and brackish estuarine water intrudes up the channel to the city's water intakes at the crossing of VA Routes 168 and 17. Precipitation, aquifer water level, and estuarine salinity data have been used to develop a predicting equation for water quality at the intakes. A stochastic model has been developed which predicts the time lag before the water supply exceeds a threshold of 250ppm chloride.

SOILS IN THE GEOLOGY CURRICULUM. W. C. Sherwood, Geol. and Geog. Dept., James Madison Univ., Harrisonburg, VA 22807. The rapid increase in employment opportunities for geologists in hydrogeology and engineering geology has created demand for courses emphasizing surficial geology and surface processes. At JMU, a junior level course titled "Soils and Land Use" has been offered each fall since 1975. Over the 16 years average enrollment has been 28.5 students with a range of 15 to 38, making it our most popular junior level offering in geology. Course content is divided into 4 major topics - Classification and Distribution, Geochemistry and Mineralogy, Engineering Properties, and Land Use. Labs include: estimation of soil textures, grain size analysis, x-ray diffraction identification of common soil clays, Proctor test for optimum moisture and maximum density determination, and use of the Universal Soil Loss Equation for soil loss prediction. Field trips are conducted in the Valley and Ridge and Piedmont where approximately 10 of the most common soils in each area are augured and examined. The course is integrated closely with our offerings in geomorphology and geohydrology. It also serves as a prerequisite for Engineering Geology. The combination of the soils and engineering geology courses provides the student with a background in soil mechanics approaching that offered in a one semester course in traditional civil engineering programs. At JMU, a new Environmental Studies minor has incorporated Soils and Land Use as one of the options in the natural sciences, so that demand for the course continues to increase.

THE GEOMETRY AND GENESIS OF FAULTS IN PAGE COUNTY, VIRGINIA. Michael J. Sarros, Dept. of Geology, Old Dominion Univ. Norfolk, Va. 23529. Recent field work indicates Cambrian-Ordovician carbonates in Page Valley south of Luray are displaced by three major faults. The oldest of these faults thrusts the Cambrian Conococheague Formation over the Ordovician Beekmantown Formation. This fault is folded by a broad anticline which is truncated by a NW striking low angle thrust tentatively named the Honeyville fault. The Honeyville fault may be correlative with the Sedwick fault mapped to the north by Hill (1988). It offsets the Beekmantown Formation by approximately 1500 meters. One mile to the east Cambrian clastics of the Blue Ridge and Cambrian-Ordovician carbonates of Page Valley are offset nearly 3300 meters by the Stanley fault. The Stanley fault is a steeply dipping fault which exhibits both dextral and strike-slip motion. Associated with these faults are mesoscopic structural features including well developed cleavage, folds, sigmoidal veins, boudinage, lineations, and fault breccias. Folded cleavage and cross-cutting cleavages indicate multiple stages of deformation in the Late Paleozoic.

THE JOHN FINCH COLLECTION OF TERTIARY MOLLUSKS IN 1824 AND ITS SIGNIFICANCE TO PALEONTOLOGY AND GEOLOGY. Lauck W. Ward, Virginia Museum of Natural History, Martinsville, VA 24112. The first important paper on invertebrate paleontology in the new world was written by Thomas Say in 1824 and described new species of mollusks. Say's paper was based on a collection of fossils made by visiting Scottish geologist John Finch. Finch bestowed his collection of Tertiary coastal plain mollusks on the members of the Academy of Natural Sciences of Philadelphia (ANSP). Besides Thomas Say, T.A. Conrad, Issac Lea, S.G. Morton and Jacob Green received fossils for description. Mysteriously, these mollusks were described as being found in Maryland, but few of the specimens occur in strata of the age found in Maryland. A biostratigraphic study of the assemblage reveals that they are of late Miocene and Pliocene age and involve taxa typical of the Eastover and Yorktown formations in Virginia. Finch (1833) described a collecting trip on the St. Mary's River in Maryland, but he also discussed in detail the geology and shell deposits at Yorktown, Virginia. Yorktown is believed to be the type area for all the mollusks left by Finch at the ANSP. The confusion of these localities has led to long-standing nomenclatural confusion in which the Pliocene fossil names have been improperly applied to Maryland Miocene taxa.

LOCATING A GROUNDWATER SUPPLY IN THE ROME FORMATION FOR ELLISTON, VIRGINIA. Chester F. Watts, Institute for Engineering Geosciences, Dept. of Geology, Radford University, Radford, Va. 24142. In September of 1990, the Virginia Department of Health ordered the Montgomery County Public Service Authority to advise all customers receiving water from the Elliston Spring to boil water for 10 minutes before use. This was based on wide fluctuations in both turbidity and bacteriological quality. Those indicators, plus the quick response of the spring to heavy precipitation, indicate a groundwater system strongly influenced by surface water. At the request of the Public Service Authority, the author conducted a geologic study with the intentions of: (1) identifying the spring's recharge area; (2) locating the source(s) of bacterial contamination; and, (3) identifying potential new water supplies for Elliston on property owned by the Authority. Objectives 1 and 2 were met with little difficulty. The bacteria appear to originate with farm animal activity in a marshy area near the spring. Complex geology has made objective 3 more difficult. The property is located within the Rome Formation, which consists of interlayered shale, fine sandstone, siltstone, mudstone, and varying amounts of fine-grained limestones and dolomite. Although the formation is mostly shale and does not conduct water well, the limestone, dolomite, and sandstone lithologies can act as water conduits thereby playing a significant role in spring formation. The spring also lies near the central axis of a syncline plunging steeply toward the southeast and cut by a series of fractures. In that the Health Department strongly favors phasing out springs as water supplies, the author located three sites for test wells, presumably into conductive zones on the property. At this time, one of the test wells has been drilled and it failed to produce the 200 gpm needed by the community. Drilling of the two remaining test wells is pending.

PARASUCHIAN OCCURRENCES IN UPPER TRIASSIC ROCKS OF THE CULPEPER BASIN OF VIRGINIA AND MARYLAND. Robert E. Weems, MS 928, U.S. Geological Survey, Reston, VA 22092, and Calvin R. Wiggs, HydroGeoLogic Inc., 1165 Herndon Parkway, Suite 900, Herndon, VA 22070.

Bones and teeth of parasuchians (crocodile-like archosaurian reptiles) are known from three sites in the Triassic sedimentary section of the Culpeper basin: 1) Manassas Sandstone (fluvial facies) at the intersection of Willard Road and River Road, Montgomery Co., Md.; 2) lower Balls Bluff Siltstone (fluvial facies) at Dulles Airport, Fairfax Co., Va. (Weems, 1979, Proc. Biol. Soc. Washington 92(4):682-688); and 3) middle Balls Bluff Siltstone (lacustrine facies) in the Culpeper Crushed Stone Quarry, Stevensburg, Culpeper Co., Va. The River Road specimen, a dentary with teeth, is the best available, but it is still inadequate to identify a specific genus. The palynologically determined early Norian age of all these specimens, however, circumstantially supports the possibility that they may represent a post-Rutiodon taxon. All of these occurrences are far below the presently accepted Triassic-Jurassic boundary within the basin.

GEOLOGIC HAZARDS IN WESTERN VIRGINIA:THE PRICES FORK ROAD LANDSLIDE, SPRING, 1987. Robert C. Whisonant, Dept. of Geol., Radford Univ., Radford, VA 24142 & Gary K. Rogers, Vecellio and Grogan, Inc., Beckley, WV 25802. In Spring, 1987, a landslide occurred along Montgomery County Road 659 (Prices Fork Road) in the western Virginia Valley and Ridge Province. The failed slope has a history of instability that extends back at least into the early 1900's. It is located in a tectonically disrupted zone associated with the western end of the Price Mountain Window. The rocks here constitute a "fault chaos"; allocthonous blocks of at least nine different stratigraphic units, ranging from Cambrian Copper Ridge sandstones to Mississippian Maccrady shales, have been identified in the chaos (Schultz, 1979). Extremely poor foundation conditions result. In addition to the geological setting, contributing factors to the Spring, 1987, landslide include: (1) construction of Prices Fork Road (adding weight to the slope and increasing the runoff); (2) removal of lateral support at the base of the slope by railroad construction; and, (3) excessive recent rainfall causing elevated pore-water pressures. Attempts to stablize the slope include regrading of the slide mass, construction of a tieback wall, and minor redirection of surface runoff. These remedial efforts have been successful to the present.

GEOLOGIC AND HYDROLOGIC CONTROLS OF WATER TABLES ON REGRESSIVE BARRIER ISLANDS. G. Richard Whittecar and Chris J. Johnson, Dept. of Geol. Sci., Old Dominion Univ., Norfolk, VA 23529. Progradation of beach and nearshore facies on a barrier island forms a surficial aquifer that is often mostly coarsening upwards. At two such regressive barrier features - Cape Henry, Virginia and Bodie Island at Kitty Hawk, N.C.- the surficial aquifer is generally 15 to 20 meters thick. On barrier islands, the water table shape is a function of barrier geometry and hydraulic conductivity, the recharge rate (mostly precipitation minus evapotranspiration), and the evaporation rate from wetlands and ponds. Water table profiles across areas with no surface water display broad symmetric domes. According to analyses of 2-dimensional ground-water flow models, deviations from this ideal shape occur where evaporative losses are significant. At Cape Henry the water table is strongly assymetric, apparently due to losses from extensive fresh water swamps in the southern half of the area; at Kitty Hawk, assymetry occurs across a zone of interdunal ponds and around a large reservoir in the middle of the island. Monthly recharge rates are estimated via water budget calculations based upon Thornthwaite formulae. Using a time-weighted average, from 18 to 36 months of recharge values are needed to calculate the "effective recharge" for a given month.

Materials Science

CONSIDERATIONS OF THE CONFORMATIONAL MULTIPLICITIES IN THE PARTITION FUNCTION FOR A LONG ALIPHATIC CHAIN. R. E. Barker, Jr.[1] and Amarjit J. Mahajan[2], [1]Dept. of Materials Science and [2]Dept. of Chemical Engineering, University of Va., Charlottesville, Va. 22903-2442. As any material approaches equilibrium in the statistical mechanical sense the statistical units of the system will establish a dynamic steady state that is determined by two types of factors: the Boltzmann terms $Bj=\exp(-Ej/kT)$ and the statistical weights (multiplicities) Wj for each member of the set {j} of possible distinct states. The link to thermodynamics is through the partition function $Z=\Sigma BjWj$. The object of this research is to consider the Wj's associated with the way trans, gauche(+) and gauche(-) conformational states are distributed in aliphatic chains C_nH_{2n+2}. Following a discussion of the general principles specific numerical examples will be considered for C_5H_{12} and $C_{20}H_{42}$.

ANALYSIS OF THE FRACTURE OF AN AIRCRAFT WING, D.A. Meyn and R.A. Bayles, Code 6327, Naval Research Laboratory, Washington, DC 20375 The separation of an aircraft wing in flight, a very rare occurrence, resulted in a concentrated effort to ascertain what caused the wing to separate and whether the cause involved an inspectable flaw, such that others of the same type could be inspected, repaired if necessary, and returned to operations. Initial analysis indicated that fracture of the lower wing panel (skin), at a point just outboard (toward the wing tip) of the fuselage attachment, had caused catastrophic fracture of the entire left wing from the rest of the aircraft. The lower panel is the major tensile structural element of the wing, consisting of aluminum alloy plate with integrally machined stiffeners, supporting the weight of the fuselage during flight. The origin of fracture was at first ascribed to fatigue initiating at a fastener hole near the aft edge of the panel in the full-thickness part of the plate. Analysis of the cause of failure based on fatigue initiation in this area was well underway, with unsatisfactory results, when subsequent re-examination proved that although fatigue cracks had indeed initiated at this fastener hole, fatigue initiating at a hole closer to the aft edge of the panel, in an area of greatly reduced thickness not considered part of the main load carrying section, had propagated into the thicker section and overtaken the first-discovered crack. The process of discovery and fracture analysis and the characteristics of the actual origin of fracture which initially masked its importance are described. Examination of other aircraft for cracks in this area forestalled future recurrences of this type of incident. (Supported by Naval Air Systems Command)

FATIGUE CRACK PROPAGATION IN MECHANICALLY ALLOYED AL-4Mg-1.3Li. Gary H. Bray, Dept. of Materials Science, Univ. of Va., Charlottesville, Va. 22903. Fatigue crack growth tests were performed on C(T) specimens at stress ratios of R=0.1, 0.4, 0.6, and 0.8 using the K-decreasing test method. The thickness of the specimens exceeded ASTM requirements for plane-strain. The crack growth rates at low stress ratios were higher than those in conventional I/M aluminum alloys due to a paucity of crack tip shielding mechanisms. The crack growth rates at high stress ratios were comparable to those in conventional I/M aluminum alloys. Closure levels increased with increasing stress ratio indicating that plasticity-induced closure contributed significantly to closure at high stress ratios even under plane-strain conditions. Single tensile overloads were applied at R=0.1 over a range of baseline ΔK. The maximum retardation in crack growth rate following the overload occurred immediately in contrast to conventional aluminum alloys which typically exhibit delayed retardation.

DETERMINATION OF SENSITIZATION LEVELS IN 304 AND 304L STAINLESS STEELS. Michelle A. Gaudett & J.R. Scully, Dept. of Materials Science, UVA, Charlottesville, VA 22903. Stress corrosion cracking (SCC) of components in nuclear reactors is a reliability concern. The primary cooling systems in commercial reactors are constructed using AISI 304 stainless steel. The heat affected zones of these steels become sensitized during welding and these regions become susceptible to intergranular stress corrosion cracking (IGSCC). The ability of a crack to propagate through a structure is intimately related to the number and distribution of sensitized grain boundaries in the material. Therefore, we need to determine the distributions of sensitization levels of individual grain boundaries for certain "average" or macroscopic values of sensitization. Sensitization levels of 304 and 304L stainless steel will be determined by electrochemical potentiokinetic repassivation tests (EPR) and a method for performing EPR on individual grain boundaries will be developed. The resulting information will be useful in a newly developed computer simulation of IGSCC and enable the prediction of structural lifetimes.

HYDROGREN ENVIRONMENT EMBRITTLEMENT IN β-TITANIUM ALLOYS. Lisa M. Hartman and R. P. Gangloff, Dept. of Mat. Sci., UVA, Charlottesville, VA. 22903. The goal of this research is to define the conditions and associated mechanisms for Hydrogen Environment Embrittlment (HEE) of advanced high strength β-titanium alloys in marine environments. We hypothesize that HEE is promoted by interactions of occluded crack electrochemistry and dynamic plastic strain that destabilize the protective film at the crack tip and enhance atomic hydrogen production and/or uptake efficiency. Computer controlled fracture mechanics experiments were designed to explore this notion, including: 1) slow rate loading with crack tip strain rate as the controlling variable, and 2) high frequency small amplitude ("ripple") cyclic loading superimposed on a constant or slowly rising load. The ripple load amplitude will subject the crack tip surface to high plastic strain, but will be below the threshold level required for bulk plastic zone fatigue damage. A new β-titanium alloy, Beta 21S (Ti-15Mo-3Nb-3Al by wt%), will be studied. Initial results will be presented for high strength HY130 steel (Fe-5Ni-0.5Cr-0.5Mo-0.1C) in 3.5% NaCl with applied cathodic polarization at -1000 mV_{SCE}. Monotonic loading promoted HEE in this resistant steel, however, ripple cycling at constant load did not induce crack growth.

EXPERIMENTS TO COMPARE SPACE CHARGE DISTRIBUTIONS IN DIELECTRIC LIQUIDS CONTAINING ANISOTROPIC IONIC ADDITIVES. David B. Holt[1], Faith B. Junghans, and R. E. Barker, Jr.[2], [1]Dept. of Chem. and [2]Dept. of Mater. Sci., University of Va., Charlottesville, Va. 22903-2442. Distributions of ions in otherwise insulating liquids are of practical relevance in several fields, e.g., in transformer fluids and in biophysical phenomena. Techniques, circuits, and apparatus have been developed to probe the local electrostatic potential $\phi(x)$ in representative liquids to which known concentrations of molecular ions have been added. According to electrostatic theory the curvature ($d^2\phi/dx^2$) of the potential is proportional to the local electric charge density $\rho(x)$. Measurements for highly anisotropic systems such as n-octanol containing sodium dodecyl sulfate exhibit some interesting effects which will be compared with results for simpler mixtures.

NUMERICAL STUDY OF BUOYANCY EFFECTS ON LAMINAR DIFFUSION FLAMES.
Paul V. Hyer, Lockheed Corp., Hampton, VA 23666, Dennis Stocker*, NASA Lewis Research Center, Cleveland, OH 44135 & Ivan O. Clark*, NASA Langley Research Center, Hampton, VA 23665.
A numerical modeling experiment has been conducted to study the influence of gravitational acceleration on the aerodynamics and chemistry of a laminar diffusion flame. The results have been compared with experiments conducted in drop towers at the NASA Lewis Research Center, in which hydrocarbon flames were observed photographically during free-fall. The experimental apparatus consisted of a circular cylindrical chamber supplied at one end with an axial source of methane fuel surrounded by a coflowing mixture of nitrogen and oxygen. The model assumed cylindrical geometry with azimuthal symmetry and used a global reaction scheme featuring seven chemical species and six reactions. Research cases included the drop-tower configuration with gravity levels set to normal Earth gravity, milli-gravity or zero gravity. Calculated distributions of chemical species were compared with published results from the literature.

CHARACTERIZATION OF X-RAY ELASTIC CONSTANTS IN A Ti-14Al-21Nb/SiC METAL MATRIX COMPOSITE. J. Jo, R.W. Hendricks, Materials Engineering, Dept., Va. Polytechnic Inst. and State Univ., Blacksburg, Va 24061, & W.D. Brewer*, K.M. Brown*, Metallic Materials Branch, NASA Langley Res. Ctr, Hampton, Va 23665. The x-ray elastic constant is a conversion factor required for the determination of residual and loading stresses by diffraction techniques. Plots of d-spacing versus $\sin^2\psi$ of the {843} family of crystallographic planes in a Ti-14Al-21Nb/SiC metal matrix composite were obtained at different stress levels using an MTS testing machine and an x-ray stress analyzer. The required elastic constant was determined from the slopes of these plots and the corresponding stresses. The extrapolation of these data to zero applied stress provides the residual stress in the unloaded material. In order to investigate the variation of the residual stresses in the metal as a function of depth below the sample surface, the sample was electropolished in steps of approximately 6 microns down to the first fiber layer. After each electropolishing, the residual stress and the x-ray constant were re-determined. The causes for the stresses will be discussed in terms of the differences in the coefficient of thermal expansion of the fibers and the metal matrix, while the spatial variation of the elastic constants will be discussed in terms of various models for the bonding between the fibers and the matrix. (Research supported by the NASA Langley Res. Ctr.)

CREVICE CORROSION OF ALLOY 625 IN SEAWATER. M. P. Jurinski & J. R. Scully, Dept. of Materials Science, Univ. of VA, Charlottesville, VA 22903. Alloy 625 is a Ni-Cr-Mo alloy with generally excellent resistance to all forms of corrosion in seawater. The corrosion resistance is due to the formation of a passive film on the alloy surface. However, Alloy 625 has been found to be susceptible to crevice corrosion when exposed to certain solution chemistries. These chemistries are the result of an occluded cell created at the metal surface. Increased concentrations of chemical species within the occluded cell are thought to be responsible for the degradation of the passive film resulting in anodic dissolution of the material. Alloy 625 has been designated as a possible replacement for cupro-nickel alloys in seawater piping systems of future naval vessels. Since tight crevices are an inherent component of flanges and other piping connections, this study is being conducted to define the regimes of susceptibility and immunity for alloy 625. (Funded by Newport News Shipbuilding)

ELECTROCHEMICAL MEASUREMENTS FOR THE VISUALIZATION OF CONVECTION IN LIQUID METAL. Ker-Yih Kao, & T. J. Anderson, & R. Narayanan, Dept. of Chem. Engr., Univ. of Fl., Gainesville, FL 32611, & A. L. Fripp, NASA, Langley Res. Ctr., M.S. 473, Hampton, VA 23665. An electrochemical technique for the visualization of natural convection in liquid metals and semiconductors in the vertical Bridgman melt-growth configuration is developed and tested. Electrochemical cells that employ the ceramic solid electrolyte yttria-stabilized zirconia as the boundaries of the fluid container are used to titrate and measure oxygen tracer in the liquid metal. Preliminary measurements of the diffusivity of oxygen in liquid tin have been made. The measurements are in good agreement with other researchers' results. An experimental cell designed to measure the effective diffusivity of oxygen in liquid tin should be able to discern transcritical points in the dynamic state of the melt as a function of imposed temperature gradient. The electrochemical technique will be modified to show the orientation of convection flow in the Bridgman simulation. (Supported by NASA Grant NAG-1-609)

AN ANNEALING STUDY OF STRAIN RELAXATION IN InGaAs/GaAs HETEROSTRUCTURE J.Kui and W.A.Jesser, Dept. of Materials Science, Univ. of Va. Charlottesville, Va. 22903. Epitaxial layers of InGaAs were grown on GaAs substrates at atmospheric pressure in such a way that a thickness gradient was realized. Anneals were performed just after growth at different times and temperatures. Strain relaxation during the growth was studied by optical microscopy and transmission electron microscopy. These experiments show that misfit strain can be relaxed by generation of misfit dislocations by means of a kinetic process. The kinetic constant has a linear relationship with excess thickness ($h-h_c$) and also is a function of number of threading dislocations of the substrates and the annealing temperature. The activation energy of the relaxation process also can be calculated from the experimental data. After long annealing time, the sample reaches its steady state in which a residual strain apparently still exists which is not accommodated by misfit dislocations. These experimental results are in good agreement with the kinetic model of misfit dislocations generation developed by Fox and Jesser.

