

ABSTRACTS OF PAPERS
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Aeronautical and Aerospace Sciences

NUMERICAL SIMULATION OF SHOCK-INDUCED COMBUSTION IN A HYDROGEN-AIR SYSTEM AND PARAMETRIC STUDIES J. K. Ahuja*, S. N. Tiwari, and D. J. Singh*, Department of Mechanical Engineering and Mechanics, Old Dominion University, Norfolk, VA 23529-0247. A numerical study is conducted to simulate the shock-induced combustion in premixed H₂ — air mixtures for blunt body. A nine-species, 18-step finite-rate H₂ — air chemical reaction mechanism coupled with the Navier-Stokes equations is solved. The flow field over the blunt body is found to be unsteady, when the projectile velocity is same as the Chapman-Jouget velocity of the mixture. The unsteadiness is caused by the periodic instabilities originating in the stagnation zone. For projectiles speeds above the Chapman-Jouget velocity the instabilities of the reaction front disappears. Numerical results shows good qualitative agreement with the ballistic range shadowgraph. The frequency of oscillations, determined, by using the Fourier power spectrum, is found to be in good agreement with the experiment. These instabilities of the reaction front has been explained by the McVey and Toong model. By reducing the size of the projectile, the instabilities in the reaction front for Chapman-Jouget velocities disappears. The oblique detonation wave structure is investigation and the important flow features are discussed.

EMISSIONS STUDIES FOR A NATURAL GAS-FIRED INTERNAL COMBUSTION ENGINE. Carlos Buitrago and A. Sidney Roberts, Jr., Dept. of Mechanical Engineering and Mechanics, Old Dominion University, Norfolk, Va. 23529-0247. Students in the College of Engineering and Technology, Old Dominion University are in the third year of the Natural Gas Vehicle Challenge competitions. In the first two years the emissions performance of the vehicle with a converted gasoline engine has been mediocre. For the purpose of the 1993 competition, a different fuel management strategy was developed. With the help of Siemens Automotive in Newport News, VA, the basic eight-cylinder engine was tested to determine the benefits in emissions that the new multi-point injection system can have over the single point injection system that had been used previously. Precatalyst, raw exhaust gas data for the more important pollutants was taken and analyzed in both systems under different loads and intake manifold pressures. The results were compared and displayed in graphical form. In addition, to obtain a minimum-emissions calibration for the engine, the effects of the spark advance on pollutant concentrations were studied.

A FLOW FIELD SURVEY APPARATUS FOR THE UNITARY PLAN WIND TUNNEL. James E. Byrd, Lockheed Engineering and Sciences Corporation. NASA Langley Res. Ctr., 16 Victory St., Mail Stop 413, Hampton, VA 23681-0001. A description of an automated flow field survey apparatus mechanism with preliminary aerodynamic results from testing a 75 degree swept delta wing in the Unitary Plan Wind Tunnel (UPWT) at Mach 2.80.

RADIATIVE INTERACTIONS IN TURBULENT SUPERSONIC REACTING FLOWS. R. Chandrasekhar* and S. N. Tiwari*, Department of Mechanical Engineering and Mechanics, Old Dominion University, Norfolk, VA 23529-0247. Effects of radiative interactions are investigated in turbulent supersonic reacting flows of hydrogen-air mixtures through axisymmetric jets. A second-order differential Reynolds Stress turbulence model has been applied to the Favre-averaged Navier-Stokes equations. An assumed Beta Probability Density Function is applied to account for the chemical source terms and the radiative flux terms in the conservation equations. A seven-species, seven-reaction finite rate chemistry mechanism is used to simulate the combustion processes. The tangent slab approximation is used in the radiative flux formulation. A pseudo-gray gas model is used to represent the absorption-emission characteristics of the participating species. The turbulent/radiation interaction is achieved via a new formulation. The resulting formulation is validated by comparison with experimental data on reacting supersonic axisymmetric jets. Results obtained for specific conditions indicate that the effect of chemical reaction on the turbulence is significant. Also, the radiative heat transfer is enhanced by the turbulence.

FINITE ELEMENT NONLINEAR RANDOM RESPONSE OF BEAMS TO ACOUSTIC AND THERMAL LOADS APPLIED SIMULTANEOUSLY. Ruixi Chen and Chuh Mei, Dept. of Mechanical Engineering and Mechanics, Old Dominion University, Norfolk, VA 23529. A finite element formulation combined with the equivalent linearization technique and the normal mode method is developed for the study of nonlinear random response of beams subjected to simultaneously applied acoustic and thermal loads. This study is the first attempt to analyze the loads applied simultaneously. Comparing with the sequential load method, this method is much logical and straightforward, it is then easier to formulate nonlinear problems. The solution procedure itself can take care of the inter-dependence between the thermal effects and the acoustic-structural response. Examples include thermally buckled random response of simply supported beam, clamped-clamped beam. To compare and validate the present formulation, results are compared with the solutions obtained by classical continuum method and Fokker-Planck-Kolmogorov method. The comparison with the solutions from existing sequential load method is also made, and significant difference has been found. (Supported by the AFOSR research contract F33615-91-C-3205.)

LEADING EDGE VORTEX FLAPS ON A DOUBLE DELTA WING. Henri D. Fuhrmann, Langley Research Center MS 406, Hampton, Va. 23681-0001. Experimental lift and drag measurements are presented for a double delta wing with leading edge vortex flaps. The wing has undeflected leading edge sweep angles of 68° and 49° for the forward and aft sections respectively. The flaps are deflected downward from 0° to 40° as the nominal angle of attack is varied from 0° to 20° . Lift over drag (L/D) data are correlated with the flap deflections in the form of a contour plot. There is a substantial increase in the lift to drag ratio with implementation of the vortex flaps. A 25% increase in the peak L/D and a 100% increase at certain high angles of attack were observed. This increase in L/D is obtained by reducing the strength of the vortices on the leading edge flaps at high angles of attack. (Research conducted at the Massachusetts Institute of Technology.)

APPLICATION OF CFD AND TRANSITION PREDICTION IN HYPERSONIC FLIGHT EXPERIMENTS. A. GODIL, High Technology Corp., Hampton, VA. & A. Bertelrud, Analytical Services & Materials., Hampton, VA.

Computational fluid dynamics(CFD) methods were used in conjunction with linear stability and N-factor computations in the design of a glove shape for the study of hypersonic cross-flow transition in flight. The flight experiment is to be performed on the delta wing of the Pegasus launch vehicle to support stability code validation and development. The wing glove was designed to have cross-flow-dominated transition on the gloved portion of the wing at a Mach number of 6 and to suppress the Tollmien-Schlichting instability. The leading-edge radius of the glove was selected such that the flow on the attachment line is laminar during the flight experiment. Sensitivity studies to various parameters such as trajectory variations, surface temperature, and leading-edge radius were also performed.

INVESTIGATION OF NONGRAY RADIATIVE INTERACTIONS IN ENTRY REGION FLOWS. R. Krishnamurthy* and S. N. Tiwari, Department of Mechanical Engineering and Mechanics, Old Dominion University, Norfolk, VA 23529-0247. The entrance region flow between parallel planes has been investigated numerically. Both laminar and turbulent flows have been considered along with the effect of variable properties. A nongray model has been used. Representative results are included for carbon monoxide gas. For the conditions considered, the results show that variable properties exert a stronger influence compared to radiative transfer alone. However, the effect of radiative transfer is significant on the surface heat flux. This work was supported, in part, by NASA Langley Research Center through grant NAG-1-363.

MEASUREMENT OF THE VELOCITY PROFILE FOR A SUBMERGED FREE JET. Jeff Pace and A. Sidney Roberts, Jr., Dept. of Mechanical Engineering and Mechanics, Old Dominion University, Norfolk, VA 23529-0247. Solenoid valves are commonly used to meter liquid flow. To understand the internal flow characteristics of a complex, three-dimensional geometry incorporating moving boundary surfaces, it is necessary to measure the velocity profile at the valve orifice exit plane. A method to accomplish this, using Particle Image Velocimetry combined with high speed imaging, is presented. Particle Image Velocimetry involves seeding the flow field with tracer particles, and using double flash illumination to determine the seed particle's time of flight. A photo microscope coupled with a digital imaging system is used to acquire and analyze the images. The strobe illumination is provided by a pair of lasers, synchronized to the activation of the solenoid valve. This technique has been used to measure the spatial and temporal evolution of the flow field as the valve is energized, reaches steady state, and then decays as the valve is turned off. This technique has been applied to several valve configurations, for a variety of flow rates and reservoir pressure.

STUDIES OF SURFACE MODELING AND GRID GENERATION AROUND AERODYNAMIC CONFIGURATIONS. A. M. Thomas*, S. N. Tiwari, and R. E. Smith, Dept. of Mech. Engrg. and Mechs., Old Dominion Univ., Norfolk, VA 23529-0247. This study presents the non-uniform rational B-spline (NURBS) approximation form as a unified approach to represent aerospace-vehicle surfaces. The advantages of using NURBS as surface definition is demonstrated by first defining an airfoil section in 2-D and then representing the surface of an ONERA M6 wing. Another objective of this study is to demonstrate the use of unstructured grids over structured grids. Grids are generated to discretize the solution domains of the mathematical models so that numerical solutions can be obtained. In a structure grid, the connectivity between the points is implicitly defined through a curvilinear coordinate system. In an unstructured grid, the connectivity is arbitrary and therefore must be explicitly specified. Solution methods that utilize a structure grid are generally more efficient than methods that utilize an unstructured grid. However, unstructured grids provide much better degree of flexibility than is available with structured grids. In this study, unstructured grids are generated around a NACA0012 airfoil, an ONERA M6 wing, and a four element airfoil in its landing configuration. Euler solutions are computed and compared with structured grid results.

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Agriculture, Forestry and Aquaculture Science

CANINE HIP DYSPLASIA (CHD) IN PERSPECTIVE, Joseph W. Berg, Jr., PhD, 3319 Dauphine Drive, Falls Church, VA 22042, and Raymond VanLienden, DVM*, Columbia Pike Animal Hospital, Annandale, VA 22003. Factors affecting Canine Hip Dysplasia (CHD) have been analyzed mathematically. Genetics, Nutrition, and Physical Activity affect CHD directly, and changes in these variables are additive. To evaluate the effects, two of the three variables must be held constant while evaluating the third. In addition to genetics, which is currently considered the primary cause of CHD, it is possible to prevent the development of CHD in some dogs by controlling nutrition and physical activity. A nutritional program should be established to provide for slow body growth during the first year. Also, a program for physical activity should be designed that eliminates unnecessary stress on the hips until ossification centers close. Further, it is shown that quantitative measurements of the changes can be made if better techniques in radiology are developed and used.

CHARACTERIZATION OF CORN EARWORM GROWTH ON SOYBEAN TERMINALS

H.L. BHARDWAJ, M. Rangappa, A.I. Mohamed, and A.A. Hamama. Agricultural Research Station, Virginia State University, Petersburg, VA 23806.

A comparison of weights of larvae, raised for 14 days on 30 soybean cultivars (five each from maturity groups II to VII), identified Gnome-85, Essex, and Padre to be susceptible and Newton, Walters, and Colquitt to be resistant to corn earworm (Helicoverpa zea). In general, the larvae grew better on cultivars of northern maturities as compared to cultivars of southern maturities. The larvae raised on susceptible cultivars had higher lipid contents (fresh weight basis) as compared to those raised on resistant cultivars. Differences existed for contents of saturated and unsaturated fatty acids in larvae raised on susceptible or resistant cultivars of northern and southern maturities. These results indicate that leaf/terminal composition might be involved in soybean resistance to corn earworm and it might be possible to develop resistant cultivars upon comparison of leaf/terminal composition of resistant and susceptible cultivars. The corn earworm larvae could also be developed as a source of Omega-3 (18:3) fatty acids.

BLACK SEA BASS, *CENTROPRISTIS STRIATA*, IN CLOSED RECIRCULATING SYSTEMS: FEEDING MAINTENANCE AND SYSTEM MANAGEMENT. Allen J. Costa and Anthony J. Provenzano, Department of Oceanography, Old Dominion University, Norfolk, VA 23529-0276. Black sea bass, *Centropristis striata*, maintained in closed recirculating systems prove to be fast growing and hardy in spite of water quality and filtration problems. Animals, averaging 228 grams initially, were kept in thirty-five to 105 gallon (134 to 401 liter) tanks with water flows of four gallons per minute (15 liters per minute). The filter systems consist of four canisters connected in series, a mechanical filter (thirty-five micron polyester), a bio-active filter (plastic balls), a buffering filter (crushed oyster shell), and an ultraviolet light. Elevated nitrite levels, and inadequate bottom circulation allowed build-up of waste material. In spite of the problems, the fish fed at 1.5% wet body weight showed a mean weight gain of 32.6%, or on average 74.2 grams per fish, over a two month period. These fish were healthy throughout the trial period. This species appears to be an excellent candidate for closed-system culture.

FISH HEALTH MANAGEMENT: A HISTOLIC APPROACH. David Crosby, VA State University, Petersburg, VA 23806. Most fish health treatments involve only the necropsy of morbid fish. In these cases, fish health specialists base recommendations on clinical findings. However, fish health management involves more than diagnosis of a disease. It also involves investigation of underlying causes that may be producing stress reactions in the aquaculture operation. By removing or reducing stress factors, operators should be able to eliminate the problem. One must consider the entire aquaculture operation in finding the underlying cause. Overall, this involves examining production management schemes of an operation for cultural practices. Secondly, consideration must be given toward the particular environment in which fish live. This implies that water quality analysis is a necessary part of any fish mortality examination. Often, a site visit is required for determining and correcting the management or environmental problem.

MODELING THE DIAMETER AND LOCATIONAL DISTRIBUTIONS OF BRANCHES WITHIN CROWNS OF LOBLOLLY PINE TREES. Paul F. Doruska & Harold E. Burkhart, Dept. of Forestry, Va. Polytechnic Inst. and State Univ., Blacksburg, VA 24061. Crown structure for 9- to 30-year-old loblolly pine trees was quantified via analysis of branch diameters and locations, both along and around the bole. The 68 trees analyzed ranged in size from 11.1 to 31.6 cm in diameter at breast height and from 8.30 to 25.67 m in total height, and were growing in unthinned stands in the Piedmont and Atlantic Coastal Plain physiographic provinces. A recursive system of 2 equations was used to predict the total number of branches within a crown. A series of 3 equations was used to describe the average of and range in diameter within a whorl. Equidistant whorl spacing was assumed and overall percentages were used to assign the number of branches within a whorl. Circular statistics were used to analyze the circular pattern of branches within a crown. Analysis of branches on a whole tree basis indicated a uniform distribution was appropriate. Circular correlation was used to analyze the rotational patterns within and between whorls, and a strong positive correlation was found for consecutive whorls with the same number of branches. (Supported by the U.S. Forest Service Southern Global Change Program.)

DEVELOPMENT OF THE PECTORAL STRIDULATORY SOUND-PRODUCING ORGAN IN THE CHANNEL CATFISH. Charles B. King*, Devang Patel*, and Michael L. Fine*, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284-2012 & Christopher Mullins and Scott H. Newton, Va. State Univ., Petersburg, Va. 23806. The first pectoral spine of catfish has three known functions: swimming, defensive locking and sound production. In this study we are examining the relative growth of the first spine and pectoral girdle for comparison with ontogenetic changes in defensive sounds. The ventral surface of the tab on the first spine has a ridged surface. During normal pectoral movements, the tab pivots quietly during adduction and abduction; however ventral rotation of the tab causes the ridges to rub against a bony channel in the girdle producing stridulatory sounds. Fin sweeps produce a train of pulses which can vary in amplitude, repetition rate and dominant frequency. The pulses increase in sound pressure level and duration and decrease in dominant frequency with fish growth. Since the mass of the first spine increases more slowly than the mass of the girdle, we suggest that 1) girdle mass will determine sound radiation and 2) a lighter spine is an adaptation to decrease muscle work during sound production.

ADVERSE WEATHER CONDITIONS, IMPLICATIONS FOR TODAY'S FOREST OPERATIONS.

Luc G. LeBel, William B. Stuart, Dept. of Forestry, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061-0324.

Among all factors affecting production of today's loggers, weather has the greatest impact. New environmental regulations like the mandatory Best Management Practices (BMP's) will magnify the influence of seasonal variations on logging operations. Production data from 23 southern independent logging contractors were collected for a period of 12 months. Nonparametric statistical procedures and regular industrial quality control tools were used to analyze patterns of production. Expected outcomes are (1) a better knowledge of loggers' sensitivity to adverse weather; (2) a comprehensive analysis of the strategies adopted to maintain production in wet conditions; and (3) tools for assessing the impact of stricter environmental regulations on contractors' ability to produce.

PLANT GENE ENGINEERING, AN IMPORTANT TOOL FOR CROP DEVELOPMENT.

Arkesh Mehta, Agri. Res. Station, Va. State Univ., Petersburg, VA. 23806. The ability to introduce and express agriculturally beneficial genes into plant cells and tissues and to regenerate viable, fertile plants from them presents an enormous potential to modify and improve crop plants. Genetic engineering of plants offers significant potential for agricultural biotechnology that includes plant breeding, hybrid seed production, biofertilizers, biopesticides and production of novel pharmaceuticals. Investment in the development of agricultural technologies can help ensure environmentally sustainable supplies of safe, nutritious and affordable food supply as well as a potential for production of foreign proteins with various applications to health care. Various methods that have been successfully developed for stable expression of genes into plants will be described along with some of the applications of genetically engineered plants in agriculture.

Industrial Utilization of Soybean: Overview and Potential in Virginia. Ali. I. Mohamed, Assistant Professor, Agricultural Research Station, Virginia State University, Petersburg, Va 23806. The U.S. soybean producer has enjoyed tremendous success in the past 20 years, plantings have more than doubled and yields per hectare have increased by more than 33%, since 1963. The soybean's top ranking is the results of its role as most prolific source of vegetable oil for human consumption and protein for animal feeds. However, due to tough foreign competition, alternative uses of soybean oil and protein should be developed and expanded. In recent years, soybean oil, flour and industrial protein concentrate are used in manufacturing the following commercial products: alkyd surface coatings, epoxidized oil, corrosion inhibitors, lubricants and lubricant additives, polyamide resins, defoamers, fuels and fuel additives, pesticide carriers, spray adjuvant, dust suppressant, pet foods, feed pelleting, fermentation, tanning, joint cements, wallboard, asphalt, pan grease, wall paper coating, plywood glue, metal polishing, detergent products, water-base paints, fire fighting foam, shoe polish, fiber board, textiles, foam concrete, printing inks, spun fibers. The identification, development, and commercialization of new non-food products from soybean will open strong worldwide market and will benefit producer.

The potential of new industrial oil crops (Vernonia and Lesquerella) in Virginia. A. Mohamed and H. Bhardwaj, Agricultural Research Station, Virginia State University, Petersburg, VA 23806. There are several reasons for diversifying Agriculture and introducing potential new crops from the vast resource of the kingdom of wild plants. Of the approximately 250,000 to 300,000 known plant species, less than 100 are grown commercially in U.S. for food, feed, and industry at economic impact level above \$1 million. Another good reason for developing new crops is the increasing reliance in the modern world upon exhaustible resources, such as natural gases, petroleum, and coal energy, and chemical raw materials. Various species of Vernonia and Lesquerella have the potential to provide U.S. farmers with a new crop and U.S. industry with domestic source of vernolic and lesquerolic fatty acids. To assess vernonia and lesquerella's prospects as new crops, Virginia State University researchers are evaluating their adaptation to Virginia's climate, developing both crops for commercialization and gathering germplasm from individuals in the public and private sectors. The resulting oil and meal can provide raw materials for industrial products. Because of their special chemical attributes, the oil and its derivatives can be used in a wide range of products, including resins, waxes, nylons, plastics, high-performance lubricants, corrosion inhibitors, cosmetics, adhesive coatings (automotive and epoxy paints), dibasic acids, epoxy resins, fermentation products, herbicide/pesticide formulations, ink, interpenetrating polymer networks, lubricants, plasticizer, sealants, surfactants and waxes/polishes.

HIGH DENSITY POND PRODUCTION OF CATFISH IN VIRGINIA. Scott H. Newton, Cooperative Extension Service, Virginia State University, Petersburg, VA 23806. During 1992, open pond culture of channel catfish, (Ictalurus punctatus), was examined in 0.25 acre research ponds located in Chesterfield County, Virginia. The primary objective was to initiate development of information on open pond culture of catfish in the Mid-Atlantic Region. Fish were stocked at rates of 1500 and 3000 per acre in triplicated ponds and fed once daily on 116 of a 151 day study period. At harvest, survival was 93% and 96%, while gross yields averaged 4421 and 2175 pounds per acre from the higher and lower density ponds, respectively. Overall, catfish weight increase approximated 200% and average fish size was 1.6 pounds. Processing yield data were collected on 1.0, 1.5 and 2.0 pound fish. Catfish averaging 1.5 pounds had the highest percentage dressed weight (61%) and fillet weight (37%). Recommendations for pond catfish culture are made based upon per acre management and investment costs.

FOLIAR FERTILIZATION OF VIRGINIA-TYPE PEANUT WITH MnEDTA PLUS AMMONIUM SULFATE OR AMMONIUM NITRATE. Norris L. Powell, Tidewater Agricultural Experiment Station, Suffolk, VA 23437-0099. Foliar application of manganese is a common practice for peanut (*Arachis hypogaea* L.) production in Virginia. Use of an anion such as SO_4^{2-} and NO_3^{-1} may improve the uptake efficiency of the chelated salt of MnEDTA (ethylene diamine tetra-acetate) by the plant foliage. In a two year field study ammonium nitrate (NH_4NO_3) and ammonium sulfate ($(\text{NH}_4)_2\text{SO}_4$) were mixed with MnEDTA and applied as a foliar spray to prevent manganese deficiency of the peanut crop. Treatments included MnEDTA, MnEDTA+ NH_4NO_3 , MnEDTA+ $(\text{NH}_4)_2\text{SO}_4$, and an untreated control. In 1991 peanut pod yield of the MnEDTA, MnEDTA+ NH_4NO_3 and MnEDTA + $(\text{NH}_4)_2\text{SO}_4$ out yielded the untreated control by 160, 154, and 176 percentages respectively. In 1992 the same treatments out yielded the control by 150, 178, and 165 percentages respectively. For both years addition of $(\text{NH}_4)_2\text{SO}_4$ to MnEDTA increased peanut pod yields by 10% compared to MnEDTA alone. In one year out of two NH_4NO_3 added to MnEDTA as a foliar spray increased peanut pod yields by 19% above the MnEDTA alone.