A TEM CHARACTERIZATION OF COBALT-ZIRCONIUM ALLOYS. Kenneth R. Lawless, Dept. of Materials Science, University of Virginia, Charlottesville, VA 22903. Considerable interest has been shown in the hard magnetic properties of Co-Zr, Co-Zr-B, and Co-Hf-B alloys. This study reports preliminary microstructural studies on the Co-Zr binary alloys with compositions near $Co_{11}Zr_2$. Melt spun samples were heat treated at temperatures around 900° C. All samples were found to be microcrystalline and multiphase in character. The major phase present in all cases was a heavily faulted phase with composition near $Co_{11}Zr_2$ or Co_7Zr_2. Also present in lesser amounts were twinned FCC cobalt and a near perfect cubic phase $Co_{23}Zr_6$. Moderately high resolution images and diffraction patterns will show the structure of these phases.

FRACTURE OF ADVANCED ALUMINUM ALLOYS AT ELEVATED TEMPERATURES. William C. Porr, Jr., Yang Leng, and Richard P. Gangloff, Dept. of Matls. Sci. and Eng., Univ. of Va., Charlottesville, Va. 22903. The unusual intrinsic ductility decrease with increasing temperature associated with advanced rapidly solidified powder metallurgy (RS/PM) aluminum alloys is discussed, with emphasis on alloy 8009. 8009 is a rapidly solidified Al-8.5Fe-1.3V-1.7Si (wt.%) alloy manufactured by Allied-Signal, Inc. that exhibits exceptional strength retention with long term elevated temperature exposure due to the thermal stability of the strengthening $Al_{12}(Fe,V)_3Si$ dispersoid. With increasing temperature, alloy 8009 exhibits a decrease in tensile ductility and fracture toughness with no apparent associated change in microscopic fracture mode. A loading rate dependence of ductility and fracture toughness at elevated temperatures is also observed, implying a time-temperature dependent mechanism for the evolution of deformation and fracture in this alloy. Evidence is presented discounting any role of environmental embrittlement in this elevated temperature behavior. Solute-dislocation interactions (strain aging) and/or novel deformation micromechanisms are hypothesized to account for the decrease in ductility and fracture toughness at elevated temperatures observed in the advanced RS/PM aluminum alloys. (This research was supported by the NASA-Langley Research Center, Grant NAG-1-745. Material was donated by Allied-Signal, Inc.)

MECHANICAL AND THERMAL PROPERTIES OF CERAMIC AND METAL PARTICULATE REINFORCED HIGH TEMPERATURE POLYMERS. D. C. Raqué and R. G. Kander, Mat. Eng. Dept., VPI&SU, Blacksburg, Va. 24061-0237. As the upper use temperature of high performance polymers continues to climb, it is important to characterize the properties of composites formed from these resins. Of specific interest in structural and semi-structural applications are composites formed from reinforcements which are also stable at high temperature (e.g., metals and ceramics). In this study, the effect of reinforcing high-temperature polymers with ceramic and metal particles is evaluated. Ceramic reinforcements include mica powder and NICALON™ chopped fibers, while metal reinforcements include fine copper and copper-aluminum-nickel alloy powders. Polymers studied include polyimide thermoplastic powders and high-temperature epoxy thermosetting resins. Mechanical properties investigated include strength, modulus, and toughness. The high temperature stability of these properties is also investigated. Thermal properties studied include thermal expansion, glass transition temperature, and heat capacity.

INVESTIGATION OF SURFACE ENERGIES OF SOLIDS BY MEANS OF CORRELATION PLOTS INVOLVING CONTACT ANGLE MEASUREMENTS. G. A. Reitz and R. E. Barker, Jr., Dept. of Mater. Sci., University of Va., Charlottesville, Va. 22903. A method of determining contact angles (θ) from the relative dimensions of height to chord ratios for small drops is presented. The result is $\cos\theta = [1-4(h/c)^2]/[1+4(h/c)^2]$. A technique is developed in which the collective data of critical surface tensions (γ_c) and θ for a number of similar solids with a single liquid are used to predict γ_c, for a solid whose critical surface tension is unknown, from a single contact angle measurement with the chosen liquid. Examples of the correlation achieved for some polymer/liquid systems are presented, and possible causes for deviation from predicted ideal behavior are discussed. The method of contact angle measurements has proved useful in investigating the effects of photochemical modifications of polymer surfaces by ultraviolet radiation.

DEGRADATION MODES IN TYPE R THERMOCOUPLES. William R. Rosch, Dept. of Mat. Sci. UVa, William J. Debnam & Archibald L. Fripp, NASA Langley Research Center. Thermocouples are the most common tool for measuring temperatures. Type R thermocouples made from platinum and rhodium are workhorses for accurate temperature measurements from 800-1600°C. Work will be presented that shows that bare wire TC's and TC's covered with a protective sheath can be contaminated and degraded by exposure to other metals at high temperatures. Results of tests will show that the amount of damage depends on the time of exposure and the exposure temperatures.

EVALUATION OF THE ELECTROCHEMICAL IMPEDANCE RESPONSE OF ALUMINUM IN SODIUM BORATE BUFFER ELECTROLYTE. *Gayle R. T. Schueller and S. Ray Taylor, Materials Science Department, University of Virginia, Charlottesville, VA 22903.* Electrochemical impedance studies were conducted on aluminum samples exposed to borate buffer electrolyte in order to confirm an equivalent circuit model for this system based on physical parameters such as oxide thickness and dielectric constant. A variety of aluminum alloys were tested with particular emphasis on high purity (99.999%) aluminum. The electrolyte, consisting of 0.1M sodium borate buffered with boric acid to pH 7 was chosen to minimize pitting, thereby simplifying the overall impedance response of the system. This impedance response was modeled by a parallel combination of oxide resistance and capacitance, in series with a solution resistance. It was found that experimental capacitance values were inversely proportional to anodized oxide thicknesses as predicted by parallel-plate capacitor equations and that capacitance increased with time in solution. Since XPS analysis of the oxide thickness of air-formed oxides before and after exposure to borate buffer indicated no statistically significant change in oxide thickness as a function of exposure time, the increased capacitance was attributed to an increase in the dielectric constant due to hydration.

DISCOVERY AND IDENTIFICATION OF THE 'CUBIC PHASE' IN REINFORCED Al-Cu-Mg ALLOYS. Randy D. Schueller, F.E. Wawner, and A.K. Sachdev*, Materials Science Dept., Univ. of Virginia, Charlottesville, VA 22901. An Al-4Cu-2Mg alloy reinforced with 20 volume percent SiC whiskers was examined after a T7 heat treatment. The expected precipitate phase was equilibrium S' (Al_2CuMg), as was confirmed in an unreinforced heat treated alloy. When reinforcement was added to this alloy, however, other precipitate phases formed in addition to S'. These included plate shaped θ' (Al_2Cu) and an interesting cubic shaped phase with edge lengths of 300-500Å. The atomic structure of this phase was determined to be cubic with a lattice parameter of 8.33Å which made it semi-coherent with the {001} Al planes. The cubic phase was identified as $Al_5Cu_6Mg_2$ and was determined to be a metastable phase which nucleated and grew during the warm water quench following solution treatment. The high concentration of these phases along with their physical properties suggests they have great potential for precipitate strengthening at intermediate and high temperatures.

THE ROLE OF RESIDUAL AND APPLIED STRESSES IN HYBRID THICK FILM CIRCUITS. N.N. Schulz, A. Elshabini-Riad* The Bradley Dept. of Electrical Engineering & M.T. Stawovy*, J.Jo, K.L. Venzant*, D. Vijay*, R.W. Hendricks, Dept. of Materials Engineering, Va. Polytechnic Inst. & State Univ.,Blacksburg, Va. 24061. We have investigated the role of residual and applied stresses on the mechanical integrity and electrical performance of thick film hybrid microelectronic circuits. Because of the significant difference in the linear coefficient of thermal expansion between the alumina substrate and the Ag-Pd metallization, there are significant tensile stresses in both the metallization and on the back (non-component) side of the substrate. It has been determined that circuit manufacturing causes residual stresses that are as large as 50% of the modulus of rupture of the material. Furthermore, it has been found that these residual stresses as well as applied loads have a significant effect on the high-frequency (10 GHz) electrical response of the metallization. We will discuss the results of our studies using x-ray diffraction and strain gages to determine the stresses. We will also describe the calibration of the relationship between stresses and electrical performance of simple circuits through the use of time domain reflectometry measurements in a calibrated cantilevered beam.

GAMMA-RAY AND X-RAY IMAGING STUDIES OF THE LOCATION AND SHAPE OF THE MELT-SOLID INTERFACE IN THE BRIDGMAN GROWTH OF LEAD-TIN TELLURIDE AND GERMANIUM. R. T. Simchick, S. Sorokach, Lockheed Engineering and Sciences Co., Hampton, VA, USA; A. L. Fripp, W. Debnam, R. F. Berry, NASA Langley Research Center, Hampton, VA, USA; and P. G. Barber, Longwood College, Farmville, VA, USA. The melt-solid interface is an important parameter in Bridgman crystal growth. Interface shape and position are important processing variables that are controlled by a combination of material properties and furnace controls. Therefore, the ability to visualize the interface in real time during crystal growth from furnaces is a valuable tool. Procedures have been developed to observe the shape and movement of the melt-solid interface during Bridgman growth of lead-tin telluride and germanium. This was accomplished by combining x-ray and gamma ray image intensified images with modified procedures for image enhancement. The techniques developed have general applicability to other crystal growth techniques. This presentation will discuss the technique used to produce real-time interface images; followed by a presentation of a few images illustrating image enhancement techniques; and finally, images showing the interface throughout the growth of the semiconductor crystals.

MICROSTRUCTURAL CHARACTERIZATION OF SILICON-GERMANIUM-GALLIUM PHOPHIDE ALLOYS. V. Srikant & W. A. Jesser, Dept. of Mat. Sci., Univ. of Va., Charlottesville, Va 22903. Two different alloys of silicon-germanium were investigated in order to investigate the effects of GaP addtions to these alloys. 10 - 15 at % GaP was added to these alloys. It was found that the maximum solubility of GaP in 50/50 Si-Ge was about 6 at% and that in 80/20 Si-Ge was about 7.8 at%. It was also found that GaP forms a low melting eutectic with these alloys. The shape and orientation of these eutectic structures depended on the rate at which they were cooled down to room temperature. On rapid cooling from temperatures above the eutectic temperatures lamellar structures oriented along [100] directions were observed. As the cooling rate was decreased these eutectic structures lost their lamellar shape. It was also found that the matrix around the eutectic became richer in germanium with decreasing cooling rate. Further it was determined that the eutectic temperature of the 80/20 Si-Ge alloy lies between 1125° C and 1150° C.

XPERT: An expert system for the validation and interpretation of X-Ray residual stress data. Marc Tricard, Scott Courtney, Robert Hendricks. Materials Engineering Dept, VA Tech, Blacksburg, VA, 24061. Although widely recognized in the research community as one of the most accurate non-destructive methods for the determination of residual stress in polycrystalline structural materials, X-ray diffraction has not been extensively adopted in the field. We believe that computer assistance could contribute to the promotion of this technique by increasing the productivity and accuracy of these measurements. We have developed a prototype of an expert system, using Nexpert Object's shell, to assist a non-trained operator in the validation and interpretation of X-ray diffraction residual stress data. Its knowledge base contains relevant examples of the rules necessary for data validation. The prototype has also validated most of the concepts required for the implementation of a full scale version by evaluating all of the major technical features such as graphic representation, external routine calls, and databases accesses.

THERMO-ACOUSTIC MONITORING OF DAMAGE ACCUMULATION IN POLYMERS AND POLYMER-BASED COMPOSITES. R. K. Verma and R. G. Kander, Mat. Eng. Dept., VPI&SU, Blacksburg, Va. 24061-0237. A damaged polymer or composite sample contains "damage areas" (microcracks, delaminations, etc.) which are typically in a state of residual stress. The internal surfaces of these damage areas would prefer to slide past one another due to this anisotropic internal stress state. However, mechanical interlocking of the surfaces hinders this sliding movement. When such a damaged sample is gently heated (≤100 °C), some of the mechanical interlocking is relaxed, and the surfaces slide past one another releasing stored elastic energy in the form of acoustic waves. Local anisotropy in the coefficient of thermal expansion leads to similar sliding movement, generating additional acoustic waves. Literature results have shown that these "thermo-acoustic emissions" can be monitored to study the extent and type of damage which exists in a polymer or composite sample. In this work, thermo-acoustic emission monitoring is developed as a quantitative tool for the non-destructive study of the damage accumulation process in polymers and composite materials. Correlations are developed between the amount and type of prior damage and the thermo-acoustic emissions produced.

THE SYNTHESIS, MICROSTRUCTURE, AND THERMAL PROPERTIES OF $(Ca,Mg)Zr_4(PO_4)_6$ CERAMICS. Y. Yang, T. K. Li*, D. A. Hirschfeld, and J. J. Brown*, Center for Advanced Ceramic Materials, Virginia Polytechnic Institute and State University, Blacksburg, Va. 2406l-0256. $(Ca_{0.6}, Mg_{0.4})Zr_4(PO_4)_6$ ceramics were synthesized by sol-gel and solid state reaction techniques. For the sol-gel derived compositions sintered within the temperature range of 1150 to 1300°C, the bulk thermal expansion coefficient varied from $3.02x10^{-6}/°C$ to $-2.18x10^{-6}/°C$ depending on the heat treatment conditions. A similar variation in the bulk thermal expansion was found for the ceramics formed using a solid state reaction technique, but the range was limited to $0.8x10^{-6}/°C$ to-$0.9x10^{-6}/°C$. The observed variation in thermal expansion was related to the microstructure of the ceramic.

Medical Sciences

ROLE OF CALCIUM IN ISCHEMIA-REPERFUSION INJURY OF THE CARDIAC SARCOPLASMIC RETICULUM. Alaa E. Abdelmeguid, Dept. of Cardiology, Med. Col. of Va., Richmond, Va. 23298, & Joseph J. Feher*, Dept. of Physiology, Med. Col. of Va., Richmond, Va. 23298. We examined the role of perfusate [Ca] in the function of the cardiac sarcoplasmic reticulum (CSR) in ischemia in a Langendorff rat heart model with 5 rats per group. All hearts were perfused for 20 min with Krebs buffer containing 1.4 mM Ca. Hearts in group I were perfused for an additional 15 min with this same solution. Hearts in group II were perfused for an additional 5 min with the 1.4 mM Ca and then were exposed to 10 min of global normothermic ischemia. Hearts in group III were perfused with 0.2 mM Ca for 5 min prior to 10 min of ischemia. The CSR function was assessed by measuring the Ca uptake rate of ventricular homogenates, expressed as nmol/min-mg protein, under two conditions: (a) with 500 μM ryanodine (RY); (b) with no RY. This concentration of RY has been shown to close the CSR Ca release channel. With 1.4 mM Ca perfusion, ischemia reduced CSR function 40% when measured with no RY (18.5 in group I compared to 10.9 in group II). This decrease was not observed when 0.2 mM Ca was perfused prior to ischemia (17.8 in group III). This protective effect of low Ca perfusion on CSR function was not observed when CSR function was measured with RY (32.6 in group II and 32.6 in group III) to close the Ca efflux pathway. These results suggest that extracellular Ca is involved in the ischemic damage to CSR by effects on the ryanodine-sensitive Ca release channel of the CSR. Perfusion with low Ca prior to ischemia prevents the persistent inappropriate opening of the release channel. (Supported by a grant from the American Heart Association, Va. Affiliate, Inc.)

ROLE OF CALCIUM IN THE LONG TERM REGULATION OF THE CALCIUM-RELEASE CHANNEL OF THE CARDIAC SARCOPLASMIC RETICULUM. Alaa E. Abdelmequid, Dept. of Cardiology, Med. Col. of Va., Richmond, Va. 23298, & Joseph J. Feher*, Dept. of Physiology, Med. Col. of Va., Richmond, Va. 23298. We examined the role of Ca in the function of cardiac sarcoplasmic reticulum (CSR) by perfusing Langendorff-mounted rat hearts with solutions of varying [Ca]. After 20 min perfusion with Krebs solution containing 1.4 mM Ca, the hearts were perfused for an additional 5 min with Krebs solution containing (a) 0.2 mM Ca, group I, n=8; (b) 1.4 mM Ca, group II, n=8; (c) 2.8 mM Ca, group III, n=8; (d) 5.6 mM Ca, group IV, n=8. The CSR function was then evaluated by measuring the Ca uptake rate of ventricular homogenates (expressed as nmol Ca taken up per min per mg protein) under two conditions: (a) with 500 μM ryanodine (RY); and (b) with no RY. The CSR function measured in the absence of RY decreased systematically with increasing perfusate [Ca] (25.7, 21.4, 17.2, and 16.3 in groups I, II, III, and IV, respectively). However, CSR function was not affected by perfusate [Ca] when the Ca release channel was blocked by RY (44.5, 46.0, 48.0, 45.6, groups I, II, III, and IV, respectively). These results point to an important role of Ca in the long-term regulation of CSR function by acting on the ryanodine-sensitive Ca release channel. This action probably involves a conformational change that can last for at least several minutes. This regulation is probably different from the beat-to-beat regulation of the CSR by Ca (Ca-induced Ca release). The channel represents a potential site at which high cytosolic [Ca] could cause a persistent opening of the CSR Ca release channel, leading to a further loss of cellular Ca homeostasis and subsequent further damage. (Supported by a grant from the American Heart Association, Va. Affiliate, Inc.)

CONTRIBUTIONS OF TUMOR NECROSIS FACTOR-α IN TUMOR-INDUCED IMMUNOSUPPRESSION. D.G. Alleva and K.D. Elgert. Dept. of Biology, Microbiology & Immunology Section, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. By increased production of suppressive molecules such as prostaglandin E_2 (PGE_2), macrophages (Mϕ) from tumor-bearing hosts (TBH) show greater suppression of alloreactivity than normal host (NH) Mϕ. Tumor necrosis factor-α (TNF-α), a tumoricidal monokine produced by Mϕ during tumor growth, can regulate Mϕ PGE_2 production. We assessed the contribution of TNF-α to tumor-induced Mϕ-mediated suppression of CD4+ T cell allorecognition by adding TNF-α, anti-TNF-α antibodies, and/or indomethacin, a blocker of PGE_2 production, to murine mixed lymphocyte reaction (MLR) cultures in the presence or absence of NH or TBH Mϕ. TNF-α increased alloreactivity in the absence of Mϕ but decreased it when NH or TBH Mϕ were added. Anti-TNF-α antibodies had little affect on T cell allorecognition in the absence of Mϕ but increased alloreactivity in the presence of TBH Mϕ to a greater extent than in the presence of NH Mϕ. Indomethacin treatment partly restored reactivity in Mϕ and TNF-α-added MLR cultures but the restoration was significantly increased in the presence of TBH Mϕ. These results suggest that TBH Mϕ can be more suppressive than NH Mϕ by producing more TNF-α and/or being more susceptible to PGE_2 production induced by TNF-α.