DYNAMIC STRESSES IN LOG TRAILER WHILE DRIVING OVER DIFFERENT ROAD TYPES. Andrzej T. Wylezinski & William B. Stuart, Dept. of Forestry, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. Experimental stress analysis of a selected light log trailer was completed using strain gage technology. Dynamic strains were recorded for extreme situations and during a typical work cycle. The objective of this paper is to compare dynamic stresses induced in the log trailer while driving over three road categories: forest sand roads, one-lane paved roads, and state highways. Both the parametric and nonparametric statistical procedures provided strong evidence ($p < .001$) that stresses occurring on sand roads are the highest, followed by those on one-lane paved roads, and then by those on state highways. A light weight log trailer design based on high tensile material (110 ksi yield) was developed which ensures structural integrity and increased payload for all types of road.

Archaeology

A PRELIMINARY REPORT ON EXCAVATIONS AT THE HURT POWER PLANT SITE (44PY144), A LATE PREHISTORIC, PROTOHISTORIC, AND POSSIBLY, CONTACT SAPONI VILLAGE IN PITTSYLVANIA COUNTY, VIRGINIA. Michael B. Barber, Preservation Technologies, Inc., P.O. Box 7825, Raonoke, VA 24019. The research design and methodology of the extensive Phase III mitigation of a seventeenth century Saponi village along the Roanoke River will be discussed. Material culture and intersite distribution will be presented and will include a discussion of European trade items (glass beads, copper, and fauna) as well as Native American artifacts. Indications of culture change within the assemblage will be included. Finally, the excavations will be viewed within the broader perspectives of the region, field recovery regimes, and cultural resource management.

A MIDDLE ARCHAIC BASECAMP/REDUCTION STATION: PREHISTORIC USAGE OF VOLCANIC RHYOLITE AT MT. ROGERS, GRAYSON COUNTY, VIRGINIA. Eugene B. Barfield, Jefferson National Forest, Roanoke, VA 24001. Human usage of volcanic material for tools and weapons has long been known in the prehistoric record. Mt. Rogers, the approximate center of a Precambrian volcano, in southwest Virginia was the only quality source of this igneous material utilized by Native Americans in Virginia prehistory. A routine archaeological survey recently rediscovered a large, single component (Guilford) site, only 4 miles from the 5,729' Mt. Rogers summit. Over 100 test pits have yielded 800 artifacts fashioned from rhyolite with indications this was a base camp/reduction station where routine hunting, and gathering activities as well as reduction of rhyolite to preforms, projectile points and tools was accomplished. An investigation of the lithic inventory, upland environment, including ecological and topographical parameters will be studied to explain the placement of this site within the overall settlement pattern for the Middle Archaic of the area. Quantitative comparisons of rhyolite sources from North Carolina, Virginia, Maryland and Pennsylvania will also be discussed.

THE VIRGINIA STATE PENITENTIARY CEMETERY: A RESEARCH UPDATE. D. Katharine Beidleman, Heritage Resource Services, Inc., and Telemarc, Inc., Richmond, VA 23225. Excavation of a forgotten cemetery at the old Virginia State Penitentiary in Richmond has produced a skeletal population of around 300 individuals of both African-American and European-American descent. In use between 1878 and 1895, the cemetery contains two types of interments which present the possibility of two source populations for the burials. Artifacts found in the graves raise questions regarding possible retention of African spiritual beliefs into the late nineteenth century. These and other research directions are discussed. (Funding provided by Ethyl Corporation, Richmond, VA.)

IN THE DIRT AND IN THE DOCUMENTS: A SEARCH FOR GENDER. Marie E. Blake, Dept. of Anthro., Col. of William & Mary, Williamsburg, VA 23185. This paper focuses on the current research being conducted by the author on the site of Hewick plantation in Urbanna, Middlesex County, Virginia. Hewick was the seat of four generations of the Christopher Robinson family, stretching back into the 17th century and serving a vital role in the community until the 19th century. Each episode of occupation has an associated archaeological site and extant written documents. Within this scope of research possibilities, attention has been focused upon the life history of an individual woman, Elizabeth Robinson Steptoe, and the subsequent insights such a study can give to an understanding of wider cultural trends. Steptoe's life spanned 1768-1832, from colonial to revolutionary to ante-bellum plantation America, with a significant portion of that life having been spent as a single woman landowner. By combining documentary evidence with archaeological excavations of the associated 18th century house, a fuller picture of social and economic relations between men and women can be gained. Discussions of research methods, theories and further questions in reference to gender relations will be included.

THE ARCHAEOLOGICAL RECORD OF ENVIRONMENTAL CHANGE AND HUMAN SETTLEMENT ALONG THE UPPER CHICKAHOMINY RIVER. Dennis B. Blanton, Dept. of Anthro., Col. of William and Mary, Williamsburg, Va. 23187. Archaeological investigations at sites along the upper Chickahominy River reveal evidence of the effects of environmental change on human settlement. Stratified sequences begin during the late Middle Archaic (ca. 5000 BP) and correspond with initial stabilization of low terraces. Subsequent lateral accretion created new areas pioneered initially during the Middle Woodland (ca. 2000 BP). These patterns appear to be closely tied to fluctuations in sea level and their effects on stream gradients and wetland/estuary development.

PRESERVATION PLANNING: THE FUTURE OF VIRGINIA'S ARCHAEOLOGICAL HERITAGE. David H. Dutton, Virginia Dept. of Historic Resources, Richmond, VA 23219. Virginia's archaeological properties are important local, state, and national assets that should be a part of everyday land use and development decisions. Because more archaeological sites are destroyed or preserved through local decision-making than through State or Federal actions, there is an immediate need for comprehensive historic preservation planning and a broader understanding of the planning process by both the general public and the archaeological community. By integrating archaeology and preservation into local decision-making processes, such as planning and zoning, we can make archaeology a part of the system, rather than outside and in conflict with it. Approaches to planning for archaeological resources are discussed with emphasis placed upon opportunities for public and professional involvement in preservation planning for Virginia's archaeological heritage.

GPS: AN INNOVATIVE APPROACH TO ARCHAEOLOGICAL SURVEY, Laura J. Galke, Gray & Pape, Inc., 406 West Franklin Street, Richmond, VA 23220. Global Positioning System (GPS) is a highly accurate system of location developed and maintained by the Department of Defense. The system is the result of the latest technology. Utilizing orbiting satellites, GPS provides worldwide coverage. This system recently was applied by Gray & Pape, Inc., to an archaeological survey in a rugged, mountainous terrain to accurately plot the precise location of discovered cultural resources. This paper will discuss GPS speed, accuracy, and ease of use.

A PRELIMINARY INVESTIGATION INTO NATIVE AMERICAN BURIAL ORIENTATION AND SEASONAL DEATH PREDICTION IN SOUTHWEST VIRGINIA. Kimberly N. Lowe, Jefferson National Forest, Roanoke, VA 24001. In southwest Virginia twenty-four prehistoric archaeological burial sites with 782 individuals have been recorded. A greater percentage of these burials are oriented with the top of the skulls pointed towards the rising sun. Because of this orientation, it is hypothesized that by determining the azimuth angles, predictions can be made as to what season (winter or summer) the prehistoric Native American burials occurred. Only one site in southwest Virginia has been documented well enough to find the azimuth angle degrees. Out of the one hundred burials that were excavated, forty-seven were drawn accurately and could be used for analysis. However, ninety-six burials were recorded with some thoroughness and 80.2% of these burials were oriented between northeast and southeast, the general direction of sunrise. Results revealed more burials occurred in the winter than in the summer. Gender, age, and bone pathologies were examined to determine if they had any significance to the burial orientation. More accuracy in recording Native American burials is needed before further inferences can be made.

SOLO PIPELINE PROJECT: BEGINNING TO END. Royce A. McNeel, Gray & Pape, Inc., 406 West Franklin Street, Richmond, VA. 23220 and Sue Ellen Kozarek, Gray & Pape, Inc. 1318 Main Street Cincinnati, OH 45210. This paper presents an overview of Columbia Gas Transmission Corporation's proposed SOLO pipeline located in South Central Virginia. These investigations were conducted by Gray & Pape, Inc. 1989 through 1991. The project begins in Petersburg and continues through Prince George, Dinwiddie, Sussex and Greensville Counties, Virginia. The pipeline corridor covered 45 miles from beginning to end and identified 92 sites. The presentation will discuss findings from seven mitigated sites including three prehistoric sites, a significant Transitional quartzite quarry and two camp sites, two Civil War earthworks and two Civil War encampments.

FORTUNES OF EMPIRE: THE SPATIAL AND TEMPORAL DIMENSIONS OF IMPERIAL CONTROL IN MEDIEVAL SOUTH INDIA, Bernard K. Means, Vijayanagara Empire Mapping Project, 9039 Cloisters East, Richmond, VA 23229. From the 1300s to 1600s A.D., the Hindu empire of Vijayanagara dominated political relations in South India. Social and political factors determined the form and degree of the empire's hold on its subject territories. Past historical and archaeological studies provide a broad framework for evaluating the exact nature of imperial power. However, these studies prove insufficient for examining spatial and temporal variations in imperial rule. Vijayanagara inscriptions can be used to address this lack of specific detail. Carved on temple walls, irrigation features and other permanent media, Vijayanagara inscriptions can be precisely dated and accurately fixed in their original locations. Techniques of spatial analysis are applied to the distribution and density of Vijayanagara inscriptions to study the variable nature of imperial control.

RINGS AND THINGS: PERSONAL ITEMS FROM THE VIRGINIA STATE PENITENTIARY CEMETERY, RICHMOND, VIRGINIA. Melba J. Myers, Conservator, Virginia Department of Historic Resources. In addition to a wealth of unidentified skeletal material, the Virginia State Penitentiary site also produced a collection of coins, buttons, jewelry, and other personal items. The nature and condition of these artifacts necessitated immediate stabilization, which was performed concurrent with the fieldwork. The consequent treatment of corroded coins provided needed chronological clues for the documentary research. The quantity and type of jewelry was a surprise, and provided at least as many questions as answers. Treatment methods as well as problems with the identification of the jet and jetlike materials will be discussed.

PRELIMINARY INVESTIGATIONS AT A DOMESTIC COMPLEX - MONTPELIER. Scott K. Parker, National Trust for Historic Preservation, Montpelier Station, VA 22957. In 1990 excavations in the yard south of the Montpelier mansion uncovered a brick foundation with an associated sheet midden and loosely laid stone pathway. Subsequent excavations revealed that the foundation was from a kitchen dating to the mid to late 18th century. Documentary and preliminary archaeological evidence indicate that the kitchen was part of a larger domestic complex that existed in this general area, possibly contemporary with the original construction of the Montpelier mansion around 1760 by James Madison, Sr., father of the fourth President. While a domestic complex in the yard near a plantation house is not unique, the Montpelier complex underscores one important characteristic of this plantation that may have implications for plantation research in general. Montpelier had become a well-developed plantation with an extensive infrastructure before President Madison inherited the property. His mark on the plantation appears to have been made in less archaeologically visible ways than his father's. Further, it is suggested that this was probably not a unique situation.

THE SCIENTIFIC PROCESS IN LANDSCAPE ARCHEOLOGY. Michael A. Strutt, The Corporation For Thomas Jefferson's Poplar Forest, P.O. Box 419 Forest, Va. 24551. This paper discusses the landscape archeology program at Thomas Jefferson's retreat home of Poplar Forest in Bedford County. The project places Poplar Forest at the forefront of technology in landscape archeology. Researchers are currently analyzing soils and plant materials from archeological contexts. The soils are being processed searching for plant opal phytoliths. These microscopic silica grains are produced by some species of plants and are diagnostic through specific characteristics. This research is adding to the base of knowledge not just for the reconstruction of the landscape at Poplar Forest, but in the field of phytolithic analysis as well. As the phytoliths are identified, we are adding to the list of plants known to generate them. Other plant materials being analyzed for identification are roots from historic planting holes. The combination of root and phytolith identification should allow Poplar Forest to accurately reconstruct the historic landscape that Thomas Jefferson developed over a period of several decades.

FROM PALEOINDIANS TO THE PATAWOMEKE: NATIVE AMERICAN SETTLEMENT PATTERNS IN STAFFORD COUNTY, VIRGINIA. J. Mark Wittkofski, Gray & Pape, Inc., 406 West Franklin Street, Richmond, VA 23220, Michael B. Barber and Michael F. Barber, Preservation Technologies, Inc., P.O. Box 7825, Roanoke, VA 24019. A recent examination of the archaeological inventory for Stafford County, Virginia produced new patterns of settlement for prehistoric Indians occupying this Upper Tidewater county. An ecological approach was initiated in an attempt to determine if environmental variables were important in site choice. Specific data were generated for each period of prehistory. General patterns suggest Native American site selection was keyed to stream rank size and particular soil series. Surprisingly, close proximity to a source of fresh water was found not to be a controlling factor.

Astronomy, Mathematics and Physics

PHYSICS DEMO ROAD SHOWS - HOW DONE AND WHO IS REACHED. D. Rae Carpenter, Jr., Dept. of Physics and Astronomy, Virginia Military Institute, Lexington, VA 24450. Demonstrations appeal to a wide variety of audiences. Examples will be shown of programs designed for K-12, college, graduate and faculty groups as well as civic clubs, senior citizens, rehabilitation hospitals, teacher workshops and professional societies. Subject matter content ranges from "gee whiz" physics to demos requiring graduate level math to explain. The same demo can be used for all of the above audiences by a suitable adjustment in vocabulary and depth of explanation.

MÖSSBAUER AND X-RAY ANALYSIS OF HIGHLY NITRIDED STEELS.

Desmond C. Cook, Old Dominion University.

A study has been made of highly nitrogenated Fe-2Al powders using Mössbauer Spectroscopy and X-Ray Diffraction. The samples were prepared using two nitrogen infusion techniques: (i) high temperature, high pressure diffusion and (ii) mechanical processing in nitrogen. Samples prepared in the HIP furnace at 1000°C with 22.5, 100 and 200 MPa of nitrogen contained up to 7.3 at% nitrogen. Powders mechanically alloyed for 24, 50 and 100 hours contained up to 8.3 at% nitrogen. Similar control samples were also prepared in an argon environment. XRD analysis indicates that for the HIP powders the lattice spacing decreased with increasing nitrogen concentration whereas for the mechanically alloyed powders the lattice spacing increased. Mössbauer analysis showed that for HIP samples containing less than 4 at% nitrogen, all of the nitrogen was contained interstitially. For larger concentrations of nitrogen, the nitride (Fe₃N) formed. The presence of interstitial nitrogen completely eliminated the conduction-electron spin-density oscillations observed in many ferromagnetic alloys.

MÖSSBAUER STUDY OF THE MORIN TRANSITION IN HEMATITE.

Michael J. Doheny, David J. Ford and Desmond C. Cook, Dept. of Physics, Old Dominion University, Norfolk, Va. 23529.

Mössbauer experiments were conducted on hematite between 78K and 300K in order to observe the Morin Transition. The sample under study consisted of 28mg of 99.999% pure α -Fe₂O₃ mixed with boron nitride and compressed into a pellet. The phase transition between the anti-ferromagnetic and ferromagnetic phases was found to develop over a large temperature range. This phase transition occurred over a larger temperature range approaching T_M from below than approaching T_M from above. The Morin Temperature was determined to be approximately 260K.

HIGH TEMPERATURE MÖSSBAUER SPECTROSCOPY OF YBa₂Cu_{2.955}Fe_{0.045}O₇.

David J. Ford and Desmond C. Cook, Dept. of Physics, Old Dominion University, Norfolk, Va. 23529.

Superconducting YBa₂Cu_{2.955}Fe_{0.045}O₇ was studied at temperatures between 300K and 1000K using Mössbauer techniques. Spectra were collected on samples which were pressed into pellets with boron nitride and were maintained within an atmosphere of oxygen at all times. At all temperatures, the four sites A, B, C and D were easily observed. The relative area of the A-site decreased while the D-site area increased with increasing temperature. The total area of the combined A and D-sites remained nearly constant thereby indicating oxygen hopping in the a-b plane. The quadrupole splitting of each site, except the B site, decreased linearly with increasing temperature.

MICROSTRUCTURAL PROPERTIES OF THE FOUR IRON-ZINC GALVANNEAL STANDARDS. R.G. Grant and D.C. Cook, Old Dominion University.

Mössbauer spectroscopy and XRD were employed to characterize the microstructural properties of iron-zinc binary alloys between 0-31 a%Fe. Samples were prepared with accuracies of +/-0.5 a%Fe and the Mössbauer and lattice parameters were monitored as a function of iron concentration across each phase. Two iron sites were observed in the Gamma phase (18-31 a%Fe) whose occupancies and isomer shifts varied continuously with iron content. However, the quadrupole splitting of each site remained constant. The iron was found to populate the inner tetrahedral and octahedral sites of the I43m Gamma structure. Within the Gamma-1 phase (19-24 a%Fe) three iron sites were observed whose isomer shifts and quadrupole splittings remained constant while their occupancies varied with iron concentration. For the first time, a third iron site was observed in the Delta phase (8-13 a%Fe) whose occupancy and quadrupole splitting increased with iron content. Analysis of the Zeta phase (6-7 a%Fe) showed the presence of one iron site, however, parameter changes were not observed due to the nominal variance in iron concentration. XRD studies indicate the lattice parameters across the Gamma and Delta phases vary continuously with iron concentration. (Research supported by International Lead Zinc Research Organization, Inc. grant ZM-403 and Virginia's Center for Innovative Technology grant MAT-92-007-01.)

EVOLUTION OF QUASAR ENGINE DISKS VIA GRAVITATIONAL RADIATION.

Kenneth C. Jacobs, Physics Dept., Hollins Col., & Sean M. Whipkey*, Northside H.S., Roanoke, VA 24020. The "standard model" of active galactic nuclei and quasar engines invokes an accretion disk onto a central massive black hole. We are skeptical of the necessity for the black hole, postulating instead that the "monster in the middle" is a thin relativistic disk of point masses (stars?), which is secularly stable against the emission of gravitational radiation. To illustrate our point, we here present calculations for the net gravitational radiation (quadrupole) from a collection of n point masses orbiting symmetrically around a circle. We reproduce the standard 2-body result; then show that all remaining cases ($n = 3, 4, \dots, \infty$) emit zero net gravitational radiation! (Supported by the Physics Dept. at Hollins College and the Mentor Apprenticeship Program at Northside High School)

ELECTRON-PHONON INTERACTIONS IN SEMICONDUCTOR QUANTUM

WIRES. Peter A. Knipp, Dept. of Physics and Comp. Sci., Christopher Newport Univ., Newport News, VA 23606, & T. L. Reinecke*, Naval Res. Lab., Washington, DC 20375. Optical-phonon emission rates are calculated for electrons propagating along a GaAs wire embedded within AlAs. The phonons, including both "confined-" and "interface" modes, are calculated from the dielectric continuum approach, and the electronic states are calculated from the effective mass approximation. Our formalism is valid for wire cross-sections of arbitrary size and shape, which we choose to be rectangular for the numerical results given here. We compare our exact results with those which assume the electron- and phonon wave functions to be separable functions of the lateral (x - and y -) coordinates. The intrasubband- and intersubband emission rates range from psec^{-1} to μsec^{-1} , depending on the electron energy and wire width. Emission of interface phonons is the dominant process for small ($< 100 \text{ \AA}$) wire width or for high electron energies, and emission of confined phonons is the dominant process otherwise. For large wire widths it is a reasonable approximation to take the phonons to be unconfined GaAs bulk modes. (Supported in part by the Office of Naval Res.)

ANALYSIS OF THE PHOTOMULTIPLIER TUBE. James Krug, Dr. Kevin Giovanetti, Department of Physics, James Madison University, Harrisonburg, Va. 22807.

A photomultiplier tube (PMT) is used to measure the intensity of very minute amounts of light. I will describe the process that occurs inside the pmt after a photon hits the photocathode. I will then interpret some data taken in the process of testing the pmts. These pmts are for use in a large acceptance particle detector that will be a component of the CLAS detector for the Continuous Electron Beam Accelerator Facility (CEBAF) in Newport News, Va.

INTERACTING WITH CEBAF. Sebastian E. Kuhn, Physics Dept., Old Dominion Univ., Norfolk, VA 23529. - The new Continuous Electron Beam Accelerator Facility (CEBAF) in Newport News, VA, will begin its physics program in 1994. Hundreds of physicists from universities throughout the United States and from abroad are developing and building detectors for the three experimental halls at CEBAF. These physicists and their students will have a unique opportunity to study the structure of nucleons and nuclei in great detail at a world-class facility. I will describe the interaction between university-based scientists and CEBAF using the example of the Old Dominion University (ODU) Nuclear Physics Group. ODU has embarked on an ambitious nuclear physics program in close cooperation with CEBAF, capitalizing on the proximity of the two institutions. The Nuclear Physics faculty will consist of a total of 6 experimentalists, 5 theorists with joint ODU/CEBAF appointments, and 3 CEBAF staff members with CEBAF professorships at ODU. CEBAF supports the ODU effort with equipment, salary funds and technical and engineering assistance.

The theory group at ODU pursues many fundamental questions about the structure of few-body nuclei and the nucleon and its excited states, with direct relevance for the experimental program. The experimental group is building several components of the CEBAF detectors; as an example I will describe the large drift chambers for region II of the CEBAF Large Acceptance Spectrometer (CLAS) detector in hall B. This detector will allow us to study multi-particle final states and rare processes, as well as polarization effects in the nucleon structure.