EXPRESSION OF DEVELOPMENTALLY REGULATED GENES IN MACROPHAGES DURING TUMOR GROWTH. D. Askew and K.D. Elgert. Dept. of Biology, Microbiology & Immunology Section, Va Polytechnic Inst. & State Univ., Blacksburg, VA 24061. Macrophages (Mϕ) play an important role in tumor-induced immunosuppression. We previously have characterized changes in Mϕ function and phenotype during tumor growth. Of interest was the discovery of an increase in immature Mϕ in tumor-bearing hosts (TBH). Mac-2, a surface marker found on mature elicited Mϕ, is considered to be developmentally regulated. Flow cytometric analyses showed a decrease of Mac-2+ Mϕ during tumor growth, which supported our earlier work. Mac-2 has lectin-like properties and has been reported to be an IgE-binding protein. Mac-2 is found in cytoplasmic and membrane fractions but lacks a transmembrane domain. Western blot analyses of TBH thioglycollate-elicited peritoneal Mϕ showed a decrease in both cytoplasmic and membrane forms. Northern blot analyses of TBH Mϕ showed a decrease in Mac-2 mRNA, which suggested that tumor growth suppresses the expression of Mac-2 mRNA and the subsequent expression of the cytoplasmic and membrane forms of the protein. The decrease in Mac-2 mRNA expression signals a shift from a population of mature Mϕ to a population of immunosuppressive immature Mϕ. (Supported by Sigma Xi and VAS Grants)

EFFECT OF MULTIVITAMINS ON SERUM VITAMIN A AND E LEVELS IN DIALYSIS PATIENTS. R.B. Brandt, W.G. Gutheim, B. Dezzutti, Dept. of Biochemistry, MCV/VCU, Richmond, VA 23298, D.A. Sica, T.W. Gehr, Dept. of Med., Div. of Nephrology, MCV/VCU & J.M. Hain, Dept. of Gen. Surgery, St. Joseph Mercy Hosp., Ann Arbor, Michigan. Serum retinyl palmitate (RP) levels closely correlate with toxicity of hypervitaminosis A. The dialysis patients studied received a two-month course of nephrocaps followed by a two-month course of a daily oral multivitamin containing 5000 IU vitamin A and 10 IU vitamin E. Nephrocaps lack vitamins A, and E. There was no statistical difference between baseline and nephrocaps-treated patient serum retinol (ROH) and RP levels, but there was an elevation for patients on multivitamins in ROH. The serum ROH levels were 110 (± 37) μg/dL (mean ± SD) (N=23) for baseline (normal 30-70 μg/dL), 116 (± 26) (N=12) on nephrocaps, and 141 (± 21) (N=7) on multivitamins. The serum RP levels were below 10 μg/dL, while hypervitaminosis patients usually exceed 50 μg/dL. Vitamin E levels in patients were not affected by supplementation of daily oral multivitamin. (Supported in part by funds from the Smokeless Tobacco Research Council, Inc.)

ATTEMPTS TO DEVELOP 5-HT1C-SELECTIVE PHENALKYLAMINES. P. Bartyzel*, R. Raghupathi, M. Teitler, R. A. Glennon, Dept. of Medicinal Chemistry, MCV/VCU, Richmond, VA 23298. 5-HT1C serotonergic receptors closely resemble 5-HT2 receptors in terms of molecular biology and pharmacology; there are no ligands currently available that show appreciable selectivity for one set of receptors over the other. Earlier studies in our laboratory have shown that phenalkylamines such as DOM, DOB and DOI bind with reasonably high affinity at both 5-HT1C and 5-HT2 receptors. Systematic modifications were introduced in the phenalkylamine nucleus which, from preliminary data, appeared to decrease 5-HT2 but not 5-HT1C affinity, in order to develop analogues with improved 5-HT1C selectivity. In addition, these studies were expected to yield structure-affinity relationship (SAFIR) data at 5-HT1C receptors, which are essentially non-existent. Although the highest 5-HT1C/5-HT2 selectivity obtained was only 14-fold, useful indications were obtained for improvement of 5-HT1C affinity and selectivity (for instance, removal of the α-methyl or the 5-methoxy substituent results in improved selectivity for 5-HT1C over 5-HT2 receptors). Using these indications, it should be possible to design compounds with enhanced 5-HT1C affinity and selectivity.

In vitro characterization of a cannabinoid receptor using the synthetic analogs (-)-11-OH-Δ^9-THC-DMH and CP-55,940. D. Troy Bridgen, Xin Wei, David R. Compton, and Billy R. Martin, Dept. of Pharmacology and Toxicology, MCV/VCU, Richmond, VA, 23298. The dimethylheptyl (DMH) analog of 11-OH-Δ^9-tetrahydrocannabinol (THC) possesses a long branched side chain, rather than the normal pentyl side chain of Δ^9-THC. However, 11-OH-Δ^9-THC-DMH more closely resembles naturally occurring cannabinoids than the bicyclic compound CP-55,940 which has been used by others to radiolabel a cannabinoid binding site. Radioligand binding assays were established using both compounds, and the characteristics of the assays compared by equilibrium, thermodynamic, and displacement analyses. 11-OH-Δ^9-THC-DMH possessed a K_D of 1.2±0.1 nM (mean±S.E.) and a B_{max} of 2.8±0.3 pmol/mg protein. CP-55,940 possessed a K_D of 0.72±0.08 nM and a B_{max} of 2.5±0.8 pmol/mg protein.Rank ordering of five compounds according to potency for displacing ^{3}H-CP-55,940 accurately indicated the potency of these compounds for their ability to also displace ^{3}H-11-OH-Δ^9-THC-DMH. The binding of either ligand at 30 °C was favorable (ΔG= -98 and -107 kcal/mol for 11-OH-Δ^9-THC-DMH and CP-55,940 respectively), and driven by entropic forces (ΔS= 369 and 152 cal/°K-mol, respectively) rather than enthalpic forces (ΔH= 13.7 and 9.7 kcal/mol, respectively). Thus, both ligands appear to label identical binding sites in a similar fashion. (Supported by NIDA grant DA-03672 and a Pharmaceutical Manufacturers Assoc. Foundation Award #90-0133.)

MEASURING LOW LEVEL CROCIDOLITE: A COMPARISON OF MICROSCOPIC METHODS USED IN THE ANALYSIS OF AIRBORNE ASBESTOS. Michael T. Chermak, Douglas J. Anderson, William E. Keefe, Robert E. Tompkins & R. Leonard Vance, Dept. of Prev. Med., Med. Col. of Va., Richmond, Va. 23298. Asbestos exposure may cause ill-health effects primarily to the respiratory system. Many believe that mesothelioma may result from low level crocidolite exposure. The objective of this study is to determine whether phase contrast microscopy (PCM) is adequate to detect airborne crocidolite. Transmission electron microscopy (TEM) will be used to ensure that airborne crocidolite fibers invisible to PCM are not present in selected offices of West Hospital at the Medical College of Va. Crocidolite is 90% of a highly friable sprayed-on asbestos insulation material located above the dropped ceiling in these offices. Patently, exposure levels will vary accordingly with activity. However, this study concludes PCM & TEM detect no substantial levels (≈0.005 f/cc, TEM) of airborne asbestos.

EFFECTS OF COOLING ON ALPHA ADRENERGIC RECEPTORS OF ISOLATED RAT BLOOD VESSELS. William Covell* and J.L. Hart. Biol. Dept., George Mason Univ., Fairfax,VA 22030

The thoracic aorta and femoral vein were isolated from Sprague Dawley rats to investigate the effects of cooling on alpha adrenergic receptors. Vessel rings were suspended in Krebs solution in jacketed tissue baths for the recording of isometric tension. The vessels were exposed to cumulative concentrations of alpha-1 (phenylephrine) or alpha-2 (oxymetazolin) agonists at 37°C and at 24°C. Vessels responded to both alpha agonists with concentration-related increases in tension. Alpha-1 responses of both vessels were depressed by cooling. However, alpha-2 contractions of the vein were significantly increased by cooling while those of the thoracic aorta were decreased. These differences in the alpha-2 responses to cooling of the superficial vein and deep artery are consistent with the suggestion that alpha-2 adrenergic receptors play a role in the redistribution of blood flow away from superficial areas of the body during thermoregulatory adjustments of the circulation.

SINGLE OR CHRONIC DOI ADMINISTRATION INDUCES SUPERSENSITIVITY TO 5-HT2 RECEPTOR FUNCTION: BEHAVIORAL AND BINDING STUDIES. N. A. Darmani, B.R. Martin, K. Miller, M. Teitler and R.A. Glennon. Depts. Pharmacol./Toxicol, Med. Chem. MCV/VCU, Richmond, VA. Both 5-HT2 selective agonists and antagonists reduce head-twitch response (HTR) upon chronic administration. The purpose of the present study was to examine agonist-induced attenuation. A single DOI injection(2.5 mg/kg, i.p.) produced 40±1 HTRs in 20 min. A second injection administered either 24, 48, 144 or 192 h following the first produced 23±1($p<0.05$), 56±3 ($p<0.05$), 53±2 ($p<0.05$) and 35±2 ($p>0.05$) HTRs respectively. When mice were injected with DOI once daily for 13 days, a significant reduction in HTR frequency (41-21%) occurred on days 2 to 6. Thereafter, the HTR number slowly returned to control. When mice were challenged with DOI either 48, 96, 144 or 240 h following cessation of chronic treatment, the respective HTR scores were: 57±2 ($p<0.05$), 46±1 ($p<0.05$), 42±1 ($p<0.05$) and 36±3 ($p>0.05$). Acute DOI administration had no effect whereas chronic administration reduced the 5-HT2 receptor capacity by 40%. Thus, acute and chronic DOI administration can induce a supersensitive effect which appears 48h following last injection and can persist for the next 144 h. Such a supersensitive state in the presence of reduced 5-HT2 receptors suggest a change in the sensitivity of its transduction mechanism.(NIDA grants DA-02396 and DA-01642).

5-HT_2 SEROTONIN BINDING PROPERTIES OF N-SUBSTITUTED PHENYLALKYLAMINES AND TRYPTAMINES. J. De Los Angeles, M. Teitler, and R.A. Glennon, Dept. of Medicinal Chemistry MCV/VCU Richmond, VA 23298. 1-(4-Bromo-2,5-dimethoxyphenyl)-2-aminopropane (DOB) and 5-methoxy-α-methyltryptamine (5-MeO-α-MeT) are representative of two major classes of 5-HT_2 agonists. DOB and 5-MeO-α-MeT bind with high affinity (Ki = 0.79 and 7 nM, respectively) to the agonist high affinity state (5-HT_{2H}) of 5-HT_2 receptors labeled by [^{3}H]DOB, but bind with significantly lower affinity to the low affinity state (5-HT_{2L}) labeled by [^{3}H]ketanserin. 5-HT_2 antagonists such as ketanserin bind with equal affinity to both states. Thus, structure affinity relationships (SAFIR) of 5-HT_2 agonists obtained using [^{3}H]DOB as the radioligand may be more accurate; therefore, it is necessary to re-examine the SAFIR of 5-HT_2 agonists at 5-HT_{2H} sites. Prior SAFIR studies of the two classes indicate that substitution with small alkyl groups on the terminal amine to yield secondary and tertiatry amines results in minor to drastic reduction in binding affinity, depending on the size of the substituents and degree of substitution. However, relatively little is known about the influence of N-monosubstitution utilizing larger substituents. The α-methyl group does little to enhance or reduce affinity. Hence, a series of α-desmethyl DOB and 5-methoxytryptamine derivatives monosubstituted at the terminal amine with small alkyl to large aralkyl groups were synthesized and their 5-HT_{2H} binding affinity was evaluated. Suprisingly, most analogs in both classes retain high affinity even with the larger aralkyl groups. In fact, the N-benzyl derivatives are equipotent with, if not more potent, than the unsubstituted parent compounds.

Pharmacological Evaluation of Nicotine and Mecamylamine Analogs. Katherine R. Dimen, Everette L. May and Billy R. Martin, Dept. of Pharmacol. and Toxicol., MCV/VCU, Richmond, VA 23298. To investigate the mechanism of mecamylamines' antagonism of nicotine in the CNS, the dose-response curves for depression of antinociception and depression of spontaneous activity by nicotine were recorded in the presence of increasing concentrations of mecamylamine analogs. Nicotine produced a dose responsive depression of antinociception and depression of spontaneous activity with ED_{84}'s of 2.9 and 0.8 mg/kg, respectively. The (±)-exo-isomer of mecamylamine antagonized the effect of nicotine at these ED_{84} doses with AD_{50}'s of 0.27 mg/kg for antinociception and 0.08 mg/kg for spontaneous activity. Antinociceptive testing revealed that compounds 7 and 15 were the most effective antagonists of nicotine with AD_{50}'s of 0.3 and 0.6 mg/kg, respectively. Compounds 1, 3, 5 and 6 produced moderate antagonism of nicotine, with AD_{50}'s of 1.7, 1.4, 1.2 and 2.8 mg/kg, respectively. Nicotine-induced spontaneous activity was antagonised most effectively by compounds 3 and 7, with AD_{50}'s of 0.9 and 0.7 mg/kg, respectively. Compound 6 antagonized nicotine with an AD_{50} of 2.3 mg/kg. Compound 1 produced 29% antagonism at a 10 mg/kg dose, and compound 15 had an AD_{50} of 12.3 mg/kg. These results indicate that one methyl group on the nitrogen gave the highest antagonistic activity in the tail flick and spontaneous activity evaluations. Increasing the length (straight chain or branched) of the N-alkyl substituent decreased antagonist activity. Also, specificity for tail flick antagonism was produced by a di-alkyl substituent at the nitrogen.

INTRATHECALLY- ADMINISTERED CALCITONIN GENE-RELATED PEPTIDE PRODUCES DOSE-DEPENDENT HYPOTHERMIA IN MICE. Dombrowski D. S., Smith F. L., Welch S. P., and Dewey W. L., Dept. of Pharm./Tox., Med. Col. of Va., Va. Commonwealth Univ., Richmond, Va. 23298. The ratio of calcium to sodium ion concentrations in the cells of the posterior hypothalamus is the major determinant of body temperature set-point. When the intracellular calcium to sodium concentration ratio rises, the body temperature set-point decreases resulting in hypothermia. When the intracellular sodium to calcium concentration ratio rises, the body temperature set-point increases, resulting in hyperthermia (sodium fever). Calcium (150-720 nmol) administered intrathecally (i.t.), 15 minutes prior to measuring rectal temperature, produces hypothermia in intact mice. However, in spinalized mice (with a mechanical block of the cerebrospinal fluid (CSF) flow at the T6-T8 vertebrae) injected i.t., showed no hypothermic response. Calcitonin gene-related peptide (CGRP) modulates intracellular calcium within the brain and the spinal cord. CGRP (53-1051 pmol, i.t.) produced significant dose-dependent decreases in temperature at 3, 12, and 15 hr. with the peak effect at the 3 hr. Calcium (75 nmol) and CGRP (5.3 pmol) in combination synergized to produce hypothermia at the 1 and 3 hr. time points. CGRP given i.t. may diffuse rostrally through the CSF to the brain and modulate calcium in the posterior hypothalamus to produce this hypothermia. This work was supported by grant # DA 06031, F32-DA05415, and Commonwealth Center on Drug Abuse Research.

DEVELOPMENT OF 5-HT_3 SELECTIVE SEROTONIN AGONISTS. M.Dukat, P.Bartyzel, M.Teitler and R.A.Glennon Dept. of Medicinal Chemistry MCV/VCU, Richmond VA 23298. 5-HT_3 serotonin receptors may be of clinical significance in the treatment of migraine, anxiety and nausea and emesis from cancer chemotherapy. To date, there are no potent and selective 5-HT_3 receptor agonists . Using 5-HT as a starting point, we examined the influence of various terminal N-substituents on 5-HT_3 affinity due to evidence that bulky substituents might be tolerated. We also studied the distance between the aromatic ring to the amine because the possibility exists that 5-HT_3 receptors may accommodate ligands with a greater distance than that found in 5-HT. We examined tryptamine analogs (homotryptamines) where the side chain was extended; these bind at 5-HT_3 receptors with low affinity (Ki> 2,000 nM). Although bulky amine derivatives also bind with low affinity, quaternary amine analogs of 5-HT bind with increased affinity and selectivity at 5-HT_3 receptors. 5-HTQ, the N,N,N-trimethyl quaternary amine analog of 5-HT, binds with higher affinity (Ki= 75 nM) than 5-HT (Ki= 530 nM), and is selective for 5-HT_3 versus other 5-HT receptors.

IDENTIFICATION OF THE SIGMA-OPIATE PHARMACOPHORE. M. B. El-Ashmawy* J. D. Smith, A. M. Ismaiel*, J. B. Fischer and R. A. Glennon. Dept. of Medicinal Chemistry, MCV/VCU, Richmond, VA 23298 and CNS Research, Cambridge, MA 02139. Sigma (σ) receptors are gaining much attention due to their implication in mental disorders. Unfortunately, σ-selective agents are currently unavailable; for example, the benzomorphan σ-opiates, such as N-allylnormetazocine, bind at σ (Ki=429 nM) and PCP sites. In the present investigation a novel class of high affinity σ-selective agents was designed. We first identified the primary pharmacophore of the benzomorphans as the N-substituted phenethylamine moiety. The structure-affinity relationships of several 1-phenyl-2-aminopropane derivatives and their conformationally-restricted analogs were evaluated and agents of high affinity (e.g. N-(5-phenylpentyl)-1-phenyl-2-aminopropane, Ki=6.2 nM) were designed. The aromatic hydroxyl group, common to most σ-opiates, does not appear to be necessary for binding. Unlike the σ-opiates, the novel compounds display no affinity for PCP sites (Ki>10000 nM) and various other receptors. (Supported by Virginia C.I.T. and CNS Research).

PREGNANCY TOXEMIA DETECTION BY SPECTRAL ANALYSIS OF BLOOD PLASMA. Lyle Evans, & Germille Colmano, Dept. of Biomedical Sciences, VMRCVM, VPI & SU, Blacksburg VA, 24061-0442. Ten blood plasma samples from pregnant women of whom 3 had pregnancy toxemia (preeclampsia, or pregnancy-induced hypertension) were spectrophotometrically scanned from 190 to 650 nm, and the spectral averages of the toxemic and not toxemic sample exhibited differences. For each spectrum the principal components of the small region (50nm) with the highest spectral difference were calculated. Using the first three principal components the samples were then plotted in three dimensions and toxemic and non-toxemic samples became separable by a plane.

^{3}H-MECAMYLAMINE BINDING TO RAT BRAIN HOMOGENATE. Fang Fan and Billy R. Martin, Dept. of Pharmacology and Toxicology, Va. Commonwealth Univ., Richmond, Va. 23298. Mecamylamine can antagonizes almost all the central effects of nicotine. Its mode of action remains unclear although it is certain that it does not act directly at central nicotinic cholinergic receptors. Precious structure-activity relationship study of mecamylamine analogues in our laboratory suggested that the antagonism of mecamylamine involved a receptor-mediated process. The goal of the present study is to characterize the mecamylamine receptor. ^{3}H-Mecamylamine was incubated with rat brain homogenate in 50 mM Tris-HCl buffer (pH 9.0) for 30 min. at 25° C. Non-specific binding was determined in the presence of 1 mM unlabeled mecamylamine. Scatchard analysis revealed two binding sites. The K_D (Bmax) of the high and low affinity binding sites are 84 nM (98 fmol/mg protein) and 8.9 μM (24 pmol/mg protein), respectively. In displacement study, mecamylamine analogues were tested for their ability to compete with the high affinity binding site. The IC_{50}'s of these mecamylamine analogues were inconsistent with their potency in vivo, which indicated that this high affinity binding sites are not responsible for mediating the antagonistic action of mecamylamine.

ANALYSIS OF COLLAGEN SYNTHESIS AND BREAKING STRENGTH DURING FETAL WOUND HEALING. Frazier W. Frantz, Robert F. Diegelmann, Bruce A. Mast*, I. Kelman Cohen*, Dept. of Surgery, MCV/VCU, Richmond, Va. 23298. *In utero* intervention to correct life-threatening congenital anomalies has mandated a thorough understanding of the mechanisms of fetal healing. In comparison to adult repair, fetal healing involves minimal collagen deposition and no scar formation. In our study, breaking strength (BS) was used as a measure of the restoration of mechanical function in fetal and adult wounds. In addition, collagen synthesis in fetal and adult wounds was analyzed using tritiated proline incorporation into bacterial collagenase-sensitive protein as a measure. Adult wounds demonstrated slow restoration of BS and a 3-fold increase in relative collagen synthesis (RCS) post-wounding. In marked contrast, fetal wounds exhibited rapid BS restoration with no appreciable increase in RCS during the same post-wounding period. These results suggest that fetal repair is functionally, as well as cosmetically, superior to adult wound healing and is successfully accomplished through processes similar or identical to normal fetal development.

CELL MONOLAYER FORMATION IN GLASS TUBES. S. Gallik, T. Plaia*, S. Hamblin*, J. Sloop* and K. Wright*, Dept. of Biol. Sci., Mary Washington College, Fredericksburg, VA. 22401. The success of cell monolayer formation in glass tubes was determined in order to elucidate the possible use of glass tubes in studies of the effects of fluid flow on adhesion-dependent cells. Balb/3T3 fibroblasts and MDBK cells were seeded at a density of 20,000 cells/cm^2 into two types of glass tubes: rectangular glass tubes having a parallel-plate geometry (0.04 cm h x 0.8 cm w x 30.5 cm l) and large-bore round glass tubes (0.8 cm diam x 30.5 cm l). Both types of cells were grown in both types of tubes under two conditions: one in which the growth medium was changed every 24 hours and another in which the tubes were continuously perfused under relatively low-shear conditions. In the rectangular glass tubes, both types of cells did not grow to confluent monolayers under either of the growth conditions. In the large-bore round glass tubes, confluent cell monolayer formation was sussessful for both types of cells under both growing conditions. It is postulated that the large surface area to volume ratio of the rectangular glass tube limits nutrient delivery and therefore limits cell growth.