DIODE LASER PUMPED CW Tm:Ho:YLF LASER. Hyung R. Lee and In H. Hwang, Department of Physics, Hampton University, Hampton, VA 23668. A diode laser pumped Tm:Ho:YLF (Yttrium Lithium Fluoride) is under study to determine the optimum operating condition. A 3 W CW diode laser with output wavelength of 792 nm is used as the pump source. The laser rod is doped at 6 at. % Tm and 0.5 at. % Ho. The dimension of the rod is 6 mm (length) x 3 mm (diameter). For efficient laser operation, the laser rod is cooled with chilled water. The output characteristics dependence on the laser parameters of the Tm:Ho:YLF laser will be presented. (Work supported by NASA Grant NAGW-1-2929)

REMOTELY CONTROLLING THE ATTENUATION OF UV LASER LIGHT, W/APPLICATIONS. Dustin E. McNulty, Dr. Kevin Giovanetti, Department of Physics, James Madison University, Harrisonburg, Va. 22807.

A stepper motor is a device which transforms digital pulses into incremented steps of rotational motion. By using a speed and direction controller chip with the stepper motor, and coupling this system to an attenuation device, the intensity of a UV light source can be varied remotely. This method will be employed to control the input intensity from a UV laser into a network of optical fiber that will be used to calibrate components in a large detector (EMC) for CEBAF.

MEASUREMENT OF TRANSPORT CRITICAL CURRENT IN YBaCuO RINGS BY A MAGNETIC INDUCTION METHOD. Sam Parikh, Jeff Turman and Chris Harrop, Northern Virginia Community College, Annandale, VA 22003. A ferrite transformer with a superconducting ring between the primary and secondary coils was used to find the critical current density of the YBaCuO samples. A changing flux, from the primary coil induces a supercurrent in the sample, whose critical value can be found from the reappearance of the signal in the secondary coil.

DEMONSTRATION OF A SUPERCONDUCTING MEISSNER HEAT ENGINE. Jason Parsons, Tom Bullock and Tim Lapham, Northern Va. Community College, Annandale, VA 22003. A new large model of the engine was designed and built, using an undergraduate research grant from the Society of Physics Students. Different configurations of the magnetic field were investigated. The model incorporates 49 1-inch superconductors and reliably operates for extended periods of time at 2 rpm.

AN EXPERIMENTAL INVESTIGATION OF INERT GAS PLASMAS. T.M. Persons, B.T. Robinson*, & Dr. G.R. Taylor, Physics Department, James Madison University, Harrisonburg, Virginia 22807.

In our study of plasma physics, the properties of inert gas plasmas have been measured using the Maxwellian distribution function as an ideal mathematical model. The graph of the electron energy distribution as a function of energy was compared with the Maxwellian model to show the variation of allowable electron energies. Plasma parameters were deduced from a plot of probe current versus voltage characteristics.

AN ANALYTIC SOLUTION FOR THE FILTER CAPACITOR VOLTAGE OF THE LINEAR POWER SUPPLY, Joseph W. Rudmin, Physics Dept., James Madison Univ., Harrisonburg, VA, 22807. The most widely used electronic circuit in the last fifty years, the linear regulated power supply, is not correctly taught in any text book, nor is it understood even in the simplest approximation. Nor is it designed in the usual sense of predicting the important aspects of behavior from valid models for the components and the circuit equations. The failure is to include the non-negligible resistance of the transformer windings. Using the diode equation for the rectifier diodes, an analytic equation for the voltages has been found. Although the equation is not integrable with functions known to the author, it does show the relevant dimensionless combinations of parameters. These can in turn be used to make small parameter approximations.

OZONE CONCENTRATIONS AS OBSERVED BY SAGE II FOR VERIFICATION OF THE CSOAR ROCKET PROJECT Edgar Russell*, Department of Physics, Hampton University, Hampton, Va. 23668. We have investigated variations in ozone concentrations in the vicinity of Wallops Island, Va. in support of the Colorado Space Grant Consortium Student Ozone Atmospheric Rocket Project. We are providing Spacecraft verification for the sounding rocket project using data from the SAGE II satellite. Data were evaluated for the period 1985 through 1992, September 1992, being the launch time of the CSOAR sounding rocket. Our previous findings have shown (1) a slight increase in total ozone concentration as North latitudes increase; (2) a slightly higher total ozone concentration in summer than in winter; (3) the peak in the ozone profile as a function of altitude occurs slightly closer to the earth surface during winter; and (4) no apparent changes from year to year for the period examine. Ozone concentrations as observed by SAGE II during the launch time have been sent to CSOAR for comparison to the rocket data. Assistance was provided by the Virginia Space Grant Consortium and NASA Langley Research Center. (Supported by NASA Grant NAG-1-1091)

BIFURCATION IN ADVANCED TWO CHAMBER MODEL FOR EDGE PLASMA IN TOKAMAK. Min Soe and Alkesh Punjabi. Hampton University. Hampton, VA 23668. Motivated by the goal of understanding the abrupt nature of H mode transition in tokamaks with divertor geometry, the Advanced Two Chamber Model is employed and variations in plasma parameters are studied as the heat flux entering the divertor is changed smoothly. We develop a method for analytical solutions of the model equations and study them from a catastrophe theory point of view. Our results show catastrophes at the fold edges of the equilibrium surfaces and bifurcations occur when the energy flux entering the divertor and ratios of plasma densities and temperatures in the main plasma scrape-off to those in the divertor scrape-off exceed some critical values. This is identified with L to H mode transition and it is seen that the behavior of the plasma during these catastrophes is in good qualitative agreement with experimental observations. This research is supported by DOE under grants DE-FG05-88ER 53265 and DE-FG0590ER54106

PERFLUOROBUTYL IODIDE AS GAIN MEDIA FOR HIGH-POWER, CONTINUOUS SOLAR-PUMPED IODINE LASER**, Bagher M. Tabibi*, Charles Terrell* Dept. of Physics, Hampton Univ., Hampton VA. 23668* & Ja H. Lee*, NASA LaRC, Hampton, VA. 23665. Perfluoro-t-butyl iodide or t-C₄F₉I was evaluated as an alternate medium for a space-based, direct solar-pumped iodine laser system that would serve as a power transmitter in the future. The CW laser was excited with a closely-simulated air-mass-zero (AMO) solar spectrum. The closely-simulated AMO solar spectrum in the absorption band of iodide (240-360 nm) was obtained by using a deionized water and acetone (150:1 concentration) filtering jacket around the laser tube. The CW laser output from the t-C₄F₉I was compared to that of the commonly used iodide n-C₃F₇I. With 240 solar constants (1S.C. = 1.35 kW/m²) pumping power, the output power of t-C₄F₉I was measured to be 4 times higher than that of n-C₃F₇I for the pressures below 12 Torr. The higher laser output of t-C₄F₉I resulted mainly from a better solar energy utilization and therefore, a larger photodissociation rate. A maximum CW laser output of 46 Watts at a vapor pressure of 6.7 Torr of t-C₄F₉I and 750 S.C. input power was achieved, which is the world's highest CW laser output with CW iodine laser system.

** Supported in part by NASA Grant NAG-1-1091.

IMAGING CARBON AND NITROGEN CONCENTRATIONS AND THE CARBON AND THE INTERDICTION OF CONCEALED NARCOTICS AND EXPLOSIVES. W. P. Trower, Physics Dept., Va. Polytechnic Inst. & State Univ., Blacksburg, Va. I describe a new nuclear technique which produces images of elemental carbon (nitrogen) in concentrations and with surface densities typical of concealed bulk narcotics (terrorist explosives.) The signal is the totality of high-energy gamma rays detected with time after irradiation of a target pixel by a ~ 30 (~ 50) MeV beam from an electron accelerator. There are no significant interfering signals. I present $180 \times 2 \times 2 \text{ cm}^2$ pixel intensity images of a kilo of cocaine (125 grams of SEMTEX).

FINE FEATURES CAUSED BY LATERAL INTERACTIONS IN THE INFRARED SPECTRUM OF CO ADSORBED ON ZnO (10-10).

A MONTE-CARLO STUDY. Yu. A. Tsyganenko, A. A. Tsyganenko, K. S. Smirnov, Institute of Physics, St. Petersburg University, St. Petersburg, 198904, RUSSIA

A Monte-Carlo simulation was carried out to study the influence of lateral interactions on the IR spectrum of CO molecules adsorbed on the (10-10) face of ZnO. The interactions are shown to cause fine structure of the adsorbed CO band which reflects the arrangement of particles in the ad layer. Changes in the spectra with surface coverage are in agreement with the experimental data. For saturating coverage a contour of the CO band can bear information about the defects or disruptions in the adsorbed layer.

DECELERATION OF A ROTATING DISK. Arun K. Verma, Dept. of Math., Hampton University, Hampton, VA 23668. The temporal development of the flow as the fluid motion induced by disk rotating in contact with an incompressible viscous fluid is analyzed when the disk is decelerating with an angular velocity proportional to inverse power of time. An attempt is made to find the solution of unsteady Navier-Stokes equations, which depends on a non-dimensional parameter S , measuring unsteadiness. Cases when $S \sim O(1)$ and $S \sim O(\infty)$ are analyzed. The second case ($S \sim O(\infty)$) corresponds to the physical situation when the disk is stopped suddenly. For this, two specific cases: the initial development ($t \ll 1$), and the final decay ($t \gg 1$) are discussed. The final steady state solution is one in which the fluid is at rest.

TRANSPORT DUE TO RESISTIVE MHD MODES IN TOKAPOLE II. Eric White and Alkesh Punjabi, Hampton University, Hampton, VA 23668. Based on the analysis of results in the Tokapole II experiments, we have constructed the spectrum of the resistive magnetohydrodynamic (MHD) perturbations in this device. We use this spectrum to evaluate the transport of electrons in Tokapole II due to MHD modes. The Monte Carlo Method for transport in toroidal plasmas as developed by Punjabi and Boozer [1] is employed. The results show that the particle diffusion coefficient for thermal electrons depends not only in the strength of perturbations, but also on the choice of perturbing modes. This research supported by DOE under the grants DE-FG05-88ER53265 and DE-FG05-90ER54106

[1] Punjabi A., Boozer A., L M., Kim M., and Burke K., J. Plasma Phys., 44, 405-430 (1990)

CALCULUS LABORATORY USING MATHCAD FOR WINDOWS. P. Wohl, P. Bogacki, and G. Melrose, Dept. of Mathematics and Statistics, Old Dominion Univ., Norfolk, VA 23529. A new computer-based calculus sequence is being developed at ODU. Issues addressed are choice of software, assessment, administration, and faculty participation. In particular, its ease-of-use and notepad features make Mathcad for Windows an excellent choice when compared with Maple and Mathematica. (Supported by a Funds for Excellence grant provided by SCHEV.)

AN END-PUMPED Cr:Nd:GSGG LASER. Jie Zhou, Apriel K. Hodari, In H. Hwang, and Demetrius D. Venable, Department of Physics, Hampton University, Hampton, VA 23668. An end-pumped Cr and Nd doped Gadolinium Scandium Gallium Garnet (GSGG) laser is developed using a diode laser for the pump source. The length of the laser rod is 18 mm and the diameter is 3 mm. The wavelength of the pump laser is 806 nm and the output beam from the GSGG laser rod is gaussian in transverse pattern. The slope efficiency of the laser is about 20 %. The optimization of the system is under investigation. The detailed operation characteristics will be presented. (Work supported by NASA Grant NAGW-1-2929)

Biology

THE EFFECT OF THE CARCINOGEN METHYL METHANESULFONATE (MMS) ON SERUM GAMMA GLUTAMYL TRANSFERASE (GGT) AND ALKALINE PHOSPHATASE (AP) LEVELS IN THE HORN SHARK, *HETERODONTUS FRANCISCI*. D.C. Abel, J. Ondrush, J. Raterman*, R. Tucker, J. Vobrak, and E. Weidman*, Dept. of Biol., Mary Wash. College, Fred., VA 22401. Although evidence suggests that sharks are protected from cancer, there has been a dearth of studies in which sharks have been exposed to chemical carcinogens. We thus injected horn sharks intraperitoneally with the direct acting hepatocarcinogen MMS (50 mg·kg⁻¹) biweekly and determined levels of the diagnostic enzymes GGT and AP in monthly serum samples. Levels of both GGT and AP were highly variable over the 7 month sampling period and were not significantly different from control and sham levels. Assays in a solvent system containing urea and trimethylamine oxide were not different. Postmortems showed no noticeable liver lesions. These results thus cannot refute the tumor protection hypothesis. They further suggest that the horn shark is a suitable species for long-term studies of chemical carcinogenesis (Supported by faculty development and undergraduate research grants from MWC).

AQUATIC MACROPHYTE DISTRIBUTION AND ABUNDANCE IN PANDAPAS POND, MONTGOMERY COUNTY, VA. Karen Barton, David Noves, Anne Seinwill*, Dept. of Biology, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. Aquatic macrophytes are an important part in pond ecosystems. Beneficial influences of macrophytes include primary production, substrate for habitat and spawning, nutrient cycling, substrate stabilization, and oxygen production. Excessive growths may eliminate spawning habitat for some species, interfere with fishing, and contribute to anoxic conditions. This study investigated the aquatic macrophyte abundance and distribution in Pandapas Pond in the Jefferson National Forest during mid-October 1992. The objectives were to determine the zonation of the individual aquatic macrophyte species with respect to depth and light penetration. SCUBA was used to sample aquatic macrophytes from two transects selected to encompass changes in depth, substrate, and shading. Five species of aquatic macrophytes were found at depths less than 2.5 meters. *Najas minor* was more abundant than other species in depths greater than 0.5 meters. Substrate seemed to be a primary regulatory factor affecting the growth of *N. minor* in the first 2.5 meters of depth in Pandapas Pond. *Typha latifolia*, the only emergent species, was located in one small area. Three other species *Hypericum denticulatum*, *Eleocharis acicularis*, and *Lemna* spp. were found in such low numbers that definitive conclusions regarding their distribution could not be determined. In October there was no aphotic zone. Light penetration was 6% of surface light at maximum depth. It is proposed that previously reported phytoplankton blooms reduced the photic zone to depths less than 2.5 meters during the critical macrophyte growing season thereby restricting distribution. Further seasonal studies are needed to test this hypothesis.

MAMMALIAN PEST SPECIES IN URBAN AND SUBURBAN ENVIRONMENTS
Jack A. Cranford, Virginia Polytechnic Institute and State
 University, Museum of Natural History and Biology Dept.
 Blacksburg, VA, 24061

Over the last 15 years an average of 46 requests for assistance with mammalian pests have been responded to by my laboratory. Chiroptera cause the greatest concern and 62% of all requests involve this taxa. Situations from nursery colonies in barns to single bats in light fixtures or walls have been encountered. When a tree service removed a heart rotted oak 14 people called within 48 hours about problems. During fall migration calls come in every day about clusters of bats on homes and more often than not it is a neighbor who wants something done today. Carnivora and specifically the Mustelidae result in the second most common problem group(18%). Third are the Rodents(17%) and Marmota monax, Glaucomys volans, and Microtines are the most numerous forms of concern.

HABITAT PREFERENCE SHIFTS IN Peromyscus leucopus (WHITE-FOOTED MICE) WHEN INFECTED WITH BOT FLY LARVA. Jack A. Cranford and David Tomblin. Virginia Polytechnic Institute and State University, Biology Department and Museum of Natural History, Blacksburg, VA, 24061

During ecological studies, some small mammals are found infected with bot flies and are often not seen again. With large grid studies or intensive trapping many are recaptured. When intensive habitat data sets are analyzed, those previously unrecaptured individuals were residing in habitat compartments not previously utilized. Of 36 habitat variables measured the significantly different habitat associations are with areas of exposed soils, shallow litter depths, and low shrub cover. Three separate studies, at three sites in Appalachian deciduous forests have verified these habitat shifts. Prior home ranges of bot infected individuals were frequently occupied by non-infected conspecifics.

PARASITES OF SUBURBAN COTTONTAILS. Ralph P. Eckerlin, Natural Sciences Div., Northern Virginia Cmnty. Col., Annandale, Va. 22003. Twenty-six cottontail rabbits, Sylvilagus floridanus, from suburban Fairfax County, Virginia were examined for parasites. Helminth parasites included one trematode species, Hasstilesia tricolor, which was the most prevalent and abundant parasite found; 2 cestode species, Cittotaenia variabilis, and Taenia pisiformis; and 6 nematode species, Obeliscoides cuniculi, Trichostrongylus affinis, Trichostrongylus calcaratus, Trichuris leporis, Dirofilaria scapiceps, and Longistriata noviberiae. Ectoparasites included 2 species of ticks, Ixodes dentatus, Haemaphysalis leporispalustris; and 5 flea species, Cediopsylla simplex, Odontopsyllus multispinosus, Ctenocephalides felis, Orchopeas howardi, and Orchopeas leucopus. The helminth parasite prevalence and mean intensity data were analyzed and compared to those of a previous study of rural cottontails. Suburban cottontail helminth parasite abundance was lower than that of the rural cottontails. However, species richness was equal to that of the rural population and species diversity (as measured by Simpson's index) was greater than that of the rural cottontail populations.

SURVEYS FOR BOTTLENOSE DOLPHINS IN LOWER CHESAPEAKE BAY, 1992. Sherman C. Jones III, Biology, Chemistry, and Environmental Science Dept., Christopher Newport Univ., Newport News, VA 23606. Thirty small boat surveys were conducted in lower Chesapeake Bay between May 20 and October 12, 1992. Objectives of this study were to: (1) determine areas frequented by the dolphins, (2) observe movement and behavior patterns of individuals and groups, (3) obtain identification photographs of individual dolphins, and (4) generate a preliminary population estimate. A total of 418 dolphins were seen (including resightings) during 23 sighting events. Dolphins were twice as likely to be found off Cape Henry as they were off Cape Charles and only occasionally seen in the southwestern Bay (James/Elizabeth River mouths). Although more data is needed, movement, behavior, and social patterns of these animals resemble those reported for other areas. Forty-five recognizable individuals were cataloged, one individual was sighted on 6 occasions and 19 were seen only once. Though there are exceptions, most comparisons (Peterson estimates) indicate that approximately 90 dolphins were present during the study period. Similar information obtained over the next 5 years will facilitate a more comprehensive description of the use of this area by bottlenose dolphins.

HIGH TEMPERATURE TRIGGERS CIRCADIAN ACTIVITY RHYTHMS OF BROWN WATER SNAKES (Nerodia taxispilota). Amy K. Luckeydoe & C. R. Blem, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284. Brown water snakes (Nerodia taxispilota) exhibit circadian rhythms of nocturnal activity when exposed to ambient temperatures $\geq 29^{\circ}\text{C}$. Snakes held at a photoperiod of 12L:12D and tested in total darkness exhibited nocturnal activity during the scotophase of the photoperiod at which they had been maintained. Change in photoperiod causes a shift in these activity patterns. At temperatures of $\leq 27^{\circ}\text{C}$ these activity patterns disappear. Stereotyped nocturnal activity initiated by thermal cues in this species is adaptive in the sense that it prepares the snake for emergence from daytime hiding sites where precise photoperiodic cues are not available.

ALLOZYMIC VARIATION IN POPULATIONS OF THE GRAY SQUIRREL, SCIURUS CAROLINENSIS, FROM EASTERN NORTH AMERICA. Nancy D. Moncrief. Department of Mammals, Virginia Museum of Natural History, Martinsville, VA 24112.

Allozymic variation within and among populations of gray squirrels (Sciurus carolinensis) from Indiana, Virginia, Maryland, Louisiana, Mississippi, Tennessee, and Georgia was analyzed. Horizontal starch-gel electrophoresis was used to assay more than 30 presumptive gene loci for more than 200 individuals. Estimates of variation within each population (mean heterozygosity and percent polymorphic loci) will be reported. Additionally, evolutionary relationships among populations of gray squirrels that inhabit central North America and the coastal plains of the Gulf of Mexico and the Atlantic Ocean will be described and discussed.

PARAIMMUNE EFFECTOR COMPONENTS ASSOCIATED WITH MURINE RESORPTION. E. Moore, J. C. Burnett 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. Effects of poly I:C injection on resorption frequency in CD-1 mice were unreliable. Injection of up to 200 ug in the tail vein on day 4 of gestation had no effect. Intraperitoneal injection of 500 ug or more on day 4 caused 60% resorption in some females and had no effect on others. Intraperitoneal injections on day 3, 5, 6, 7, 8, or 9 had no effect. In contrast, injection of 1, 5, or 10 ug of lipopolysaccharide (LPS) into a tail vein on day 9 caused 90-100% resorptions. Thirty minutes after tail vein injection, fluorescein-labeled LPS was observed in macrophages in splenic red pulp, in macrophages in the paracortex and in the subcapsular sinus of dorsal (para-aortic) lymph nodes, in scattered macrophages in periembrionic decidua, and in trophoblastic giant cells of the embryo. This pattern of localization is consistent with LPS acting directly on the embryo or through cells derived from the spleen or lymph nodes.

INVOLVEMENT OF MACROPHAGES IN LIPOPOLYSACCHARIDE-INDUCED MURINE RESORPTION. P. S. Nyantakyi, J. C. Burnett 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. Intravenous injection of 1, 5, or 10 ug of lipopolysaccharide (LPS) on day 9 of gestation caused 90-100% resorption in CD-1 mice. Injections on day 7, 8, or 10 were less effective. Intraperitoneal injections were less effective than intravenous injections, and subcutaneous injections were least effective, suggesting that LPS acts through a blood-related mechanism. Intraperitoneal injection of 10 mg of N^G -monomethyl-L-arginine on days 8, 9, 10, and 11 failed to reduce the percentage of resorptions induced by intravenous injection of 1 ug of LPS. This indicates that resorptions are not dependent on nitric oxide released from macrophages in response to LPS.