EFFECTS OF NERVE GROWTH FACTOR ON VOLTAGE-DEPENDENT ENDOGENOUS DOPAMINE RELEASE FROM PC-12 CELLS. John Harms and John J. Woodward, Dept. of Pharmacology and Toxicology, MCV/VCU, Richmond, VA 23298. Neurotransmitter release is an essential component of signal generation in brain neurons and is initiated by the opening of voltage-sensitive calcium channels (VSCC) during depolarization. Brain neurons possess several different types of VSCC with differing sensitivities to pharmacological agents. The clonal cell line PC-12, which secretes dopamine upon depolarization, appears to possess at least two different types of VSCC which can be differentially expressed under different growth conditions. Under normal conditions, PC-12 cells released dopamine during exposure to KCl. Release was concentration dependent with half-maximal release occuring at approximately 35 mM. Stimulation of PC-12 cells with KCl also produced significant increases in intracellular calcium as measured by the calcium indicator dye, fura-2. Both KCl-induced increases in dopamine release and intracellular calcium were potentiated by the dihydropyridine (DHP) calcium channel agonist, Bay K 8644, and were potently inhibited by the antagonist nifedipine. PC-12 cells treated with nerve growth factor (NGF) for four days developed extensive processes and took on a neuronal-like appearance. Under these conditions, KCl-induced dopamine release was still potentiated by Bay K 8644 but was totally resistant to inhibition by nifedipine. These results indicate that NGF treatment results in the expression of a DHP-insensitive calcium channel in PC-12 cells that may be similar to those expressed in neurons and illustrates the usefulness of this cell line as a model for studying neurotransmitter release. (Supported by NIAAA AA08089).

STIMULUS PROPERTIES OF TFMPP: EVIDENCE FOR A SIGMA COMPONENT. J. L. Herndon, M. E. Pierson, R. A. Glennon, Dept. Medicinal Chemistry, MCV/VCU, Richmond, VA 23298. Using standard two-lever operant procedures with rats trained to discriminate TFMPP (0.5 mg/Kg) from saline, tests of stimulus antagonism and stimulus generalization were performed. The agents examined for ability to antagonize the TFMPP stimulus were prazosin, quipazine, buspirone, 8-OH DPAT, NAN-190, zacopride, haloperidol and 1-PP; only buspirone attenuated the response to TFMPP. In separate experiments, the lowest non-disrupting dose of buspirone (1.2 mg/Kg) caused a rightward shift in the TFMPP dose-response curve (TFMPP alone, ED_{50} = 0.19 mg/Kg; TFMPP + Buspirone, ED_{50} = 0.43 mg/Kg). In addition, CP 93,129, CGS 12066B, DOI, NAN-190, zacropride, 1-PP, (+)-NANM and MDMA were analyzed in tests of stimulus generalization. Only CGS 12066B (ED_{50} = 4.2 mg/Kg) and (+)-NANM (ED_{50} = 8.8 mg/Kg) generalized to the TFMPP stimulus. Tests of DOI and MDMA resulted in partial generalization. Up to doses that disrupted behavior, all other agents were inactive. The results of these and other published studies suggest roles for 5-HT_{1B}, 5-HT_{1C}, and sigma receptors in the mediation of the TFMPP stimulus and indicate a lack of involvement of 5-HT_{1A}, 5-HT_2, 5-HT_3, dopaminergic and adrenergic mechanisms in this behavior.

STIMULUS PROPERTIES OF RING-METHYL AMPHETAMINE ANALOGS. **R.A. Higgs* and R.A. Glennon. Department of Medicinal Chemistry, MCV/VCU Richmond. VA 23298.** The terms methamphetamine or methylamphetamine are commonly employed to refer to the N-Methyl analog of amphetamine (AMPH), where the methyl group is attached to the terminal amine. There are three possible ring substituted methyl AMPH analogs or tolylaminopropanes (TAPS): oTAP, mTAP and pTAP. These are positional isomers of methamphetamine where the methyl group is attached directly to the aromatic ring. Ring-substituted methylamphetamines have been reported to possess AMPH-like character. Few studies have examined all three agents in comparison with AMPH. Male Sprauge-Dawley rats were trained to discriminate 1 mg/kg of (+) AMPH sulfate (ED50 = 0.4 mg/kg) from saline in a 2-lever operant chamber using a VI - 15s schedule of reinforcement. In stimulus generalization tests, doses of the TAP isomers were administered in a random order. Results of the stimulus generalization studies with oTAP reveal complete stimulus generalization (ED50 = 4.1 mg/kg). The mTAP and pTAP isomers resulted in partial generalization followed by disruption of behavior. It cannot be concluded that mTAP and pTAP lack amphetamine-like character.

HISTOLOGICAL AND BIOCHEMICAL ANALYSES OF EPIDERMAL GROWTH FACTOR INFLUENCES ON PREPUBERTAL ANTERIOR PROSTATES OF SWISS-WEBSTER MICE. Vincent L. Hottinger, Richard T. Kratz, Stephen A. Johnson, and Roman J. Miller, Dept. of Biol., Eastern Mennonite Col., Harrisonburg, VA 22801. To further define epidermal growth factor (EGF) inhibition on androgen-induced seminal vesicle growth and function, 20 day old prepubertal Swiss-Webster male mice were placed in one of four treatment groups each which received five injections during a 10 day period. (I. BSA&Oil, 0.5 ug/injection; II. EGF, 0.5 ug/inj.; III. DHT, 200 ug/inj.; IV. EGF&DHT, 0.5 ug & 200 ug/inj.). Post treatment seminal vesicles were removed and fixed for histology or homogenized for biochemical analysis. Based on organ wet weight, the EGF group significantly increased 140% from the BSA&Oil group, the DHT group increased over 200%, while the EGF&DHT group was 28% lower than the DHT group. Morphometric analysis of light microscopy plastic-embedded sections assessed glandular, stroma, and lumen components. Glandular volume density (um^3 component/um^3 tissue x 10^2) was significantly higher in the BSA&Oil group and lowest in the EGF group (I = 68.8; II = 47.5). Stroma volume density was significantly higher in the EGF group as compared to other groups (II = 47.2; total mean 27.8). Analysis of the absolute stroma and glandular contents (mg tissue/10 g body weight) for the EGF&DHT group revealed 43% and 18% declines, respectively, from the DHT group. (Research funded by D.B. Suter Biology Endowment.)

A QSAR STUDY OF CHOLECYSTOKININ ANTAGONISTS INCORPORATING EMPIRICAL HYDROPHOBIC INTERACTION CALCULATIONS. Helen L. Jiang, Glen E. Kellogg, & Simon F. Semus, Div. of Biomedical Engineering, Medical College of Virginia, Virgina Commonwealth Univ., Richmond, Va. 23298-0694. Nonpeptidal antagonists of the peptide hormone cholecystokinin (CCK), are highly potent, orally effective ligands for peripheral (CCK-A) receptors. A series of 3-substituted 5-phenyl-1,4-benzodiazepines, with binding affinities approaching or equaling that of the natural ligand CCK-8, were selected from the literature for a QSAR study. Their structures were built and optimized by using the Sybyl suite of molecular modelling programs. The model which associates the biological activity (drug-receptor binding affinity) with the steric, electrostatic and hydrophobic factors is obtained by adding a hydrophobic field into the standard Comparative Molecular Field Analysis (CoMFA). This model is compared to the one obtained from standard CoMFA methods. The hydrophobic atom constants are calculated by using HINT and the hydrophobic field obtained for each individual molecule is imported into Sybyl where it is employed in CoMFA. CoMFA steric, electrostatic and hydrophobic coefficient maps were obtained based on 46 analogs. Improved chemical information, which is helpful for drug-design purposes, is obtained by this method.

MORPHOMETRIC ANALYSES OF CELLULAR AND TISSUE CHANGES IN THE SEMINAL VESICLE OF PREPUBERTAL VERSUS ADULT SWISS-WEBSTER MICE. Judith L. Leatherman, Brent L. Lehman, and Roman J. Miller, Dept. of Biol., Eastern Mennonite Col., Harrisonburg, Virginia 22801. Tissues for light and electron microscopy were fixed in glutaraldehyde and post-fixed in osmium tetroxide prior to embedment in plastic. Light microscopy sections, stained with Toluidine blue, were analyzed and photographed with a Nikon Microphot system at 100x magnification, while electron microscopy sections, stained with uranyl acetate and lead citrate, were viewed with a JOEL 100s transmission electron microscope at 2000-3000x magnifications. In this preliminary study, tissues from 20, 30, and 120 day (d) old mice were examined. Organ wet weights (mg) significantly increased (20 d = 1.4; 30 d = 11.0; 120 d = 84.1) Volume density measures (um^3/um^3 x 10^2) for the glandular component of the seminal vesicle averaged 49.5 for all three groups with no statistically significant differences among them. Stroma volume density values progressively declined (20 d = 43.6; 30 d = 30.6; 120 d = 8.3), while the lumen component progressively increased (20 d = 6.4; 30 d = 16.9; 120 d = 44.6). Epithelial cell examination (glandular component) showed that individual cell volume increased about four-fold between 20 and 120 days of age, while nuclear volume did not significantly change. Early pubertal influences largely reflect increases in lumen volumes with secretions and structural changes in glandular epithelium. (Research funded by D.B. Suter Biology Endowment.)

Δ^9-TETRAHYDROCANNIBINOL (Δ^9-THC) INHIBITS THE ACOUSTIC STARTLE RESPONSE. A.H. Lichtman, R.S. Mansbach, and B.R. Martin Virginia Commonwealth University, Richmond, VA.

Several reports in the literature suggest that administration of Δ^9-THC and other cannabinoids may have a hyperactive effect in rodents. Therefore, the present study examined the impact of Δ^9-THC on the acoustic startle response as well as its effects on prepulse inhibition, a phenomenon in which exposure to a weak acoustic stimulus inhibits the response to a louder stimulus presented 60-200 msec later. Rats were administered vehicle or Δ^9-THC (1, 3, or 10 mg/kg) and twenty minutes later placed in a restraining tube where they were presented with 25 startle trials, some of which consisted of a 122 db startle stimulus alone, and others in which the startle stimulus was preceded by an 80 db prepulse stimulus with durations of 1, 3, or 10 msec. Although Δ^9-THC failed to affect prepulse inhibition, 10 mg/kg of Δ^9-THC significantly decreased the startle amplitude to 60% of the vehicle amplitudes. In addition, the underlying pharmacology of Δ^9-THC-induced inhibition of startle was examined. Subjects were administered either the muscarinic antagonist, atropine (10 mg/kg), or saline and 10 min later injected with Δ^9-THC (10 mg/kg) or vehicle. They were than assessed for the acoustic startle response, followed by a five min catalepsy test. As previously reported, atropine pretreatment blocked Δ^9-THC-induced catalepsy, however, it failed to reverse Δ^9-THC's inhibition of the startle response. These results indicate that Δ^9-THC's effects on the startle response and catalepsy are mediating through different neurochemical mechanisms. This work is supported by MH-46631 and NIDA grants DA 03672 and DA 07027.

PRENATAL EXPOSURE TO COCAINE AFFECTS SERUM THYMOSIN ALPHA-1 AND THYMUS MORPHOLOGY IN OFFSPRING. Lauren E. McGurk, G. Dawn Royall, Karen K. Oates, Dept. of Biol., George Mason Univ., Fairfax, Va. 22030. Pregnant Long-Evans hooded rats were given daily subcutaneous injections of cocaine on Gestational Days 8-20 of 5, 10, 20, or 40 mg/kg. Control groups included pairfed/vehicle injected (PF/V) and uninjected (UN) animals. Litters were culled to four sex pairs at birth; blood samples and thymi were obtained from the remainder via decapitation. Neonatal thymus weights of the high dose were 28 percent lower than those of the UN control group. Serum thymosin alpha-1 (Ta-1) levels were quantified by radioimmunoassay. Neonatal Ta-1 levels for the 40 mg/kg group were 18 and 22 percent higher in PF/V and UN groups, respectively. One sex pair from each litter was sacrificed on Postnatal Day 21 (PD21) and similar evaluations were performed. PD21 thymus weights of the high dose group were 23 percent higher than the UN group. Additionally, Ta-1 levels were 22 and 15 percent higher than those of the PH/V and UN controls.

THE EFFECT OF COCAINE ON THE BLOOD PRESSURE AND CEREBRAL BLOOD FLOW IN BRAIN - INJURED RATS. J. K. Muir and E. F. Ellis*, Department of Pharmacology and Toxicology, Medical College of Virginia, Richmond, VA 23298

Cocaine abuse has increased dramatically in the past decade. Besides its marked dependence potential, cocaine also has sympathomimetic properties due to its ability to block synaptic reuptake of norepinephrine(NE). Previous studies have shown that cocaine will potentiate the blood pressure (BP) and cerebral blood flow (CBF) response to exogenous NE. (Muir & Ellis, FASEB J, 5:A675 1991). The purpose of this study was to see if cocaine would alter BP and CBF following fluid percussion injury, since this model of brain injury involves the massive release of NE both centrally and peripherally.

Sprague-Dawley rats (n=17) were initially anesthetized with thiopental (75 mg/kg, ip) and maintained with pentobarbital. The animals were ventilated with room air and blood gases were maintained within normal limits. Two craniectomies were made over each hemisphere and the dura was left intact. The injury device was placed over the right parietal cortex and a laser-Doppler probe for measurement of CBF was positioned over the left parietal cortex. Both were secured with dental acrylate.

Cocaine (2 mg/kg, iv) or saline was administered and ten minutes later the animals received a moderate level of injury (2.0-2.1 atm). Upon injury both groups showed a similar acute hypertensive phase, but this phase was followed by a period of pronounced hypotension in the cocaine group (68±4 vs 100±6 mmHg) . The BP response recovers and is similar to the saline controls by 20 minutes post injury. CBF also increases dramatically following injury in both groups, but falls below control within minutes. The animals that received cocaine had higher blood flows than the saline group, including the hypotensive phase. One hour post injury, the CBF of the cocaine and saline groups were 28±7 % and 47±6 % below control, respectively.

The Effects of Opiate Tolerance on Calcitonin Gene-Related Peptide (CGRP) Levels in Rat Brain Regions. Olson, K. G., Bass, P. P., Welch, S. P., and W. L. Dewey. VA Comm. Univ., Richmond, VA . Animals were implanted with a subcutaneous osmotic minipump containing either morphine sulfate or the distilled water vehicle. Animals receiving the morphine minipump became tolerant to morphine prior to CGRP measurement. Some morphine minipumped animals were also injected twice daily with 2 mg/kg naltrexone which prevented tolerance development. Effects of acute administration were shown by subcutaneous injections of morphine sulfate or naloxone 20 minutes prior to CGRP measurement. Levels of CGRP were measured via radioimmunoassay in the following regions: cerebellum, corpus striatum, cortex, hippocampus, hypothalamus, medulla, midbrain, and spinal cord. Significant differences in CGRP levels were found between morphine tolerant animals and those with a vehicle minipump in the hypothalamus, medulla, midbrain, and spinal cord. In the presence of vehicle minipumps and chronic s.c. injections levels of CGRP were 408, 929, 454, and 527 fmol/mg protein in the hypothalamus, medulla, midbrain, and spinal cord, respectively. These were reduced to 115, 546, 139, and 223 fmol/mg in the respective regions following chronic morphine. Chronic naltrexone in the rats receiving chronic morphine significantly reversed the effects of morphine in the hypothalamus, medulla, and midbrain. No significant effect on CGRP levels was found following acute subcutaneous administration of morphine or naloxone. These data indicate that opiate tolerance decreases CGRP levels in selective brain regions and the spinal cord. These alterations may contribute to the development of tolerance to morphine. Supported by grant # DA06031 and the VA Commonwealth Center for Drug Abuse.

COMPARATIVE MOLECULAR FIELD ANALYSIS OF NON-PEPTIDE ANGIOTENSIN II ANTAGONISTS. M. Edward Pierson, Dept. of Pharmacology and Toxicology, Med. Col. of Va. / Va. Commonwealth Univ., Richmond, Va. 23298. Angiotensin II (AII) is a peptide hormone implicated in the regulation of blood pressure. Recently several series of nonpeptide AII antagonists have been reported. DuP 753, a biphenylimidazole, is the prototypic AII nonpeptide antagonist and it is currently undergoing evaluation as an antihypertensive agent. Using the multifit program in the molecular-graphic platform SYBYL (Tripos) DuP 753 can be overlaid with AII. Comparative molecular field analysis of the benzamidobenyl- and biphenyl-imidazole nonpeptide angiotensin II antagonists was done for the steric and electrostatic components of these compounds. The C-terminal tetrapeptide portion of AII that DuP 753 is proposed to mimic was also included in this analysis. This type of analysis may lead to a better understanding of how AII interacts with its receptor and provide new insights for development of AII agonists and antagonists.
Supported by American Heart Association, Virginia Affiliate.

BACK PROPAGATION NEURAL NETWORK MODEL USING SPICE. Jeffrey A. Prideaux, BME Program MCV/VCU, P.O. Box 694 Richmond, VA. 23298-0694. SPICE, an electrical circuit simulator, will be used to simulate a back-propagation neural network. The network will attempt to learn the x-or function, which is the simplest non-linear separable problem. Some advantages and disadvantages in using an analog circuit simulator will be discussed along with some similarities and differences between this neural network and real biological networks. The challenge is not modeling how the neurons intercommunicate, but how they "learn" (change structure or connection strength).

ALLOSTERIC INHIBITORS OF HEMOGLOBIN: DESIGN AND COMFA STUDY. **Ramnarayan S. Randad, Glen E. Kellogg, Fred C. Wireko and Donald J. Abraham. Department of Medicinal Chemistry. Medical College of Virginia, VCU, Richmond, VA 23298.**

Allosteric Inhibitors of hemoglobin (Hb) facilitate dissociation of oxygen bound to Hb. Recently we have reported three series of potent allosteric inhibitors of Hb[1]. The binding sites of the new compounds have been determined crystallographically[2]. We now report QSAR studies using the computer program COMFA using three fields, electrostatic, steric, and hydrophobic.[3]

1. Randad, R.S., Maharan, M.A., Mehanna, A.S. and Abraham, D.J. *J. Med. Chem.* **1991**, *34*, 752.

2. Wireko, F.C., Kellogg, G.E., Abraham, D.J. *J. Med. Chem.*, **1991**, *34*, 758.

3. Kellogg, G.E., Semus, S.F., Abraham, D.J. *J. Computer-Aided Mol. Design* (in press).

PRENATAL EXPOSURE TO COCAINE AFFECTS SERUM PROLACTIN AND GROWTH HORMONE IN OFFSPRING. G. Dawn Royall, & R. F. Smith*, Dept. of Psych., George Mason Univ., Fairfax, Va. 22030. Pregnant Long-Evans hooded rats received daily SC injections of 5, 10, 20, or 40 mg/kg of cocaine on GD 8-20; controls included pairfed/vehicle injected (PF/V), and uninjected (UN) groups. Serum PRL and GH levels obtained from neonates sacrificed at birth via decapitation were quantified by radioimmunoassay (RIA) with reagents obtained from the National Pituitary Hormone Distribution Program of the NIDDK and evaluated against the rPRL-RP-3 and rGH-RP-2 reference preparations. Significant dose-dependent decreases in serum levels of PRL and GH were observed. Neonatal concentrations of PRL in the 40 and 20 mg/kg groups were 22 and 18 percent, and 18 and 16 percent less than those of the UN and PF/V control groups, respectively. In contrast, neonatal concentations of GH in the 10 and 5 mg/kg groups were 37 and 38 percent, and 28 and 30 percent less than those of the UN and PF/V control groups, respectively.

THE RELATIONSHIP OF CALCITONIN GENE-RELATED PEPTIDE, PROTEIN EXTRAVASATION AND HEAT NOCICEPTIVE THRESHOLD AFTER ACUTE SKIN INCISION IN THE MOUSE HINDPAW. M. SAXEN, S. WELCH, and W.L. DEWEY, Dept. of Pharmacology/Toxicology, Virginia Commonwealth University, Medical College of Virginia, Richmond, VA 23298. Calcitonin Gene-Related Peptide (CGRP) exists in abundance in the free nerve endings of primary afferent nerves and is thought to act locally to alter nociceptive threshold. We designed experiments to determine if a relationship exists between the amount of CGRP in dorsal hindpaw mouse skin and heat nociception. RIA was used to quantitate CGRP levels in skin, dye spectroscopy for protein levels, and a modification of the tail flick assay for threshold levels. Protein as a % of weight dropped to 68% of control 1 hr after incision before returning to control levels at 3 hrs. CGRP dropped to 47% of control at 1/2 hour and remained at 61% and 63% of control at 1 hr and 3 hr respectively. Heat nociceptive threshold rose to 125% of control at 1/2 hr, 122% of control at 1 hr, and returned to control level at 3 hrs. These data demonstrate the lack of a direct relationship between CGRP and heat nociceptive threshold in the first 3 hrs. after skin incision. An inverse relationship exists between % protein and heat nociceptive threshold. This work was supported by NIDA grants DA06031, DA01647 and NIDR grant DE00151.

THE EFFECT OF HOLOTHURIN ON TRYPANOSOMA MUSCULI INFECTION IN AN INBRED FN STRAIN OF FEMALE MICE. Dilip K. Sen, Lora Wan, Hunter D. Hamlett and William R. Jones, Dept. of Biol., Va. State Univ., Petersburg, Va 23803. This study was conducted to investigate the effect of a marine biotoxin, holothurin (a saponin of animal origin), on infection caused by Trypanosoma musculi in an inbred FN (fawn) strain of female mice. In previous studies (Sen and Lin 1977, Sen et al. 1981), various strain of mice were shown to have increased their resistance for this stercorarian hemoflagellate when a holothurin inoculum was administered. The results indicated in the present study that the drug treated mice had fewer parasites in the peripheral circulation than the untreated control group. The parasitemias in all experimental groups showed a significant difference at the 5% level as compared with their untreated control counterpart.

EFFECT OF DEHYDROEPIANDROSTERONE (DHEA) ON THE ULTRASTRUCTURE OF Nb2 LYMPHOMA CELLS. Yanal Shafagoj, Milton Sholley, and Mohammed Kalimi, Depts. of Anatomy and Physiology, Medical College of Virginia, Virginia Commonwealth University, Richmond, VA 23298. We previously reported that DHEA induces cytoplasmic granules in cultured human endothelial cells. The granules were identified as multilamellar lipid structures (MLL), which are secondary lysosomes containing phospholipid membranes and free cholesterol. We have now found that DHEA also induces MLL in Nb2 lymphoma cells. Nb2 cells were incubated for 24 or 72 hours in culture media containing 1 or 50 μm DHEA in 0.25% DMSO or 0.25% DMSO alone (control). Cells were pelleted, prepared for electron microscopy, and photographed with a JOEL JEM-1200 electron microscope. Prints were analyzed with a Zeiss MOP-3 image analyzer. Parameters measured were cytoplasmic area, area of MLL, and area of neutral lipid (NL) droplets. There were no significant differences between any of the parameters for cells in medium alone, control medium, or medium containing 1μM DHEA. Interestingly, 50 μM DHEA-treated cells showed significantly ($P<0.05$) greater areas of MLL at both 24 and 72 hours; NL was significantly greater at 72 but not at 24 hours. In addition, the same significant differences were found when MLL and NL were expressed as ratios to cytoplasmic area. It is concluded that DHEA at a high dose elevates the content of lipid-associated organelles in Nb2 lymphoma cells. The mechanism and significance of this phenomenon remains to be determined.
Supported by Elan Corporation, Ireland.

ANALYSIS OF cDNA CLONES OF SCHISTOSOMA MANSONI. Maryanne C. Simurda, J. Kenyon, M. Lubkowitz. Dept. of Biol. Washington & Lee Univ. Lexington, Va. 24450. Various procedures were used to isolate clones from a cDNA library of the adult stage of S. mansoni in order to study antigens important in the disease process of this human blood fluke. One clone, pSMSOD, from this collection has been characterized and the amino acid sequence derived from the mRNA sequence shows about 40% homology with the known sequences for the enzyme superoxide dismutase. Amino acids crucial for the activity of this enzyme are conserved. Interestingly, this sequence contains a potential hydrophobic signal sequence for secretion. The protein product, resulting from the in vitro translation of the hybrid selected mRNA, is immunoprecipitable with sera from human patients with a chronic infection and enzyme analysis of adult worms shows superoxide dismutase to be associated with the parasite's tegument. Other current work involves the initial characterization of other cDNA clones: pSML4, pSML7, pSM4-28, by restriction enzyme mapping, DNA sequencing, and genomic DNA Southern Blot analysis.

SELECTIVE PROTECTION BY GANGLIOSIDE FOLLOWING EXPERIMENTAL BRAIN INJURY IN RATS. Amrita K. Singha, Robert J. Hamm, Clifton E. Dixon, Brian R. Pike, & Ronald L. Hayes. Depts. Psychology and Neurosurgery, Va. Commonwealth Univ., Richmond, Va. 23298. The present study examined the effectiveness of pretreatment with ganglioside (G_{M1}) on mortality, motor, and cognitive deficits following a fluid percussion injury. Rats were moderately injured (2.25 atm) and received either G_{M1} (n=8-10) (30 mg/kg, i.p.) or saline (n=7-8) (1 ml/kg, i.p.) for 3 days prior to injury. Immediately following injury, rats were assessed for their acute neurological responses. Chronic motor responses were evaluated for 5 days after injury using the beam balance and beam walk. These tasks assess motor impairments where the latency of the animal to walk or balance on the beam is measured. Animals were additionally evaluated for cognitive function using the Morris water maze on days 11-15 after injury. The water maze measures spatial memory indicated by the rat to locate a hidden goal platform. Results revealed a selective protection for the G_{M1} treated rats. Animals treated with G_{M1} had a significantly lower mortality rate than the saline-treated animals. There were no significant group differences on acute neurological, motor, or cognitive responses. These observations suggest that treatment with G_{M1} prior to injury may be therapeutic in increasing survival rates, but it is ineffective in reducing behavioral deficits observed after injury.

CHARACTERIZATION OF THE MAJOR HYDROLYSIS PRODUCTS OF AMOBARBITAL N-GLUCOSIDES. F.B. Vest*, W.H. Soine, and R.B. Westkaemper, Dept. Med. Chem., Va. Commonwealth Univ., Richmond, Va. 23298-0540. Phenobarbital (PB) N-glucosides have been observed to decompose via ring opening under conditions in which no decomposition of PB occurs. Structurally related amobarbital N-glucosides (AMG-R and AMG-S) are urinary excretion products of amobarbital (AM), but the decomposition products of these metabolites have not yet been identified. The decomposition products of the AM N-glucosides were prepared by dissolving AMG-R or AMG-S in 0.10M TRIS buffer at pH 7.4 and heating the mixtures at 37 ° C for a period of 34 days (12 half-lives). The reaction mixtures were monitored by HPLC using a mobile phase of CH_3CN:H_2O (30:70, v:v) at a flow rate of 1.0 ml/min with detection at 198 nm. The major decomposition product was observed in the solvent front for both epimers. It was anticipated that the ring opened product contained a carboxylic acid, so the reaction mixture was treated with BF_3·MeOH to form the methyl ester derivative. Major peaks eluting at 10 and 11 min were shown by HPLC analysis for the R and S epimers of the AM N-glucosides, respectively. The products were purified by semi-preparative HPLC. Based on IR, NMR, and UV studies, the product for both epimers was determined to be 3-(1-β-**D**-glucopyranosyl)-3-(2-ethyl-2-(3-methyl)butylmalonyl)urea methyl ester, which is different ring opening from what was observed for PB N-glucoside decomposition. (Supported by NIH grant GM 34507.)

GRANULOCYTE-MACROPHAGE COLONY-STIMULATING FACTOR AND MACROPHAGE COLONY-STIMULATING FACTOR CONTRIBUTE TO MACROPHAGE-MEDIATED SUPPRESSION OF CD4+CD8- T CELL AUTORECOGNITION DURING TUMOR GROWTH. T.M. Walker and K.D. Elgert. Dept. of Biology, Microbiology & Immunology Section, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. Autoreactive T lymphocytes (ATLs) are CD4+CD8- T cells that respond to syngeneic MHC Ia antigens. Macrophages (Mϕ) are stimulatory cells for ATLs because Mϕ express Ia antigens and secrete regulatory cytokines. Tumor growth disrupts autorecognition by altering Mϕ Ia expression, but tumor-induced cytokine alterations are poorly understood. Colony-stimulating factors (CSFs) are secreted by both Mϕ and T cells, and the present study assesses their contributions to autoreactivity during tumor growth. Autorecognition by normal host (NH) ATLs and Mϕ was altered with granulocyte-Mϕ CSF (GM-CSF) and Mϕ CSF (M-CSF), but autorecognition using NH ATLs and tumor-bearing host (TBH) Mϕ was unaltered by GM-CSF and M-CSF. Indomethacin reversed some tumor-induced suppression, but with GM-CSF and M-CSF only a small additive effect was observed. GM-CSF and M-CSF did not reverse suppression induced by additional TBH Mϕ, and suppression was higher when high doses of GM-CSF or M-CSF were used with high percentages of TBH Mϕ. These data suggest GM-CSF and M-CSF do not reverse tumor-induced Mϕ-mediated suppression of T cell autorecognition.

Parenterally Administered Xanthan Gum Lowers Blood Glucose in Mice

C.R. Ward, D.A. Brase and H.L. Tripathi, Dept. of Pharmacol. and Tox., MCV/VCU Richmond, VA 23298

Arabic, guar, locust bean, tragacanth and xanthan gums were tested for possible hypoglycemic effects in male ICR mice after parenteral administration. Glucose levels were measured in serial blood samples taken hourly from the retro-orbital sinus after i.p. saline(10 ml/kg), insulin(1 U/kg) and gum(50 mg/kg). Insulin and xanthan were the only agents tested that significantly lowered blood glucose; however, the xanthan had a much slower onset (≥2 hr) and a much longer duration (≥24 hr) than insulin. Xanthan had an ED-50 of 2.5 mg/kg (at 7hr) and a maximum decrease of 55% from basal blood glucose. Oral, i.v. and s.c. routes were also investigated, with only the i.v. and s.c. routes resulting in hypoglycemia. The lag period was present even after i.v. administration, indicating that time is needed for an active metabolite or an endogenous mediator to form. The hypoglycemic effect of xanthan was greatly attenuated in mice rendered diabetic by streptozotocin (STZ) pretreatment, but xanthan normalized blood glucose for 24 hr in genetically diabetic C57BL/KsJ (db/db) mice. Mice pretreated 5 hr with xanthan showed a significant increase in glucose tolerance; however, 5 hr pretreatment with xanthan did not significantly affect serum insulin in ICR mice when compared to controls, but significantly lowered insulin in the hyperinsulinemic (db/db) mice. Thus, xanthan appears to lower blood glucose by both an insulin-dependent mechanism, as indicated by experiments with STZ-diabetic mice, and an insulin-independent mechanism, as indicated by serum insulin measurements. (Supported in part by the Commonwealth of Virginia Center for Drug Abuse Research.)

INJUSTICES IN HUMAN GENETICS. Lisa C. Wisniewski, and J. I. Townsend, Dept. of Human Genetics, Va. Commonwealth Univ./Medical College of Va., Richmond, Va. 23298. Information about women who have made important contributions to our basic knowledge of genetics is virtually non-existent. Barbara McClintock, the 1983 Nobel Prize recipient, is a recent exception. Yet her remarkable discovery of transposable elements was not recognized for almost 40 years. This fate is not unlike that of the father of genetics, Gregor Mendel. Acceptance of Mendel's work came only after other scientists reached the same conclusions as Mendel and attempted to publish them without citing him. Likewise, some scientists presented findings in other organisms unquestionably related to McClintock's work on maize and did not cite her. It is ironic that the very reason neither Mendel nor McClintock were recognized for their brillance is in fact the greatest compliment of all. Both of these scientists were so far ahead of their time that their colleagues could not fathom, much less support their findings. We believe that oversights suffered by McClintock and other female scientists as well as by Mendel will be much less likely to reoccur if scientists scrutinize the work of their colleagues with an eye for the potential implications of the findings, rather than just a critical eye for disbelief of the unknown or unfathomable.

Microbiology

ERWINIA CAROTOVORA: FUSIONS BETWEEN *pelA* AND *pelB* HAVE PECTOLYTIC ACTIVITY. Lyudmil S. Antonov and George H. Lacy, Lab. Molec. Biol. of Plant Stress, Dept. Pathol. Physiol. Weed Sci., Virginia Polytechnic Institute and State Univ., Blacksburg, VA 24061-0330.

The plant soft-rot bacterium *Erwinia carotovora* subsp. *carotovora* (Ecc) contains three (or four in some strains) genes coding for pectate lyases (PLs). The PL genes *pelA* and *pelB*, coding for highly basic PLs (pI 9.28 and 11.44), are located next to each other on the Ecc chromosome and were cloned on a single plasmid in *E. coli* where they are expressed and their products retain the ability to degrade polygalacturonic acid (PGA). We subcloned each isogene into a different *E. coli* plasmid and sequenced them. For most of their lengths, the two genes are homologous to each other and to the PLbc family of *Erwinia* extracellular enzymes. However, the 3'-terminal part of *pelB* is unique and, therefore, can be used as a probe, specific for this gene. We also constructed the fusion genes *pelAB* and *pelBA* by joining at a *Bgl*II site, respectively, the 5' part of *pelA* with the 3' part of *pelB* and the 5' part of *pelB* with the 3' part of *pelA*. The fusion proteins degrade PGA when expressed by *E. coli* as evidenced by IEF and SDS-PAGE with activity staining. Partial genes also expressed active PLs; this may be important in connection to the possible mechanism of origin of the PL isozymes.

UV AND PEROXIDE RESISTANCE IN DEEP SUBSURFACE BACTERIA. A. A. Arrage* & R. E. Benoit, Dept.of Biol., Va. Polytechnic Inst. & St. Univ., Blacksburg, VA 24061, & T. J. Phelps*, Inst. for Applied Microbiol., Univ. of Tenn., Knoxville, TN 37932. The UV resistance trait was screened in 60 non-sporeforming deep subsurface soil bacteria isolated from depths of 150 - 500 m near the Savannah River Plant in South Carolina. Controls included Tennessee surface soil and ATCC reference bacteria. After millions of years of evolution in the deep subsurface habitat, some aerobic, gram +, pigmented bacteria tolerated high levels of UV radiation when compared to the survival of control bacteria. In general, subsurface microaerophilic bacteria were more sensitive to UV than some subsurface aerobic and control bacteria. Photoreactivating activity was detected in some subsurface bacteria exposed to 365 nm light. The UV and peroxide resistance of some subsurface isolates were related. Given the slow in situ rate of bacterial growth and metabolism in the deep subsurface, UV radiation resistance may reflect a general protective mechanism against free radical damage to cell components in deep subsurface microorganisms.

EFFECT OF IMMUNOMODULATION BY NITROSOUREAS IN THE SUCCESSFUL TREATMENT OF CANCER. Victoria Baldwin, Aruna Seth, Prakash S. Nagarkatti and Mitzi Nagarkatti. Department of Biology, Virginia Polytechnic Inst. & State Univ., Blacksburg, Va 24061.

Earlier studies from our laboratory have demonstrated that the chemotherapeutic efficacy of nitrosoureas such as BCNU, Chlorozotocin (CLZ), and Streptozotocin (STZ) depends on their immunomodulating properties (Cancer Res. *49* :6587, 1989). In the current study, we extended these observations to other nitrosourea congeners such as MeCCNU, PCNU and ACNU. It was observed that BCNU, ACNU, PCNU and MeCCNU were highly tumoricidal in vitro and in vivo whereas STZ was less tumoricidal. Injecting 20mg/kg bodyweight of BCNU, MeCCNU, PCNU and ACNU cured 75-100% of the tumor-bearing mice, whereas, STZ failed to cure tumor-bearing mice. When nitrosoureas were tested for their immunomodulating properties, it was observed that MeCCNU, PCNU and ACNU suppressed the T cell responsiveness to ConA, anti-CD3 mAb and anti-$\alpha\beta$TCR mAb by ~60-70%, similar to the immunosuppression mediated by BCNU. In contrast, STZ failed to bring about significant immunosuppression. Lastly, 5-FU, a different anticancer drug was found to be highly tumoricidal but nonimmunosuppressive and was found to cure only 60% of the tumor-bearing mice. These data are consistent with our earlier hypothesis that in the LSA tumor model, nitrosoureas with immunosuppressive activity also inhibit the tumor-specific T suppressor cells thereby permitting the tumor specific $CD4^+$ and $CD8^+$ T cells to mediate tumor-rejection. In contrast, nitrosoureas such as STZ, or other anticancer drugs such as 5-FU which are less immunotoxic, fail to inhibit the T suppressor cell activity thereby permitting the tumor cells spared from the drug activity, to regrow and kill the host. (Supported in part by NIH grants CA45009 and CA45010).

MECHANISMS FOR CALMODULIN REGULATION OF PHOSPHORYLASE KINASE ACTIVITY. P.K. Bender and R. Lanciotti*. Dept. of Biochemistry, Va. Polytechnic Inst., Blacksburg, VA 24061. The interaction between the phosphorylase kinase catalytic subunit, γ, and its integral calmodulin subunit mediate the calcium regulation of the enzyme. An unique feature of this interaction is that in the absence of calcium calmodulin inhibits γ activity while in the presence of calcium the enzyme is activated, although, the calmodulin remains bound. Within γ, two calmodulin binding domains have been identified. These two domains are separated by approximately 14 amino acids. We are investigating the role each of these domains and the 14 amino acid inter-domain sequence have in mediating the calmodulin regulation of γ activity. For these studies, we are expressing wild type and mutant γ protein in the baculovirus/insect cell culture system. Using synthetic polypeptides of the inter-domain sequence we have demonstrated that this sequence is an inhibitor of wild type γ activity. We propose a mechanism for the calcium independent calmodulin regulation of γ by invoking an interaction of each calmodulin binding domain in γ with a different calmodulin head region. This places the inter-domain sequence into the catalytic site. Addition of calcium leads to the conventional model for calmodulin binding involving interactions of both calmodulin heads with only one γ domain and displacement of the inter-domain sequence from the catalytic site. Supported by grant #J-236 from Jeffress Tr.

PROTEIN INTERACTION WITH PARVOVIRUS TERMINI I. CELLULAR AND VIRAL PROTEINS INTERACT SPECIFICALLY WITH BOTH BOVINE PARVOVIRUS TERMINI. Virginia R. Braddon, Muriel Lederman, Dept. of Biology, Va. Polytechnic Inst. and State Univ., Blacksburg, VA 24061. The BPV origins of replication are within the double-stranded, hairpinned termini of the single-stranded genome. Replication requires nicking of the termini by virally-coded proteins and a cellular factor that is active during S-phase of the cell cycle. Gel retardation assays using radiolabelled left terminus of BPV and proteins in a 1M NaCl extract of nuclei from BPV-infected, synchronized bovine fetal lung cells show the formation of three specific DNA-protein complexes. The first is caused by interaction with a viral capsid protein, the second by interaction with a non-structural protein and the third by interaction with a cellular factor that is present in five-fold higher concentration in synchronized cells than in contact-inhibited cells. Gel retardation assays using radiolabelled right terminus of BPV and proteins in a 1M NaCl extract of nuclei from uninfected, synchronized BFL cells show a single DNA-protein complex. Competition assays indicate this cellular factor interacts with both termini of BPV and is a candidate for the S-phase protein required for replication.

PROTEIN INTERACTION WITH PARVOVIRUS TERMINI. II. CELLULAR PROTEINS OF DIFFERENT CELL TYPES INTERACT WITH DIFFERENT PARVOVIRUS TERMINI. Catherine M. Deville, and M. Lederman, Dept. of Biol., Va. Polytechnic Inst. and State Univ., Blacksburg, Va. 24061. Dependent parvoviruses, such as adeno-associated-virus (AAV), require a helper virus for productive infection, while the autonomous parvoviruses, like bovine parvovirus (BPV), only need an S-phase factor for progeny formation. AAV, however, can replicate autonomously in synchronized HeLa cells, suggesting that the S-phase factor substitutes for the helper virus. To investigate the nature of this cellular S-phase factor, we performed DNA retardation assays with uninfected nuclear extracts of hydroxyurea-synchronized cells and radiolabeled parvoviral termini in their hairpinned conformation. It has previously been demonstrated that a cellular protein of bovine fetal lung (BFL) cells, a tissue culture host for BPV, interacts with these forms of the BPV left and right terminus (whose sequence and conformation differ). Proteins of HeLa extracts also caused gel retardation of the BPV left *ori*, and of a deleted AAV terminus. Proteins of this extract do not bind to the right end of BPV. Preliminary characterization of the proteins bound to the BPV left *ori* has been carried out by SDS-PAGE electrophoresis of the retarded complexes. The protein gels showed a protein of ~ 54 kd in the BFL/BPV complex, and two phosphoproteins of ~ 55 and 90 kd in the HeLa/BPV complex.