A SURVEY OF AMPHIBIANS AND REPTILES ON A PROPOSED SITE FOR THE CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM IN KING GEORGE COUNTY, VIRGINIA. Brian L. Patrick and Werner Wieland, Dept. of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. Thirty-one species of amphibians and reptiles representing 12 families and 17 genera were identified on the Woodlawn and Walsingham farms in King George County. Only 67 percent of the species expected, based on the available literature, were captured. However, nine species not expected based on current known ranges were also taken. Two species, Chrysemys floridana and Nerodia erythrogaster were taken that represent range extensions within Virginia.

OCCURRENCE AND ABUNDANCE OF LARVAL ALOSIDS IN THE UPPER RAPPAHANNOCK RIVER, VIRGINIA. Susan I. Raabe and Werner Wieland, Dept. of Biological Sciences, Mary Washington College Fredericksburg, VA 22401. Weekly sampling occurred within a 26 mile stretch of river at about three mile intervals beginning at mile 67 to mile 92 and lasted from March 10 until July 23, 1992. Larval densities and size ranges indicated that peak spawning activity occurred between April 7 and April 21 when surface water temperature ranged between 9.8 °C and 17.2°C. The highest densities of alosid larvae were recovered within the upper 10 mile stretch of river on April 21. Relative spawning success could not be determined due to lack of comparable data.

SOME DEMOGRAPHIC FEATURES OF NORTHERN FLYING SQUIRRELS (GLAUCOMYS SABRINUS) IN VIRGINIA. Richard J. Reynolds, & Mike Fies, Va. Game & Inland Fisheries, Charlottesville, Va. 22901, & John Pagels, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284. A total of 339 nest boxes was monitored at 25 locations throughout the mountains of western Virginia from October 1985 to May 1992. A total of 62 individual northern flying squirrels (Glaucomys sabrinus) was captured at five sites. The average tail length for squirrels in the Mt. Rogers Ranger District was 128.6 mm, suggesting that this population is more closely related to G. s. coloratus than to G. s. fuscus. The sex ratio for captured squirrels was 1.1 males per female. The adult female to juvenile ratio was 1.3 adult females per juvenile. The mean number of juveniles captured per year was 3.5 (range 0-8) and the mean litter size was 2.3 (range 1-3). The mean body weight of adult males and females was 109.8 grams (range 93-126) and 120.6 grams (range 98-141), respectively. Reproductive activity was first recorded in December for males and in March for females.

FUNCTIONAL MORPHOLOGY OF THE MOUTHPARTS IN THE MITE FAMILY ALGOPHAGIDAE. Laura A. Romano* & Norman J. Fashing, Dept. of Biol., Col. of William and Mary, Williamsburg, Va. 23187. The feeding behavior of each of six species of mites belonging to the astigmatid family Algophagidae was inferred by examining its cheliceral morphology with a scanning electron microscope. Three species, *Algophagus pennsylvanicus* from the eastern U.S. and two undescribed genera from western Australia, inhabit water-filled treeholes. The chelicerae of *A. pennsylvanicus* and one of the Australian genera appear to be adapted for grazing fungal hyphae from the surface of decomposing leaves. The second Australian genus is probably adapted for biting chunks out of leaves, thereby ingesting leaf material and the associated microbes. *Algophagopsis* new species, collected from algal mats in Crater Lake, Oregon, has robust chelicerae with large blunt teeth which appear adapted for feeding on diatoms and algae. *Hericia* new species and *Fusohericia lawrenci*, inhabitants of sap flux on trees in the eastern U.S., exhibit chelicerae that probably function in scooping detritus and/or microbes from the fluid medium.

PRELIMINARY INVESTIGATION OF THE EFFECTS OF ORGANIC ENRICHMENT ON A CAVE AQUATIC COMMUNITY. Kevin S. Simon and Arthur L. Buikema Jr., Dept. of Biology, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. Faulty septic systems are influencing the aquatic community in several seep-fed pools in a southwestern Virginia cave. Based on dye tracing and water quality parameters, pools in the cave may be categorized as heavily impacted, moderately impacted, or unimpacted. Moderate levels of enrichment have led to high densities of Caecidotea recurvata, a troglobitic isopod, relative to unimpacted sites. Increased food supply is the suspected cause of increased isopod densities. Fine particulate organic matter from the septic systems may be consumed by the isopods or serve as a substrate for microbial films used by C. recurvata. Heavily impacted pools have low dissolved oxygen levels and are devoid of macroinvertebrates. The troglobitic amphipod Stygobromus mackini occupies only unimpacted pools and may be especially sensitive to the effluent. (Supported by the National Speleological Society and the Graduate Student Assembly, VPI&SU)

UBIQUITIN CONCENTRATIONS IN MURINE UTERI DURING THE ESTRUS CYCLE AND FOLLOWING PARTURITION. B. Stuart and A. F. Conway, Dept. of Biol., Randolph-Macon Col., Ashland, VA 23005. Wet weight, soluble protein concentration (turbidity assay), and total ubiquitin concentrations (ELISA) were measured in CD-1 mouse uteri during the estrus cycle and following parturition. Wet weight and soluble protein per uterus increased during proestrus, reached maximum levels at estrus, then declined during metestrus and remained low during diestrus. Total ubiquitin concentrations per mg soluble protein were at a maximum in proestrus, declined in estrus, were at a minimum in metestrus, and increased to moderate levels in diestrus. This pattern suggests that ubiquitin is involved with protein turnover during proestrus but is not heavily involved in protein removal in metestrus. Wet weight and soluble protein per uterus declined by approximately 50% from day 0 to day 1 postpartum, then stabilized at slightly lower values on days 2 and 3 postpartum. Total ubiquitin concentration per mg soluble protein was relatively unchanged from day 0 through day 2, then declined slightly on day 3 postpartum. This pattern is consistent with ubiquitin involvement in protein removal following parturition.

MID-SUMMER REPRODUCTIVE INHIBITION IN A WILD POPULATION OF WHITE-FOOTED MICE: AN EXAMINATION OF DENSITY INFLUENCES. C. Richard Terman, Lab. of Endocrinology and Population Ecology, Biology Dept., College of William and Mary, Williamsburg, VA 23185. A white-footed mouse population on an 11 ha area has been studied monthly with 600 live traps since 1983. Trappability is greater than 90%. Past data show that the proportion of adults which were reproductive was significantly lower during May, June and July than during February - April and August - October. The gonads and sex accessory glands were also significantly smaller during May - July. In the present study resident adults were removed monthly from half of the study area from April through August of 1992. The reproductive characteristics of immigrant adults to the vacated area, of resident adults remaining on the "non-vacated" area, and of adults living outside the study area were compared. All data indicate significant suppression of reproductive function during May and June. Thus removal of residents did not prevent reproductive suppression of immigrating adults.

EFFECTS OF PREGNANCY AND PREVIOUS PREGNANCY ON THE REPRODUCTIVE TRACT AND SPLEEN OF CD-1 MICE. Suzanne R. Thornton¹, Arthur F. Conway², and Carolyn M. Conway¹, ¹Dept. of Biology, Va. Commonwealth Univ., Richmond, VA 23284, and ²Dept. of Biology, Randolph-Macon Col., Ashland, VA 23005. Female mice of different pregnancy status (nonpregnant or at day 12.5 of gestation) and number of previous pregnancies (0 or 1) were sacrificed and reproductive tracts and spleens removed and weighed. Single cell suspensions prepared from pregnant uteri (using collagenase digestion) and from spleens were used to determine the number and types of endometrial and splenic cells. Significant changes in endometrial cell populations occurred as a result of previous pregnancy. Spleen weight, total spleen cells and splenic WBCs were significantly greater in pregnant females (and especially in females with 1 previous pregnancy) as compared with nonpregnant females. Changes in splenic cell populations occurred as a result of both pregnancy and previous pregnancy. A greater proportion of small mononuclear cells occurred in pregnant (especially 1st pregnancy) females and a greater proportion of large mononuclear cells occurred in nonpregnant females. The pattern of pregnancy-associated changes suggests that 1st pregnancy exerts a "priming effect" on immune and paraimmune responses occurring during subsequent pregnancy.

EFFECTS OF GYPSY MOTH DEFOLIATION ON SMALL MAMMALS. David C. Tomblin and Jack A. Cranford, Virginia Polytechnic Institute and State University, Biology Dept. and Museum of Natural History, Blacksburg, VA, 24061

Changes in small mammal community structure were evaluated at three sites in a chestnut oak dominated community at three stages of gypsy moth caused disturbance: a high tree mortality, defoliation in process, and a reference site. Small mammal populations showed noticeable differences between sites in community species composition, densities, and habitat use. Summer populations of Peromyscus leucopus had an affinity towards reference site habitat in a canonical variate analysis of all species and site habitat means. All other species had affinities towards either the in process or high mortality site. The greatest pairwise species separations occurred at the in process site between P. leucopus, P. maniculatus, and T. striatus. Gypsy moth defoliation seems to initially improve the quality of habitat for small mammals.

CAN THE MITE SPECIES RHIZOGLYPHUS ROBINI (ASTIGMATA : ACARIDAE) SUBSIST ON A DIET OF FILTER PAPER? Mark W. Wooddy & Norman J. Fashing, Dept. of Biol., Col. of William and Mary, Williamsburg, Va. 23187. Rhizoglyphus robini Claparede, commonly known as the bulb mite, has been reported to complete its life cycle utilizing filter paper as a sole dietary source. However, the presence of a complete "cellulase complex," necessary for cellulose degradation, rarely occurs in arthropods. We therefore hypothesized that R. robini derived nutrients from the fungal mycelia growing on the filter paper rather than from the filter paper itself. To test this hypothesis, newly hatched larval R. robini were placed on both plain filter paper and filter paper treated with methyl benzoate, a non-toxic fungal retardant. In two trials on treated filter paper, all larvae failed to molt, dying after an average of 2.4 days in trial one (n=32) and 2.5 days in trial two (n=33). Of the 30 larvae placed on untreated filter paper, 19 molted to protonymphs, 15 to tritonymphs and seven to adults, thereby supporting the hypothesis that the fungal mycelia served as the actual nutrient source, albeit a rather poor one.

EFFECTS OF CARBON DIOXIDE ON SEXUALITY AND GERMINATION IN THE TETRASPORE ASCOMYCETE PODOSPORA ANSERINA NISSL. Emilie W. Ziegler and James E. Perham, Dept. of Biology, Randolph-Macon Woman's Col., Lynchburg, VA. 24503. Studies show perithecial development requires zinc in Podospora anserina. In addition, a recent observation illustrates development of perithecia in the absence of zinc, if growth of the fungus occurs on a single layer of dialysis membrane in contact with the surface of a zinc-free agar medium. This method of cultivation permits free exchange of oxygen and carbon dioxide between the mycelium and the environment. An enzyme related to both zinc and gas exchange is carbonic anhydrase. Electrometric analysis of carbonic anhydrase activity supports the hypothesis that this enzyme may be involved in induction of sexuality in P. anserina. An ancillary study shows germination of ascospores of P. anserina can be induced through the reduction of carbon dioxide in the environment.