CHARACTERIZATION OF BOVINE PARVOVIRUS TRANSCRIPTS BY THE POLYMERASE CHAIN REACTION. Nanette Diffoot, Robert C. Bates, Muriel Lederman Dept. of Biol., Va. Polytech. Inst. and State Univ., Blacksburg, Va. 24061. A transcription map for bovine parvovirus (BPV) has not been developed. Construction of BPV cDNAs by conventional methods has proven to be a difficult task due to low concentrations of viral transcripts in BPV-infected cell lysates. Amplification of BPV low abundance mRNAs has been possible by the polymerase chain reaction. Previous experiments have demonstrated that, like the human parvovirus B19, all BPV transcripts initiate from one promoter; these promoter sequences are located at map unit 4 (P4). Therefore, a primer containing nucleotide sequences of the expected cap site and internal BPV-specific primers were used to amplify the 5′ ends of the transcripts. The 3′ ends were amplified with other BPV specific primers and a universal T17 primer. DNA fragments containing sequences from the major BPV open reading frames have been obtained and are in the process of being cloned. Several clones containing BPV cDNA fragments have been sequenced. Three splice sites have been identified, one of which could represent a major splice site of the mRNAs for the viral nonstructural proteins.

EFFECTS OF MEDIA ALTERATIONS ON SWARMING IN *Proteus spp.* Kevin Dixon & Anne Lund, Dept. of Biology, Hampden-Sydney College, Hampden-Sydney, VA 29343. In broth culture *Proteus* cells are short motile rods of slightly greater than 1 μm in length, but on solid media, the cells can be up to 80 μm long, migrating in regular cycles across the surface of plates. This swarming phenomenon is associated with slime production and is a multicellular behavior. *Proteus mirabilis* fails to swarm on nutrient agar which normally contains no added NaCl. On trypticase soy agar (TSA) that is commercially prepared, *P. mirabilis* swarms later after inoculation and more slowly (measured by distance between migration rings) than on TSA prepared by us. Reducing the NaCl concentration of lab-prepared TSA by increments decreases swarming and causes irregular patterns in normally concentric rings of migration around the inoculum. However, if cells are selected from swarming areas on low NaCl plates and inoculated onto low NaCl plates, swarming occurs sooner, migration rings are more concentric, and the slime layer is thinner compared to controls. The amount of NaCl in media necessary for swarming to occur was determined. Observations were made of *P. vulgaris* inoculated onto experimental TSA as well. Flagella stains were prepared.

CHARACTERIZATION OF DNA ASSOCIATED WITH UNSTABLE CLONES FROM THE STAPHYLOCOCCAL CONJUGATIVE TRANSFER REGION. Denise Michelle Eaton and Gordon L. Archer*, Dept. of Microbiology and Immunology, Va. Commonwealth Univ., 23298-0678. The conjugative transfer region (tra) of the staphylococcal antibiotic resistance plasmid pGO1 has been identified. When the cloned tra region is introduced into S. aureus, only deleted transformants are obtained. Subclones of the region which deletes cannot introduced into S. aureus by protoplast transformation or by electroporation. This phenotype, characterized by the inability to be transformed, has been named Itr. Exonuclease III was used to create deletions of the cloned tra region in E. coli. These deletions were screened for Itr in S. aureus by electroporation. The portion of the tra region conferring Itr was identified by deletions which could be transformed. DNA sequence analysis of the region revealed an open reading frame that may encode the product responsible for this phenotype. Characterization of this region will elucidate the role of this open reading frame and possible cis-acting sequences in transformation of the tra region.

PHOSPHO-HISTIDINE PHOSPHATASE ACTIVITY IN RAT LIVER. Brenda Faiola and Peter J. Kennelly, Department of Biochemistry and Nutrition, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. A homopolymer of histidine, average degree of polymerization approximately 125, was partially phosphorylated by chemical means (approximately one in nine histidines as phosphohistidine) and used to ask whether phospho-histidine specific protein phosphatase activity was present in rat liver tissue. It was found that rat liver did indeed contain such an activity. It resided in a soluble protein that was dependent upon divalent metal ions for activity. Mg^{2+}, Mn^{2+}, and Co^{2+} all activated the enzyme with the corresponding order of effectiveness, while Ca^{2+}, Ni^{2+}, Cu^{2+}, and Fe^{2+} had no effect. Zn^{2+}, NaF, and EDTA inhibited the enzyme. The alkaline phosphatase inhibitor tetramisole did not inhibit it, neither did the acid phosphatase inhibitor tartrate or the tyrosine phosphatase inhibitor orthovanadate. Microcystin, which potently inhibits protein phosphatases 1 and 2A, was also ineffective. Gel filtration chromatography has produced an initial estimate of molecular weight of 66,000 daltons. Based on its size, metal ion dependence, and inhibitory signature, we conclude that this phospho-histidine phosphatase is protein phosphatase 2C, an enzyme previously discovered by virtue of its phospho-serine phosphatase activity. To our knowledge, this represents the first report of the existence of a phospho-histidine protein phosphatase.

THE EFFECT OF CARBON SOURCES ON EXPRESSION OF CARBOHYDRATE CATABOLIC ENZYMES AND THE PRODUCTION OF AGROCIN 84. J.V. Formica, Dept. Microbiol. & Immunol., Va. Commonwealth Univ., Richmond, Va., 23298. The nucleotide bacteriocin (agrocin 84) produced by Agrobacterium radiobacter K 84 controls crown gall disease caused by some biovar 1 and 2 strains of A. tumefaciens but not biovar 3 strains. The basis for this difference is not well understood; consequently, the effect of carbon sources on growth, enzyme expression and agrocin 84 production was evaluated. Growth was monitored turbidometrically in a chemically defined medium and agrocin 84 production was assessed by well-diffusion assay. Mannitol was the better carbon source for growth, but fructose was the better source for production. Growth could not be uncoupled from production. Enzyme activities measured at 340 nm in cell extracts of strains C 58 (biovar 1), K 84 (biovar 2) and CG 49 (biovar 3) revealed key enzymes of the HMP but not the EMP as expected. Surprisingly, only strain K 84 lacked key enzymes of the ED pathway. The three strains grew in mannitol but lacked cytosolic mannitol kinase and dehydrogenase, suggesting a membrane-associated activation of mannitol.

GLUCOSE CATABOLISM IN EUBACTERIA ISOLATED FROM NITROGEN-FIXING AZOLLA. Gina Gibson, Brian Shannon, James Gates and Sara McCowen. Department of Biology, VA Commonwealth Univ., Richmond, VA 23284. We previously identified eubacteria isolated from leaf cavities of N-fixing Azolla as members of the genus Arthrobacter. Although data on carbohydrate metabolism in arthrobacters are sparse, two distinct groups have been identified. A few species have been reported to employ the Entner-Doudoroff(ED),rather than the Embden-Meyerhof(EM) pathway used by the type species, A. globiformis. Cell extracts of Arthrobacter isolated from Azolla caroliniana and A. filiculoides were assayed for activity of key glycolytic enzymes. The specific activity of phosphofructokinase of the EM pathway and two enzymes unique to the ED pathway,6-phosphogluconate dehydratase and 2-keto-3-deoxy-6-phosphogluconate aldolase, were determined. The presence of phosphofructokinase activity and absence of induced levels of ED enzyme activity provide strong suggestive evidence that the EM pathway is the major route of glucose catabolism in these organisms. (Supported by the Undergraduate Research Grant Program of Va.Commonwealth Univ.)

MEPRIN-A AND -B: TWO METALLOPROTEASES OF THE MOUSE KIDNEY. Carlos M. Gorbea and Judith S. Bond, Dept. of Biochem., Va. Polytechnic Inst. and State Univ., Blacksburg, Va. 24061. Meprin-A and -B are disulfide-bridged, tetrameric metalloendopeptidases in renal brush border membranes. Meprin-A contains α-subunits of 90 kDa, and it is expressed in random bred and some inbred strains of mice. Meprin-B contains β-subunits of 110 kDa, and, it has been purified from mice that do not express α-subunits. It is expressed, however, in all mouse strains. Lectin blotting revealed that random bred mice express three oligomeric proteins of approximately 390, 440, and 490 kDa as determined by SDS-PAGE in the absence of reducing agents. Western blotting with either anti-α monoclonal antibodies or anti-β polyclonal antibodies indicated that the 390 and 490 kDa complexes are homotetramers composed of $\alpha 4$ and $\beta 4$, respectively. In contrast the 440 kDa molecule is a heterotetramer composed of disulfide-linked α and β subunits. (Supported by NIH Grant DK19691)

T CELL RECEPTOR-INDEPENDENT ACTIVATION OF CYTOLYTIC ACTIVITY OF CYTOTOXIC T LYMPHOCYTES MEDIATED THROUGH CD44. Lisa Gote, Aruna Seth, Prakash S. Nagarkatti and Mitzi Nagarkatti. Department of Biology, Virginia Polytechnic Inst. & State Univ., Blacksburg, Va 24061. CD44 is a transmembrane glycoprotein found on a variety of cells including those of myeloid and lymphoid origin. The CD44 molecule has been recognized to be identical to three other molecules: pgp-1, Hermes and extracellular matrix receptor type III. CD44 is highly conserved among various species, although its exact function in different cell types is not clear. In the present study, using a $CD44^+$ $\alpha\beta TCR^+$ tumor-infiltrating CTL clone, we demonstrate that mAb against CD44 can activate the lytic potential of the CTL clone and redirect the lysis to antigen-negative Fc receptor (FcR)-positive target cells, similar to mAb directed against the $\alpha\beta$TCR or CD3. In contrast, mAb against CD45R, CD8 and J11d molecules expressed on the CTL clone, failed to activate the lytic activity. Also, the mAb against CD44 could inhibit the TCR-mediated lysis of antigen-specific targets. In contrast, mAb against $\alpha\beta$TCR [$F(ab')_2$ fragments] failed to inhibit the CD44-mediated lysis of non-specific targets. Together, these data suggest that binding of CD44 to its ligand on a target cell in the absence of TCR occupancy, may be sufficient to trigger the cytotoxic potential of the CTL leading to lysis of the antigen-negative target cells. Recent studies have shown that the CD44 molecule may bind to specific ligands on endothelial cells and within the extracellular matrix. Thus, binding of the CD44 molecule, expressed on the CTL, to endogenous ligands such as those expressed on endothelial cells, may activate the CTL leading to expansion and lysis of such cells at sites of tissue inflammation. (Supported by NIH grants CA45009 and CA45010).

CD4$^-$CD8$^-$ THYMOCYTES FROM MRL-LPR/LPR MICE EXHIBIT ABNORMAL PROPORTIONS OF $\alpha\beta$-TCR$^+$ CELLS AND DEMONSTRATE DEFECTIVE RESPONSIVENESS WHEN ACTIVATED THROUGH THE TCR. V.N. Kakkanaiah, Mitzi Nagarkatti and Prakash S. Nagarkatti. Department of Biology, Virginia Polytechnic Inst. & State Univ., Blacksburg, Va 24061.

MRL-lpr/lpr (lpr) mice develop profound lymphadenopathy resulting from the accumulation of CD4$^-$CD8$^-$ (double-negative, DN) cells in the peripheral lymphoid organs. The source and mechanism of this abnormal accumulation of cells is not clear. In the present study, we investigated the TCR phenotype of DN thymocytes and their responsiveness to activation through the TCR, in lpr mice. The DN thymocytes of MRL +/+ mice and young lpr mice contained ~63% CD3$^+$ cells of which ~46% were $\alpha\beta$ TCR$^+$ and ~42% were $\gamma\delta$ TCR$^+$. Interestingly, however, in old lpr mice the CD3$^+$ T cells increased to ~86% and majority of these (~81%) were $\alpha\beta$ TCR$^+$ and only ~3% were $\gamma\delta$ TCR$^+$. Young lpr DN thymocytes demonstrated strong proliferative response to stimulation with PMA + calcium ionophore, PMA + IL-2, and to immobilized mAb directed against TCRs, (CD3, $\alpha\beta$ and $\gamma\delta$), comparable to the responses obtained with similar cells from MRL +/+ mice. In contrast, old lpr DN thymocytes demonstrated marked defect (~90% decrease) in responding to the above stimuli. The present study suggests that in MRL-lpr/lpr mice with age, DN $\alpha\beta$-TCR$^+$ cells are produced in large numbers majority of which express CD45R and respond poorly to mitogenic stimuli or when activated through the TCR. It is likely that these cells give rise to the abnormal DN T cells found in large numbers in the periphery of old mice. (Supported by NIH grants CA45009 and CA45010).

NOVEL PROTOCOL FOR SATURATION MUTAGENESIS OF CLONED VIRAL GENES. P.C. Kilian and D. L. Russell, Dept. of Biol., Washington and Lee Univ. Lexington, Va. 24450. The most effective method to protect an organism against infection by a virus is immunization with an active attenuated vaccine strain of the virus. It is imperative that a number of attenuating mutations be present in the vaccine strain to prevent reversion to virulence within the vaccinated host. The advent of molecular biology has made the construction of genetically engineered vaccine strains with known attenuating mutations possible, however these mutations must first be selected from the wild-type population or created by mutagenesis and characterized individually and in combination. This presentation concerns a novel methodology which is currently being developed for creating a library of mutants in a viral gene known to be involved in early events of viral infection. This work is Ms. Kilians Undergraduate Honors Thesis and has been supported by funds from Washington and Lee University.

PROBING INTERACTIONS BETWEEN RNA POLYMERASE AND A PHAGE-ENCODED TRANSCRIPTIONAL ACTIVATOR USING SITE-DIRECTED MUTAGENESIS. Rodney A. King and Gail E. Christie, Dept. of Microbiology and Immunology, Va. Commonwealth Univ., Richmond, Va, 23298-0678. The bacteriophage P2 *ogr* gene encodes a 72 amino acid, zinc-binding protein which is required for activation of P2 late gene transcription. P2 late transcription is blocked by the host mutation *rpoA109*, which is a leucine to histidine substitution in the alpha subunit of DNA-dependent RNA polymerase. Spontaneous P2 mutants that overcome this block have been isolated and are the result of a tyrosine to cysteine amino acid substitution at amino acid 42 in the Ogr protein. The compensatory nature of this mutation suggests a direct interaction between Ogr and RNA polymerase. Using suppression of an *ogr* amber mutation and site-directed oligonucleotide mutagenesis, we have studied the effect of all possible amino acid substitutions at this position in both wild type (*rpoA+*) and mutant (*rpoA109*) strains of *E. coli*. Our results indicate that substitution of a charged amino acid results in a nonfunctional Ogr protein, regardless of the strain background. Multiple polar and non-polar substitutions are functional to varying degrees in the *rpoA+* strain. In sharp contrast, only substitutions of cysteine, alanine and glycine will support growth of P2 in the *rpoA109* background. These results support a direct interaction between Ogr and the host RNA polymerase and suggest that the inability of wild-type Ogr to function in an *rpoA109* strain is due to steric constraints.

CHARACTERIZATION OF DEFECTIVE ANTIGEN PROCESSING BY GENETIC COMPLEMENTATION. B.J. Merkel and K.L. McCoy, Dept. of Micro., Va. Commonwealth Univ., Richmond, VA 23298. Antigen processing, occurring in antigen-presenting cells, is the mechanism by which immunogenic peptides are generated from native proteins within intracellular compartments. The regulation and mechanism of antigen processing are largely uncharacterized. WAB4, a Chinese hamster ovary cell line transfected with I-A^d MHC class II genes, processed native antigens ineffectively and was unable to stimulate 3D054.8, an I-A^d-restricted, ovalbumin-specific T_h cell hybridoma. To understand the mechanism responsible for the defect, we examined whether normal antigen processing in these cells could be restored by genetic complementation. WAB4 was fused by polyethylene glycol with L cells, a fibroblast transfected with I-E^k MHC class II genes, known to be a competent antigen-presenting cell. Two distinct hybrids, WALC and LLC were isolated by a double drug selection protocol. LLC predominantly expressed I-E^k MHC class II gene products and stimulated 2B4, an I-E^k-restricted, pigeon cytochrome c-specific T_h cell hybridoma. WALC expressed both I-A^d and I-E^k MHC class II molecules. In contrast to WAB4, WALC was very effective in activating an antigen response by 3D054.8 suggesting that the normal genes contributed by the L cells, corrected the recessive antigen-processing defect. Finally, the identification of the gene(s) responsible for complementing the antigen processing defect would lead to a better understanding of the regulation of the mechanism. (Supported by Thomas F. Jeffress and Kate Miller Jeffress Memorial Trust J-173.)

INDETERMINATE HIV-1 WESTERN BLOT RESULTS AND THEIR CLINICAL SIGNIFICANCE. R. Rodriguez-Bayona, M.R. Escobar and C.W. Moncure, Dept. of Pathology, Box 106, MCV Station, MCV-VCU, Richmond, VA 23298. This is a retrospective study to correlate Abbott ELISA (repeat positive) and Western Blot (WB, Bio Rad) antibody test results with clinical history and risk group in 671 patients suspected of having HIV-1 infection whose sera were collected from March, 1988 to December, 1990. The WB results of this study population were: 623 (92.8%) reactive; 36 (5.4%) nonreactive; and, 12 (1.8%) indeterminant (IND). None of the 12 WB-IND had clinical findings consistent with HIV-1 infection, whereas the 19 WB reactive (WB-R) used as controls had a clinical history compatible with HIV-1 infection. Virtually all the WB-IND had ELISA O.D. values close to the cut-off. On the other hand, there was a positive correlation between the O.D. values ($\geq$ 2.0) and the number of bands seen in the WB. None of the 12 WB-IND admitted to being homosexual or bisexual; however, 7 were intravenous drug users (IVDUs), 4 were transplant recipients, 5 had received transfusion(s) and 4 were on hemodialysis. None of the 19 WB-R were transplant recipients, but 11 were IVDUs, 7 were homosexual or bisexual, 1 was a hemophiliac, 1 was a female who had been exposed to her HIV-1 positive heterosexual partner, and 1 was an infant whose parents were both HIV-1 positive. Of the 19 WB-R, 2 had received transfusion(s) and 2 were on hemodialysis. It is suggested that close clinical consultation and follow-up are essential for all patients with WB-IND.

INHIBITION OF AUTOCRINE GROWTH AND TUMORIGENICITY INDUCED BY A T CELL CLONE *IN VIVO* USING MONOCLONAL ANTIBODIES AGAINST IL-2 AND IL-2R. Aruna Seth, K. Manickasundari, Mitzi Nagarkatti and Prakash S. Nagarkatti. Department of Biology, Virginia Polytechnic Inst. & State Univ., Blacksburg, Va 24061.

The development of tumors requires the simultaneous presence of a number of molecular perturbations and autocrine growth factor production is one such factor. We have recently isolated a $CD4^+$ autoreactive T cell clone (designated AutoD1.T) which was found to grow independent of exogenous T cell growth factors or stimulation through the TCR. The autocrine growth of this T cell clone, *in vitro*, was inhibited by the presence of anti-IL-2 or anti-IL-2R mAb but not anti-IL-4 mAb. These data suggested that the *in vitro* transformation of the T cell clone resulted from unregulated endogenous secretion of and responsiveness to IL-2. The AutoD1.T clone could also induce tumors when injected into nude mice. Inasmuch as it is not proven that autocrine growth factors are the only limiting factors for the neoplastic transformation *in vivo*, we next addressed whether the tumorigenicity of AutoD1.T could be inhibited by using mAb against T cell growth factors. Interestingly, mAb against IL-2 and IL-2R but not against IL-4, completely inhibited the tumorigenicity of AutoD1.T *in vivo*. Also, cyclosporin A when used alone or in combination with anti-IL-2 mAb, inhibited the tumor growth significantly. Together, our data suggest that T cell transformation and tumorigenicity *in vivo* can result exclusively from autocrine growth factor production and such tumors can be effectively treated by antibodies against the growth factors or their receptors. (Supported in part by NIH grants CA45009 and CA45010 and a fellowship award from the American Foundation for Aging Research)

REGULATION OF GLYCOGEN PHOSPHORYLASE GENES IN *DICTYOSTELIUM DISCOIDEUM*. Joseph F. Sucic, S. Luo*, P.V. Rogers*, O. Selmin*, Y. Yin*, R.B. Peery*, K.P. Lindgren*, and C.L. Rutherford*, Va. Polytechnic Inst. and State Univ., Blacksburg, Va. 24061. The cellular slime mold, *Dictyostelium discoideum*, undergoes a well documented developmental cycle during which cellular differentiation occurs. A crucial event in cellular differentiation in *Dictyostelium* is glycogen degradation, which provides glucose precursors used to synthesize components of differentiatied cells. Glycogen degradation is catalyzed by glycogen phosphorylase, and we have identified two developmentally regulated glycogen phosphorylase activities in *Dictyostelium*; these activities are associated with two distinct proteins which are the products of separate but related genes. Sequence comparisons showed that these genes are similar to glycogen phosphorylase genes of other organsims. Northern blots revealed that the two glycogen phosphorylase genes are developmentally regulated. The regulation of both genes is mediated by cAMP, but each gene appears to be regulated through a different intracellular molecular mechanism.

MICROBIOLOGICAL AND SPECTROPHOTOMETRIC DETECTION OF ENTERIC PATHOGENS FROM POULTRY RINSES. Helen C. Sutton, Dept. of Food Science, & Germille Colmano, Dept. of Biomedical Sciences, VMRCVM, VPI & SU, Blacksburg VA, 24060-0442. Differences between ultrafiltrates of sterile media and of media with bacterial cultures were detectable in recorded spectrophotometric scans (650nm-190nm). The bacterial growth in the culture media, by modifying the content of the original nutrients by uptake and waste production, gave noticeable differences not only in the 24 hr cultures, but also in the zero time cultures. These differences were large enough to differentiate S. typhimurium from S. arizona, E. coli and a combination of all three, allowing for their detection in samples immediately after their collection time (time zero). It should be noticed that this detection was possible not only on the bacterial cultures at time zero, but also in the water rinses of raw chicken breast, and in the cultures of the rinses in broth, leading us to believe that we are offering the food industry a novel, rapid and simple way to test for the differentiation of human enteric pathogenic bacteria in poultry and other food products.

NA-CA EXCHANGE, CA-ATPASE, AND ALTERED CALCIUM HOMEOSTASIS IN LENS FROM SELENITE-TREATED RATS. Zhaiqi Wang, J. L. Hess, and G. E. Bunce, Dept. of Biochem. & Nutr., Virginia Polytechnic Inst. & State Univ., Blacksburg, VA 24061-0308. Subcutaneous injection of 30 nmoles Na_2SeO_3/g body wt into 10-14-day old rats leads to altered Ca homeostasis after 36 hr. Bilateral nuclear cataract appears within 72-96 hr and is accompanied by a 3-5 fold increase in lens total Ca. Incubation of lenses from selenite-injected rats in medium containing 15 mM $CaCl_2$ has shown that, within 24-36 hr post-injection, passive permeability of Ca is doubled and active Ca transport is reduced to 50% compared to age-matched control lenses. Both of these effects can be reversed by the sulfhydryl reductant, DTT (2-5 mM). Experiments with Na gradients indicated that Na/Ca exchange participates in lens Ca homeostasis. (Supported by NIH R01EY06123 and Pratt Nutrition Program, VPI & SU).

Psychology

THE EFFECT OF A BIASED QUESTIONNAIRE USING ACQUIESCENCE AND MARKED MODIFIERS ON POLITICAL ATTITUDES. Douglas C. Bates, Dept. of Psyc., Old Dominion Univ., Norfolk, Va. 23529. The ability to influence political attitudes by using biased questionnaires was investigated. It was thought that subjects' answers to factual questions about a news story could be biased through the use of acquiescence (expecting a positive response style), and marked-unmarked modifiers (i.e. "few" vs. "many"). Afterwards, it was expected that subjects' attitudes toward the domain in the news story (Israeli-Palestinian issues) would be swayed in the direction of the biased questionnaires. Eighty-one subjects were randomly assigned to four groups of about 20 each. All filled out Israeli-Palestinian attitude surveys. The control group did nothing else; another group watched the news story first, the other two groups watched the news story and answered biased questionnaires (either positive or negative) before answering the attitude surveys. No significant differences in attitude were found, although the survey was found to be both reliable and valid. It is assumed that the concurrent United Nations war against Iraq solidified subjects' attitudes toward the Middle East, thereby wiping out the effect of biasing questions.

SEARCHING FOR LOVE: A COMPARISON OF MALE AD PLACERS FROM TWO METROPOLITAN AREAS. Chet H. Fischer, Department of Psychology, Radford Univ., Radford, Va. 24142. A central concern for many of the sixty-five million adult singles is how to unite with other appropriate and compatable singles. Fischer (1990) randomly sampled male and female ad placers who advertised in Washington, D.C. and Roanoke, VA metropolitan magazines. The results indicated that women advertisers tended to be quite similar with reference to income, education, age employment and assertiveness. Male advertisers, on the other hand, tended to be significantly dissimilar. The present study examined the important differences between male advertisers from these two areas. The males from the smaller metropolitan area tended to be less educated, have substantially lower incomes, employed in fewer professional occupations, have had fewer marriages and received a larger number of replies from age discrepant women. The males from the larger metropolitan area were considerably more satisfied with advertising than were their small town counterparts.

DUI-PREVENTION RESEARCH AT PARTIES: SOME PRACTICAL CONSIDERATIONS AND IMPLICATIONS. K.E. Glindemann, E.S.Geller, & C.M. Coleman, Dept. of Psyc., Va. Tech., Blacksburg, Va. 24061. The Center for Applied Behavior Systems has conducted a series of alcohol consumption studies at university parties over the past ten years, and in so doing has developed methodologies for accomplishing objective field research in such naturalistic settings (e.g., Geller & Kalsher, 1990; Geller, Kalsher, & Clarke, in press; Geller, Russ, & Altomari, 1986; Glindemann, Evans, & Geller, 1989; Russ & Geller, 1988). Much of this research was designed to determine situational determinants of excessive party drinking, whereas other research was designed to determine individuals' accuracy at estimating partiers' intoxication levels through behavioral testing and observation. This paper discusses the methodology we have developed for this type of research, strategies for collecting relevant data in the field, and implications for the prevention of DUI (driving under the influence of alcohol).

A LONGITIDUNAL STUDY OF THE EFFECTS OF NAVY DEPLOYMENT ON THE MARITAL SATISFACTION OF NAVY WIVES. Brenda G. Gooch, Marci Harris*, Michelle Kelley*, Old Dominion Univ., Dept. of Psychology, Norfolk, VA 32529. The purpose of this research was to assess the effects of Navy deployment on the perceived marital satisfaction of military wives. Fifty-one women whose husbands were deployed to the Persian Gulf completed the Index of Marital Satisfaction (IMS: Hudson, (1985) at pre-deployment (one month prior to departure), and mid-deployment (12-16 weeks after the husband's departure). Results of a 2 (husband's rank) X 2 (employment) X 2 (phase of deployment) X 2 (wife's age) showed a 3-way interaction, $F(1,44) = 6.18$, $p < .05$. Although marital satisfaction increased slightly for enlisted wives from pre-deployment to mid-deployment regardless of employment, and for officers' wives who worked, marital satisfaction declined substantially from pre-deployment to mid-deployment for officers' wives who were not employed. Thus, it appears that officers' wives that are not working (and who are presumably educated and employable), may be particularly vulnerable to marital stress in the husband's absence.

MMPI TRENDS IN AN ADOLESCENT SEX OFFENDER POPULATION. Dennis W. Goodwin, Dept. of Psych., Old Dominion Univ., Norfolk, Va. 23508, John A. Hunter Jr. Ph.D., Pines Treatment Center, Behavioral Studies Program, Portsmouth, Va., & Robin J. Lewis Ph.D., Old Dominion Univ., Norfolk, Va. 23508. Sex offenders as a population are considered to be heterogeneous. A need exists to find more homogeneous subtypes. Although there is a plethora of research with adult sex offenders, there is a dearth of literature dealing with adolescent offenders. The current study looks at the utility of the MMPI to differentiate different subtypes of adolescent offenders. Subject consist of 60 adolescent male sex offenders divided into groups based on their own history of victimization and whether their own offence was incestuous or non-incestuous. Results are compared to the current adult literature as to the ability of the MMPI to differentiate subtypes.

EVALUATION OF OCCUPATIONAL SAFETY WORKSHOPS: A NEED FOR TOP-MANAGEMENT SUPPORT. Melody Griffin-Hamilton, Gisele Wright* and E. Scott Geller, Dept. of Psychology, VPI & SU, Blacksburg, VA 24060. The purpose of this study was the evaluation of safety behavior training workshops given by trained professionals in a corporate setting. Five hundred and seventy four wage employees of the plant participated in the sessions. The sessions consisted of slide presentations, work booklets and lectures. At the end of each session the employees were asked to complete a questionnaire evaluating the strengths and weaknesses of the sessions. The questionnaire was completed by 60% of the 574 employees that participated in the sessions. Forty-four percent of the employees responded that their own attitude toward plant safety, positive behavior change and self-esteem was affected negatively by management's lack of support. The results of this study suggest that for corporations to have employees concerned about work safety in the plant, there first must be support and involvement from management.

AN EVALUATION OF REACTION TIME TESTS APPLICABLE IN A PARTY SETTING FOR ASSESSING BAC. R.D. Halsey, D.M. Maglietta, & C.T. Buchholz, Dept. of Psyc., Va. Tech., Blacksburg, Va. 24061. This study tested possible procedures for assessing intoxication in a university drinking-age population. Partiers signed an informed consent sheet and were assigned a subject number as they entered a designated party where alcohol was present. During the course of the evening, a researcher approached a potential subject and asked them to enter a separate room to participate in three tests. These tests were designed to test the subjects psychomotor performance and were presented to the subjects in a counter-balanced fashion. After completing the tasks, the subjects were escorted to another area where their blood alcohol concentration (BAC) was determined by a breathalyzer. BAC readings were later correlated with perfomance on the three psychomotor tasks. It was expected that performance on the tasks would decrease as subjects' levels of intoxication increased. Results of the study, as well as implications of the findings, are discussed.

CLASSROOM ARRANGEMENT AND INSTRUCTOR RATING PREDICTION. J. Richard Holcomb, & Raymond Kirby, Dept. of Psychology, Old Dominion University, Norfolk, Va. 23501 Predictions of instructor ratings were studied with reference to classroom arrangements using questionnaire responses to pictures of different classroom arrangements. Arrangements were varied for student-desk placement and instructor desk type. It was hypothesized that circular student-desk arrangements and informal instructor-desk type would be related to higher ratings of instructor openness, fairness, and effectiveness. 112 undergraduate students at Old Dominion Univ. participated. Analyses of variance by condition indicated significant main effects for student-desk arrangement and instructor-desk type on each measure except for instructor-desk type and effectiveness. Post-hoc analyses indicated that means for each condition were significantly more positive as student-desk arrangement became more circular and instructor-desk type became more informal. These results support previous research on student-desk arrangement. Further research is suggested on instructor-desk type and the benefits of different classroom environments on different subject matter.

MOTIVATIONAL TECHNIQUES FOR RECYCLING BEHAVIORS: GROUP DISCUSSION vs. GROUP COMMITMENT. Shawn E. Johnson & Lynette A. Barn, Dept. of Psychology, Virginia Polytechnic Inst. and State Univ., Blacksburg, Va. 24061. The purpose of this study was to motivate recycling behaviors in male college dorm residents. Past studies have concluded that commitment techniques, where individuals agree to perform specific target responses, can be used in modifying behaviors. A three-floor male dorm, consisting of 327 subjects, was sampled. The first and third floors served as experimental groups while the second floor served as the control group. Two intervention techniques were administered. The first intervention consisted of group discussions, which were facilitated in an effort to promote an awareness on the benefits of recycling. During the second intervention, dormitory residents were encouraged to sign pledge cards of commitment to recycle aluminum for two weeks. Results of this study indicated a significant increase in recycling in the experimental groups, but also in the control group. The amount of recyclables collected after the interventions decreased, but remained significantly higher than the amount collected during the baseline phase. The ease and convenience with which these commitment and group discussion procedures were disseminated suggested economical as well as effective methods of modifying desired behaviors in recycling.

COMPARISON OF SURVEYS OF TWO CORPORATE-BASED RECYCLING SITES. Sharon K. Kollas, *Kathy Rumrill, *Dan Stetler, Dept. of Psych., VA Polytechnic and State Univ., Blacksburg, VA 24060. Two companies in rural Southwest Virginia participated in a program to increase recycling by their employees (n=32, n=300). Recycling sites were set up at each of these companies for the employees to bring their recyclables from home. As the second intervention of an ongoing intervention program, a survey was administered to employees as they were leaving work. The survey consisted of eight questions that inquired about the employees knowledge and opinions of the recycling program. The surveys were analyzed as to determine the correlation between the employees' awareness of the implemented programs and their rates of participation.

ASSESSING INTOXICATION IN THE FIELD: USE OF SIGNATURES TO ESTIMATE PARTIERS' BACS. S.E. Little, J.M. Satz, & K.E. Glindemann, Dept. of Psyc., Va. Tech., Blacksburg, Va. 24061. The use of writing samples as indicies of alcohol impairment was explored. A pilot study performed by the research team suggested that handwriting can, in fact, serve as a valid index of alcohol impairment. In this study, students at a campus fraternity party (N=72) wrote a sentence before and after consuming alcohol (in beer and mixed drinks). In the exit condition (i.e., after consuming alcohol), one half of the subjects were informed that the samples of their handwriting would be analyzed in an attempt to determine their level of impairment (i.e., experimental condition), and the remaining half of the subjects were left uninformed as to this purpose (i.e., control condition). When leaving the party, students' blood alcohol concentration (BAC) was assessed with a breathalyzer. Later, undergraduate and graduate students (N=25) attempted to discriminate between pre- and post-party handwriting samples, and then classified the presumed post-party samples along a continuous scale of BAC level. Results of this study, along with relevent implications of the research, are discussed.

EFFECTS OF LESIONING THE ENTORHINAL CORTEX AND VENTRAL SUBICULUM ON LATENT INHIBITION. Gregory L. Lyford and Leonard E. Jarrard, Dept. of Psychology, Washington and Lee University. Latent inhibition is retarded learning about a stimulus after that stimulus has been preexposed in a nonreinforced context. Conventional lesions of the hippocampus are known to increase learning to the preexposed stimulus. In the present study, the entorhinal cortex and ventral subiculum were aspirated in rats. Using a within-subjects conditioned suppression procedure, we tested these animals for latent inhibition. Contrary to our expectations we found that the lesioned animals did not differ from controls as both groups demonstrated a robust latent inhibition effect. Further study of the hippocampal formation is necessary to discover the crucial neural substrates of latent inhibition.

SPATIAL MEMORY IN THE YOUNG AND THE ELDERLY. Andrew B. Manson, Dept. of Psyc., Washington and Lee Univ., Lexington, VA 24450. College undergraduates (Mean age = 19.5 years) and elderly faculty or former faculty (Mean age = 66.2 years) viewed an apparently three-dimensional table top displayed on a computer. The display included 1 or 4 landmarks and a target object. After viewing the display for 5 sec, the target was moved and the subjects had to replace it in its original position. The landmarks were systematically moved either to the left or the right of the observer. Errors in relocating the target followed the movement of the landmarks, and relocation errors tended to be greater when there were 4 landmarks than when there was 1. These results are consistent with a vector sum model of spatial memory. The two age groups did not differ in their ability to relocate the target accurately, and both age groups reacted similarly to movement of the landmarks. Since healthy older adults performed well, the task may be a valuable one for assessing spatial, non-verbal memory in demented elderly people.

EFFECTS OF ASTHMA ON THE SOCIAL DEVELOPMENT OF CHILDREN. Chelley A. Merrell & Michelle L. Kelley*, Dept. of Psychology, Old Dominion University, Norfolk, Va. 23508. The purpose of the present research was to examine the impact of asthma on children's (6 to 12-years old) social development and behavior. Mothers of severe asthmatics (i.e., steroid-dependent), moderate asthmatics (i.e., non-steroid-dependent), and non-asthmatic siblings were administered the Vineland Adaptive Behavior Scale-Survey Form (Vineland: Sparrow, Balla, & Cicchetti, 1984) and the Child Behavior Checklist (CBCL: Achenbach & Edelbrock, 1986). Three areas of social development were assessed by the Vineland: Communication, Daily Living Skills, and Socialization. The following dimensions of the CBCL were assessed: Internalizing, Externalizing, Depressed, Aggressive, Hyperactive, Obsessive, and Somatic Complaints. It is hypothesized that children with severe asthma will demonstrate lower levels of social development and exhibit higher levels of negative child behaviors than either the moderate asthmatics or non-asthmatic siblings. Findings will be discussed in terms of the impact of chronic illness on the child and family functioning. (Supported by the Dept. of Pediatrics, Children's Hospital of The King's Daughters, Norfolk, Va.)

ON THE NEURAL BASIS OF THE CONDITIONED EMOTIONAL RESPONSE: EFFECTS OF IBOTENATE LESIONS OF THE HIPPOCAMPUS. Margaret G. Mckernan, Dept. of Psych., Washington and Lee Univ., Terry L. Davidson, Dept. of Psych., Purdue Univ., Leonard E. Jarrard, Dept. of Psych., Washington and Lee Univ., Lexington, VA 24450. Rats with selective ibotenate lesions of the hippocampus were trained to bar-press on a variable interval schedule of reinforcement. When a baseline level of responding was achieved, the rats underwent fear conditioning, pairing a steady light (CS) with a .5s shock (UCS) to elicit a "freezing" response. The strength of this conditioned emotional response was then measured by looking at suppression of bar-pressing during CS-presentation. While hippocampus-lesioned animals displayed an overall decreased tendency to freeze relative to controls during fear conditioning, they did not differ significantly from controls in bar-pressing suppression ratios, suggesting that the hippocampus may not be essential for the acquisition of conditioned emotional response.

INTERNATIONALIZING PSYCHOLOGY CURRICULA: LESSONS AND MATERIALS FOR EASTERN EUROPE AND THE SOVIET UNION. James P. O'Brien, Tidewater Cmnty. Col., Virginia Beach, VA 23456. A recent state commission report "The University in the 21st Century" emphasized the need for preparing our students to survive and prosper in a world of increasing national interdependence. This is to be accomplished by faculty in all curricula providing a global perspective. Instructional modules and related materials prepared for a faculty seminar are discussed; in particular, behavior control, Ivan Pavlov, and ergonomics. They are designed to provide the student with the social, cultural, geographical, and historical context in which major contributions to the field have been made or different approaches have been used. Topics and individuals already covered in psychology courses (e.g., Wilhelm Wundt, gestalt psychology, propaganda, social power, etc. in addition to the above) can easily serve as vehicles to familiarize students with political, economic, social and other factors which provide a context for psychological research and theory developed overseas.

AUTOMATIC PROCESSING AN AUDITORY ORIENTATION: AN AUDITORY STROOP EFFECT. Jason L. Parker, Dept. of Psyc., Old Dominion Univ., Norfolk, Va. 23508, & W. Lichty, Dept. of Psyc., Old Dominion Univ., Norfolk, Va. 23508. Research has shown that cognitive performance is effected by word, color and word-color incongruities. Current research suggests that a similar effect may exist with words presented aurally. This study proposes a method in which the Stroop Color Word Test may be transferred into an auditory form. The subjects for the experiment were 12 undergraduate college students from Old Dominion Univ.. The Auditory-Stroop task asked subjects to respond to right and left stimulus presentations played into stimulus congruent and incongruent ears. An Analysis of Variance was calculated. The results of the experiment were compared to those of the Color Word Stroop and a 2 color version of the Stroop.

MOTIVATING RECYCLING BEHAVIOR: A COMPARISON OF MOTIVATIONAL TECHNIQUES. Kim Randall, *Gisele Wright, Melody Griffin-Hamilton, & Sharon Kollas, Center for Applied Behavior Systems, Psychology Dept., VA Polytechnic Institute and State Univ., Blacksburg, VA. The need for recycling and other proenvironmental behaviors has been a topic of increasing concern in both the scientific and popular press. This research examined a novel format for collection of household recyclable material, while also testing a motivational package designed from a taxonomy of behavior change techniques. The employees at two industrial sites (n=32, n=300) were encouraged to bring their recyclable materials from home to the work site. Posters, feedback, a group meeting, and questionnaires were the techniques used to increase participation in the program. Analysis of dependent measures indicated the relative effectiveness of the separate techniques, as well as the combination of the techniques, and social validity (i.e., the satisfaction of the employees as consumers).

VEHICLE SAFETY BELTS: CAN AN AUTOMATIC SYSTEM BE DETRIMENTAL? Kim Randall, * Gisele Wright, and Melody Griffin-Hamilton; Dept. of Psychology, VPI&SU, Blacksburg, Va. 24061-0436. Automatic shoulder belts are very popular in the automobile industry. In addition to the automatic shoulder belt, most cars have a manual lap belt. In automobile collisions, the automatic shoulder belt decreases the impact between the driver and the car's dashboard. A number of automobile deaths result from the driver being thrown from the vehicle. For this reason it is important that lap belts are used to restrain the driver from being tossed during a vehicle collision. This study observed the influence of automatic shoulder belts on the use of manual lap belts. Subjects (n=60) were surveyed on their past use of manual safety belts compared to their present use of the manual lap belt (in cars with automatic shoulder belts) and their feelings regarding use of both the automatic shoulder belt and the manual lap belt (i.e., Are you safe with use of the shoulder belt alone). Results show that for 37% the automatic shoulder belt does not influence lap belt use, for 38% the automatice shoulder belt increases the use of the lap belt, for 18% there was a decrease, and 7% did not know.

ABOUT FACES: A STUDY IN ELECTRO-DERMAL ACTIVITY (EDA) AND THE PROCESSING OF FAMILIAR AND DISTINCTIVE FACES. Don Shearer, Jr. and Peter Mikulka*, Dept. of Psych., Old Dominion Univ., Norfolk, Va. 23405. This study focuses on two dimensions of the facial recognition process - the familiarity and distinctiveness of faces. One hundred and three black and white slides of various faces gathered from current periodicals were made into 35mm slides. These stimuli were then viewed by 50 undergraduate student subjects to rate verbally familiarity on a 1-7 Likert scale, and were also asked to name the faces if possible. Forty-eight different subjects were asked to rate verbally the same stimuli for distinctiveness on a 1-7 Likert scale. Forty stimuli were selected from the original 103. These 40 stimuli represented both high and low ratings on the two dimensions and were shown to an additional 25 subjects. Using EDA measures and verbal ratings of a feeling of knowing or identification of the face, data were collected. A GLM analysis of these data showed a significant main effect for familiarity which indicated that larger EDA amplitude occurred to the more familiar faces. While administering the trials, a "double arousal" pattern termed the "W" effect was uncovered. Familiarity had a significant effect on this phenomenon as well.

EFFECTS OF MOVING LANDMARKS ON SPATIAL MEMORY. Heather A. Turner, Anne Culley, David G. Elmes, Courtney Penn, & Joseph B. Thompson, Dept. of Psyc., Washington and Lee Univ., Lexington, VA 24450. On a computer display, college students viewed an apparently three-dimensional table top. The display included 1, 2, or 4 landmarks and a target object. After viewing a display for 5 sec, the target was moved and the subjects had to replace it in its original position. Landmarks were systematically moved either toward or away from the observer. Errors in relocation were unrelated to the number of landmarks. However, the magnitude and direction of the error followed the displacement of the landmarks. The results are consistent with a vector sum model of spatial localization that accounts for characteristics of animal spatial memory.

EFFECTS OF ENTORHINAL CORTEX LESION ON RETENTION IN NON-MATCHING TO SAMPLE TASK IN RATS. W. Kelly Vandever, Scott E. Miller, Greg L. Lyford, and Leonard E. Jarrard, Dept. of Psych., Washington and Lee Univ., Lexington, VA 24450. In the present study, we used rats and a non-matching-to-sample task (NMTS) in order to study the rule of the entorhinal cortex (EC) in memory. In previous experiments, lesioning of the hippocampus has led to disruption of spatial acquisition and retention in rats but not in acquisition of a non-spatial test of working memory-delayed non-matching-to-sample (DNMTS). In our experiment, rats were trained to select the novel of two stimuli (NMTS task) in a Y-arm maze. Once attaining criterion level (80%) for the acquisition task, EC lesions were performed on half of the rats followed by post-operation testing. There was no significant difference in performance between the lesioned and control rats, thus suggesting that the cortical inputs to the hippocampus via EC do not play an important role in this type of learning.

USING PHYSICAL CHARACTERISTICS AS A PREDICTOR OF NEGATIVE DRIVING OUTCOMES. John A. Wangler, Bryan E. Porter, E.Scott Geller, Dept. of Psychology, and R.B. Frary*, Learning Resources Center, Va. Polytechnic Inst. and State Univ., Blacksburg, VA 24061. Automobile safety involves many complex factors. In particular, risky driving behavior may be correlated with an individual's physical traits and driving experience. This study examined four main independent variables (handedness, visual acuity, number of speeding tickets accumulated, and years of driving experience) and their correlation with reported automobile accidents. It is plausible that any or all of these variables may be used as a predictor of future automobile accidents. A questionnaire was devised asking college students about physical traits (i.e. left-handedness), driving speeds, and driving records. Subjects consisted of undergraduates enrolled in introductory Psychology courses, as well as a cross sample of other college-age students enrolled in other psychology courses. A four-variable multiple regression procedure was performed. The number of driving tickets that one has accumulated and one's visual acuity were shown to be variables which allow us to significantly predict an individual's number of automobile accidents. Implications of this study are discussed.

Statistics

LOGISTIC REGRESSION APPLIED TO TREE MORTALITY PREDICTION. Olga B. Avila & Harold E. Burkhart, Dept. of Forestry, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061-0324. The probability of mortality for an individual tree with certain characteristics growing under certain conditions was modeled. A particular algorithm SCREEN was used to find the best set of predictor variables. This algorithm was specially created to be used when the dependent variable can take only two values like in this binary case (dead or alive tree). The logistic model with different independent variables, which were found to be significant through the SCREEN algorithm, was fitted to the data. The appropriateness of the logistic model obtained using as independent variables individual tree crown ratio, ratio of tree total height to the average height of dominant and codominant trees, and competition index was studied. The value of the model deviance did not reject the null hypothesis that the logistic was an appropriate model. The analysis was repeated when substituting the ratio of the stand quadratic mean diameter to the individual tree diameter at breast height for the competition index. Similar results were obtained. Validation of the models showed no major improvements of the logistic model when including more than three independent variables.

BAHADUR EFFICIENCIES FOR CONTAMINATED NORMAL DISTRIBUTION. Narasinga Rao Chaganty and Akhil K. Vaish, Dept. of Mathematics and Statistics, Old Dominion University, Norfolk, Va. 23529. In this paper we obtain the Bahadur slopes of the common test statistics used for testing a hypothesis for the location parameter of a mixture of two normal distributions. We use these results to study the robust properties of the test statistics using Bahadur efficiency, which is defined as the ratio of Bahadur slopes, as a criteria for normal populations in the presence of contamination.

METHODS FOR MEASUREMENT OF GEOGRAPHICAL VARIATIONS FOR EVALUATING THE QUALITY OF HEALTH CARE. R. Clifton Bailey, Health Standards and Quality Bureau, ME 2-D-2, 6325 Security Boulevard, Baltimore, MD 21207(BITNET: R3B@NIHCU)
The Health Standards and Quality Bureau (HSQB) is charged with the assurance of the appropriateness and effectiveness of the medical care provided to Medicare beneficiaries. The presentation will focus on methods and models for analyzing the mortality outcome for the health care delivered to Medicare Beneficiaries and population based mortality and hospital use. The presentation will describe a general approach for this type of assessment. Specific applications include a modified Makeham survival model in which concomitant variables are used to evaluate the long- and short-term risks, and a modified zero-class Poisson regression The points illustrated by the examples can be applied broadly in the evaluation the quality of health care.

A ROBUST F TEST IN MULTIPLE REGRESSION. Jeffrey B. Birch, Dept. of Stat., Va. Tech., Blacksburg, Va. 24061, & David B. Agard*, N. Ky. Univ. Outliers are observations of the response variable not consistent with any pattern or trend expressed by the remainder of response data. It is well known that outliers in a multiple linear regression (MLR) analysis can distort the estimates of the unknown parameters. In addition, inferences made on parameters can also be adversely affected by outliers. In this paper, we study the impact of several types of outliers on the classical inferential techniques used in MLR. We also present several inferential procedures, introduced in recent literature, designed to be robust against outliers and propose two new alternative robust methods, the F-tests based on robust weights. The power of these robust procedures, along with the power of the classical methods, will then be compared in a simulation study.

MULTIVARIATE EXPONENTIALLY WEIGHTED MOVING AVERAGE CONTROL CHARTS FOR THE MEAN VECTOR AND VARIANCE-COVARIANCE MATRIX WITH VARIABLE SAMPLING INTERVALS. Gyo-Young Cho* and Marion R. Reynolds, Jr., Dept. of Stat., Va. Polytechnic Inst. and State Univ., Blacksburg, VA 24061. When using control charts to monitor a process it is frequently necessary to simultaneously monitor more than one parameter of the process. Multivariate exponentially weighted moving average (EWMA) control charts for simultaneously monitoring the mean vector and variance-covariance matrix of a process with a multivariate normal distribution are investigated. A variable sampling interval (VSI) feature is considered in these charts. For multivariate EWMA control charts for the mean vector and variance-covariance matrix, three procedures which depend on how past sample information is used are presented. The first multivariate EWMA procedure reduces each multivariate observation to a scalar and then forms a EWMA of the scalars. The second multivariate EWMA procedure accumulates past sample information for each parameter and then forms a univariate EWMA statistic from the multivariate accumulations. The third procedure uses p separate EWMA charts for each parameter. These three control procedures are compared on the basis of their average time to signal (ATS) performance.

DISCRIMINANT ANALYSIS OF EXPERIMENTAL DATA FROM SPECTRAL DATA OF BLOOD SERUM FROM SELENIUM DEFICIENT AND PREGNANT HEIFERS. Lyle Evans & Germille Colmano, Dept. of Biomedical Sciences, VMRCVM, VPI & SU, Blacksburg VA, 24061-0442. Discriminant Analysis to identify pregnant and Se deficient heifers was based on UV-VIS spectrophotometry of their blood serum using absorbance values from 190nm to 650nm (a challenge to statistical analysis as there are many more variables than observations and the variables are correlated). A small number of principal components were used to effect a reduction in dimensionality. Discriminant analysis was performed using those principal components that exhibited the best separation capability rather than those with the largest eigenvalues. In this respect our results confirm the work of Chang (1983). Discriminant analysis on a small portion of the spectra of 39 heifers (2/3 pregnant and 2/3 selenium deficient) using 20 known samples (out of 39) as training samples, performed with SAS, gave a true error of 26% A final discriminant analysis, using the identity of all 39 samples, was performed to classify the Se+ and Se- samples. The resulting discriminant analysis gave an apparent error rate of 12.8% and gave an estimated true classification error rate of 17.9% by the method of leaving-one-out.

NECESSARY AND SUFFICIENT CONDITION FOR BOX-BEHNKEN DESIGNS. Jinnam Jo* and Klaus Hinkelmann, Dept. of Stat., Va. Polytechnic Inst., Blacksburg, Va 24061. A class of three-level incomplete factorial designs for the estimation of parameters in a second-order model was developed by Box-Behnken (1960). These designs can be constructed by combining ideas from incomplete block designs (BIBD or PBIBD) and factorial experiments, specifically 2^k factorials. We present the Box-Behnken design matrix in its general form using a PBIB(2) characterized by parameters t, r, b, k, λ_1, λ_2. We provide the X'X matrix when we fit the second-order model. Then we consider the estimability of the mixed quadratic coefficients, and show that a necessary and sufficient condition for mixed quadratic coefficients to be estimable is that both λ_1 and λ_2 are positive. We extend the result to PBIB designs with m associate classes (m>2). We also apply this result when we use fractional factorials instead of full factorials such that the two-factor interactions are not confounded with main effects.

RESPONSE SURFACE OPTIMIZATION WHEN PROCESS MEAN AND VARIANCE ARE MODELED. Yoon G Kim, Department of Statistics, Virginia Tech, Blacksburg, VA 24061 & Raymond H. Myers, Department of Statistics, Virginia Tech, Blacksburg, VA 24061. We often encounter a need to develop experimental strategies to achieve some target condition for the process mean while simultaneously minimizing its variance. G. Taguchi has emphasized the need for considering both mean and variance of the characteristic of interest. His proponents have also made significant contributions in the use of experimental design methods to achieve certain objectives - minimizing risk under a certain loss function - in a mean response while simultaneously minimizing the variance. In this article, we describe how an appropriate index and the concepts of prediction and tolerance bounds for future values at each of K separate settings of the independent variable can be used in our quest for the optimal experimental condition. These methods can be extended to the simultaneous optimization of several response variables which depend upon a number of independent variables or sets of conditions. A simple example will illustrate their usage.

MAXIMUM LIKELIHOOD ESTIMATION OF FIRST PASSAGE TIME PROBABILITIES IN A MARKOV RENEWAL PROCESS. Indira Kuruganti and Robert E. Johnson, Dept of Math Sciences, Virginia Commonwealth University, Richmond, VA 23284-2014. The National Cancer Institute has published guidelines for the preventive screening of cancer amongst asymptomatic patients. A two state Markov renewal model is proposed here to characterize the time taken for a patient to be screened after (s)he becomes indicated for such screening. Let p denote the probability of transition from the indicated to the screened state. If a patient can undergo state transitions only at the time of a visit to the clinic, the time intervals between visits being i.i.d. Weibull(α,β), then the time to screening is the sum of a random number of Weibulls and does not have a recognizable distribution. However, given the number of visits (n) to the clinic, the distribution of the time to screening can be approximated by a Generalized Gamma distribution with parameters a, b and n where a and b depend on n and the Weibull parameters α and β. The m.l.e.'s of α , β and p are found (when right censoring of data is allowed) by taking advantage of the property of stochastic renewal at each visit epoch. These are used to find the m.l.e.'s of a and b for a given value of n. The values $\hat{a}$ and $\hat{b}$ (for each value of n) and $\hat{p}$ are then used in a weighted sum of Generalized Gamma distributions to estimate the c.d.f. of the time to screening. Finally probability estimates computed directly from simulated data are compared with the m.l.e. obtained using the proposed model.

LET'S MAKE A DEAL: THE PLAYER'S DILEMMA. J. P. Morgan, N. R. Chaganty*, R. C. Dahiya*, and M. J. Doviak*, Dept. of Math. & Stat., Old Dominion Univ., Norfolk, Va. 23529. In a trio of recent columns entitled "Ask Marilyn" in *Parade Magazine* (September 9, 1990, December 2, 1990, and February 17, 1991) the following question was posed: "Suppose you're on a game show and given a choice of three doors. Behind one is a car; behind the other two are goats. You pick door No. 1, and the host, who knows what's behind them, opens No. 3, which has a goat. He then asks if you want to pick No. 2. Should you switch?" This problem has been long known in guises such as the prisoner's dilemma of Mosteller (1965), and this is not the first time it has been the focus of a lively debate. The current setting, however, opens questions not addressed in previously published solutions. These questions will be explored here, along with a look at some of the more popular false solutions and a brief treatment of the problem's history.

CONSTRUCTION OF OPTIMAL DESIGNS FOR THE LOGISTIC MODEL. William R. Myers. Dept. of Biostatistics, MCV Station, Box 32, Medical College of Virginia, Va. Commonwealth Univ., Richmond, Va. 23298-0032. Logistic regression is widely used to relate a quantal response to the levels of one or more explanatory variables. Since this model is nonlinear an optimal design will depend upon the model parameters. Several different criteria (eg. D,G,Q,E optimality) have been found useful in designing linear models. For nonlinear models D-optimality has been extensively investigated. The purpose of this paper is to explore the use of several of these criteria for designing experiments for the logistic model. Robustness relative to initial parameter estimates is considered for some of these designs. In addition, a two stage experiment that forms optimal designs for various criteria is also constructed.

COMPARING AND PREDICTING TIME-RELATED, PATIENT SPECIFIC OUTCOMES AFTER INTERVENTION FOR HEART DISEASE. David C. Naftel,* Dept. of Surg., University of Alabama at Birmingham, Birmingham, AL 35294. Currently there are several treatments (medical therapy, coronary artery bypass surgery and percutaneous, transluminal coronary angioplasty) available for the patient with ischemic heart disease. Assessing the treatment of choice is a multi-dimensional process. In fact, the preferred treatment for a particular patient is a function of 1) patient specific characteristics, 2) treatment specific characteristics, 3) which outcome (death, return of angina, subsequent operation, etc.) is examined and 4) patient preferences regarding the possibly time-changing superiority of a treatment. Quantitatively evaluating and comparing treatments is a statistical challenge that should consider 1) the quantity, quality and source of the available data, 2) the available and implemented statistical methods and 3) the potential to translate the analytic results into interpretable and useful graphical formats. Statistical methods do exist that quantify this decision making process and aid the physician and patient in making informed decisions including the degree of uncertainty. This paper focuses on the statistical methodology (specifically parametric survival analysis) that can be and has been used for comparing treatments through time-related predictions of the probability of outcome after intervention for ischemic heart disease.

A NOTE ON GENERALIZED SPATIAL MEDIAN. Dayanand N. Naik, Dept. of Mathematics and Statistics, Old Dominion University, Norfolk, Va. 23529. This note is concerned with the derivation of a generalized spatial median (GSM). The equations obtained to derive the GSM are also the equations used to obtain the maximum likelihood estimates of parameters in a certain multivariate distribution. Using these maximum likelihood estimates, inference about the moment correlation coefficient in a bivariate situation is done. Results are illustrated using a simulated data set.

A STATISTICAL APPROACH TO ENVIRONMENTAL IMPACT ASSESSMENT. Sungsue Rheem, Dept. of Stat., Va. Polytechnic Inst. & State Univ. and Eric P. Smith, Dept. of Stat., Va. Polytechnic Inst. & State Univ., Blacksburg, Va. 24061. The before-after control-impact (BACI) method is a powerful approach for evaluating the effect of the discharge from, for example, a chemical or power plant on the aquatic environment. Detection of the effect of the discharge is achieved by testing whether the difference between abundance of a biological population at a control site (upstream) and that at an impact site (downstream)changes once the discharge begins. This requires taking samples, replicated in time, before the discharge begins and after it has begun, at both the control and impact sites. Frequently the data set has problems that hinder simple analysis of the effect such as irregular sampling, outliers, a large number of zero values and trend in the data. In this talk, two of the problems, the problem of zeros and that of trend are discussed. First, an approach to analyzing the zero and nonzero data is described. In data without joint zeros, the difference between the control-site abundance and the impact-site abundance may be dependent upon the magnitudes of abundances and may have the trend. An analysis of covariance will be described to distinguish the effect of discharge from the effects of the magnitudes of abundances and the trend.

A GENERALIZED MODEL APPROACH TO FREQUENCY DOMAIN SPECTRAL ESTIMATION. Keith Selander and Robert V. Foutz*, Dept. of Stat., Va. Tech., Blacksburg, Va 24061. Peter McCullagh (1983) outlined the theory of quasi-likelihood estimation in generalized models. Chiu (1988) showed that an iterated, reweighted least squares procedure applied to the periodogram produces estimates of spectral density model parameters for Gaussian univariate time series which have the same asymptotic variance as those produced by maximizing the true likelihood. In this paper, McCullagh's theory is combined with a functional analysis approach and extended to parametric estimation over frequency bands of the spectral density matrix components of a non-Gaussian bivariate time series. An asymptotic optimality theorem is given, which shows optimality of an iterated, reweighted least squares procedure within a class of procedures. Parametric cospectral estimation over frequency bands allows transfer function analysis of two non-Gaussian time series which are not necessarily ARMA processes when some frequency bands may be contaminated, and non-ARMA multivariate model fits.

DETERMINING THERAPEUTIC SYNERGISM IN A NONPARAMETRIC REGRESSION SETTING. E. Kenneth Sullivan, Dept. of Biostatistics, Med. Col. of Va., Va. Commonwealth Univ., Richmond, Va. 23298-0032. In multiple drug clinical trials it is of interest to estimate the drug levels which provide maximum therapeutic benefit. In particular, we want to know if there exists a drug combination with benefit superior to that provided by using either drug alone (i.e., therapeutic synergism). Statistical development in this area, up to now, has focused on parametric estimation. This includes the work of Carter, et al., who developed methods for calculating confidence regions about the stationary point and about the response at the stationary point useful in defining the existence of a therapeutic synergism. This paper presents a parameter-free estimate of the response surface stationary point and extends the work of Carter by considering the response at the stationary point in a nonparametric regression setting. Re-sampling techniques are used to construct a confidence region about the response at the stationary point, and a statistical test of therapeutic synergism is proposed.

A NEW APPROACH TO DESIGN AUGMENTATION. Sindee S. Sutherland* and Jeffrey B. Birch, Dept. of Stat., Va. Tech., Blacksburg, Va. 24061. We consider the response surface problem of augmenting designs by adding points sequentially to a new region of interest. The methods of sequential design augmentation through the use of performance criteria such as D-optimality or I_{SV}-optimality (minimizing integrated prediction variance over spherical regions) are used under the assumption of correct model specification. However, under model misspecification, the sequential placement of points in the new region of interest using either of the above optimality criteria may not be the most desirable. We present a new methodology, based on a modified kernel regression procedure called HATLINK, that incorporates model misspecification into its sequential augmentation of points to the new region. Our method is then compared to others for various degrees of model misspecification.

PERFORMANCE OF EWMA CHARTS IN THE PRESENCE OF CORRELATION, M.R. Reynolds and L. VanBrackle, 202 Ardmore Street, Blacksburg, VA 24060.
In Statistical Process Control, it is usually assumed that observations taken from the process at different times are independent with a constant mean and with variation due only to measurement error. In many processes this assumption of independence is not satisfied. The lack of independence of observations taken at different times may have a significant effect on the properties of a process monitoring technique.
We consider a first order autoregressive process which is observed subject to measurement error. We use both integral equation and Markov chain approaches to evaluate the average run length (ARL) of an exponentially weighted moving average (EWMA) control scheme used to monitor the process. The effects of correlation and measurement error on the ARL's of the EWMA scheme are studied for a process which is in control and for a process which has undergone a shift away from the target value.