Biomedical and General Engineering

RADIATIVE INTERACTIONS IN NONGRAY GASES UNDER LOCAL AND NONLOCAL THERMODYNAMIC EQUILIBRIUM CONDITIONS. M. K. Jha* and S. N. Tiwari, Department of Mechanical Engineering and Mechanics, Old Dominion University, Norfolk, VA 23529-0247. Basic formulations, analyses, and numerical procedures are presented to investigate radiative heat interactions in diatomic and polyatomic gases under local and nonlocal thermodynamic equilibrium conditions. Essential governing equations are presented for both gray and nongray gases. Information is provided on absorption models, relaxation times, and transfer equations. Radiative flux equations are developed which are applicable under local and nonlocal thermodynamic equilibrium conditions. The problem is solved for fully developed laminar incompressible flows between two parallel plates under the boundary condition of a uniform surface heat flux. For specific applications, three diatomic and three polyatomic gases are considered (CO, NO, OH, CO₂, H₂O, and CH₄). In general, results demonstrate that the gray gas approximation overestimates the effect of radiative interaction for all conditions. The conditions of NLTE, however, result in underestimation of radiative interactions. The method developed for this study can be extended to solve complex problems of radiative heat transfer involving nonequilibrium phenomena.

"SIMPLE SIMULATIONS" NOT SO SIMPLE. William P. Harrison, Div. of Engineering Fundamentals, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061-0218. The classification of freight trains entering a rail yard constitutes an old and almost classic problem in simulation modeling. In the 1960's this popular exercise was conducted by many engineering college students "manually"; that is, no electronic calculating equipment was used in the solution process. Today's students, attacking the problem with their microcomputers, discover new demands that their earlier counterparts either did not confront or simply circumvented through use of their erasers. This paper discusses these differences and suggests that one of them represents a fundamental principle that must be considered when analyzing certain kinds of Monte-Carlo type digital simulations.

Botany

DIAMETER RECRUITMENT IN A MIXED OAK/HARDWOOD FOREST IN WESTERN VIRGINIA OVER A FIFTEEN YEAR PERIOD. H. S. Adams, D. S. Lancaster Cnty. Col., Clifton Forge, VA 24422 and E. G. Haverlack[†], USDA For. Serv., Covington, VA 24426. A permanent 1.0 hectare plot was established in a maturing, second-growth mixed oak/hardwood forest on the George Washington National Forest in fall of 1976. All trees ≥ 2.5 cm DBH were measured, tagged for future identification and accuracy of re-measurement, and their locations mapped. Resurveys were conducted after 5, 11, and 15 years. Throughout the study, the stand has exhibited processes considered typical of normal forest development. After fifteen years, density (N/ha) of trees decreased from 1,442 to 1,001 (-31%), while basal area (m²/ha) increased from 28.4 to 31.1 (+10%). Initially, nineteen taxa were dominated by *Acer rubrum* (Importance Value [IV] = 37.4) and *Quercus velutina* (IV = 16.5), followed in importance by *Q. alba*, *Nyssa sylvatica*, and *Q. coccinea*, respectively. In the most recent tally, little overall change in importance values of taxa had occurred, composition being 96% similar to that of the original. The most substantial changes (IV change > 1) were recorded for *Q. alba* (-1.9) and *N. sylvatica* (+1.7). Two species (*Hamamelis virginiana* and *Robinia pseudo-acacia*) died out, whereas *Acer pensylvanicum* grew into the tree layer. Size class analysis revealed that recruitment was bimodal, one acceleration found in the smaller (< 15 cm DBH), more shade tolerant understory species (e.g., *N. sylvatica*) and another in the larger (> 40 cm DBH), dominant overstory species (e.g., *Q. velutina*). Absence of *Quercus* saplings from the understory suggests a possible species composition shift in the future.

A GRADIENT ANALYSIS OF THE RED SPRUCE/HARDWOOD ECOTONE IN THE CENTRAL APPALACHIANS. H. S. Adams, D. S. Lancaster Cmnty. Col., Clifton Forge, VA 24422, S. L. Stephenson, Dept. of Biology, Fairmont State College, Fairmont, WV 26554, D. M. Lawrence, Dept. of Env. Sci., Univ. of Va., Charlottesville, VA 22903, and M. B. Adams*, NE For. Exp. Sta., Parsons, WV 26287. We are currently investigating patterns of species composition and distribution, ecologically important population processes, and microenvironmental gradients in permanent transects (each consisting of a series of contiguous 10 X 10 m quadrats) established across the rather abrupt and narrow spruce/hardwood ecotones at several localities in the mountains of central West Virginia and western Virginia. Primary emphasis of our research is directed toward testing three basic hypotheses: (1) red spruce communities in the mid-Appalachians are decreasing in areal extent due to encroachment of surrounding hardwood communities, (2) stress-induced growth decline in red spruce is a factor in this decrease, and (3) the direction and rate of successional change can be predicted from models developed from quantitative data obtained from field studies of spruce/hardwood ecotones. Preliminary data obtained during the 1992 field season suggest that mid-Appalachian red spruce communities presently exist at least in static equilibrium with respect to surrounding hardwoods and exhibit, at some localities, advance regeneration into the hardwood region. (Supported in part by funds provided by the USDA Forest Service.)

A ROLE FOR THE SEM IN UNDERGRADUATE BOTANY COURSES. J. Rex Baird, Dept. of Natural Science, Clinch Valley College of the University of Virginia, Wise, Va. 24293. The increasing availability of the scanning electron microscope (SEM) provides an opportunity for significant course enrichment for biology instructors at all educational levels. The remarkable depth of focus of the SEM makes possible a view of structures, tissues, and cells that are simply not possible with light microscopes, nor even with the transmission electron microscope. When three-dimensional photography is included, the impact on the viewer's perception is greatly multiplied. Examples are here presented of photographs produced by undergraduate students, representing several major fields, in our introductory SEM course or other courses or special projects in which the SEM is used. A special stereo viewer is available for the 3-D photographs.

ADVENTITIOUS ROOT EMERGENCE IN *LEMNA GIBBA*. Thomas N. Buckley and Michael H. Renfro, Department of Biology, James Madison University, Harrisonburg, VA 22807. The single endogenous root of *Lemna gibba* has long been considered adventitious, due to the absence of a discernable embryonic radicle. However, the consistent temporal and spatial locus of root emergence, as well as the presence of a distinct and persistent epidermal structure marking the site of emergence, suggest the genetic control of root development in *Lemna*. Very young individuals were isolated from parent colonies and examined using light and scanning electron microscopy to determine the presence or absence of this epidermal structure prior to visible root development.

PLANT COMMUNITIES OF THE FRESH TO OLIGO-HALINE TIDAL MARSHES OF THE YORK, JAMES, NORTH LANDING, AND BACK BAY WATERSHEDS. Christopher A. Clampitt, Dept. of Conservation and Recreation, Div. of Natural Heritage, 1500 E. Main St., Suite 312, Richmond, VA 23219. Marshes bordering the upper tidal reaches of Virginia's major Atlantic-slope rivers are alternately emersed and submersed with fresh to oligo-haline (< 5 ppt) water. These marshes support a diverse and complex vegetation. Similarly diverse marshes along Back Bay and the North Landing River experience "wind tides" rather than lunar tides. As part of the Dept. of Conservation and Recreation's ongoing efforts to describe and classify the communities of Virginia, vegetation data were collected in these marshes during the summers of 1991 and 1992. The data were analyzed using a modified Braun-Blanquet table analysis, with supplemental multivariate analysis (TWINSPAN, DECORANA). Comparisons were also made to existing classification systems, especially that developed by VIMS. Several well-known, broad community types (e.g. Spartina alterniflora, Peltandra virginica-Pontederia cordata and Hibiscus moscheutos--Typha angustifolia) are readily recognizable. Finer subdivisions of these community types (e.g. Eleocharis fallax--Scirpus americanus) are also apparent and, in part, reflect marked differences between marshes under the influence lunar and wind tides.

FOREST VEGETATION, EDAPHIC FACTORS, AND SUCCESSIONAL DIRECTION IN THE CENTRAL PIEDMONT OF VIRGINIA. Alex M. Cole and Stewart Ware, Dept. of Biol., Col. of Wm. & Mary, Williamsburg, VA 23187. Data from 32 stands in Cumberland State Forest and Powhatan Lake Wildlife Management Area were analyzed using detrended correspondence analysis and canonical correlation analysis for large tree, small tree, and sapling layers. Quercus alba, Q. velutina, and Q. coccinea were the three most important species among large trees. Quercus prinus was abundant only on more level, low Mg, low Ca areas on a monadnock. Nyssa sylvatica, Acer rubrum and Cornus florida were the most important understory species, with the last two species strongly dissociated from one each other. Our stands lacked the high abundance of Q. falcata in the large tree layer and Fagus grandifolia and Ilex opaca in the understory found by Elizabeth Wolff in Pocahontas State Park in the Piedmont-Coastal Plain transition area near the Fall Line.

SURVIVABILITY OF Discula destructiva CONIDIA ALONG THERMAL STRESS REGIMES. J. B. Crozier, K. T. Thornham, R. J. Stipes and H. L. Warren. Dept. Plant Pathol., Physiol. and Weed Sci., VA Tech, Blacksburg, VA 24061-0331. Dogwood anthracnose, the new killer disease, appears to be restricted in warmer climates (elevations of 1,000 ft. or less, piedmont and coastal plain areas in VA), therefore indicating a heat sensitivity in the pathogen, Discula destructiva which we herein investigated. Thermal stress regimes were then tested on conidia of the pathogen in vitro to determine the thermal death point (TDP), and thermal death times (TDT) at 35, 45 and 55C. The TDP was 46-47C at 10 min. exposure. The TDT for 10 min. exposure. The TDT for 35C is presently thought to be ca. 100 hrs based on our work and that of others, while the TDTs for 45 and 55C were 20 min. and 30 sec., respectively. We have not determined thus far whether autofluorescence will be a good method to determine the mortality of head-stressed spores. This work will enhance our knowledge of the thermal biology in vivo of D. destructiva, as well as increase the possibility of treating diseased tissues through specified thermal regimes (thermotherapy).

FLORISTICS AND PRELIMINARY CLASSIFICATION OF GREENSTONE GLADE VEGETATION IN VIRGINIA. Gary P. Fleming, Va. Dept. of Conservation and Recreation, Div. of Natural Heritage, Main Street Station, 1500 E. Main St., Suite 312, Richmond, Va. 23219. Greenstone glades are natural forest openings which occur locally on outcrops of basic Catoctin metabasalt in the Blue Ridge and western piedmont of Virginia. Floristic data collected from 24 large or exemplary glade sites revealed a rich flora of 300 taxa, 17 of which are threatened or endangered in the state. Exotic taxa comprised just 2.7% of this flora. Species richness within a site ranged from 18 to 83 taxa. The life-form spectrum of greenstone glade flora was somewhat intermediate between the spectra reported for temperate dry grassland and oak woodland formations. A preliminary stand-table analysis segregated two major community-types: a high-elevation scrub alliance characterized by *Sorbus americana*, *Deschampsia flexuosa* and *Saxifraga michauxii*, and a low-elevation scrub alliance characterized by *Fraxinus americana*, *Carya glabra* and *Andropogon scoparius*. These communities appear to be relatively stable and self-maintaining due to harsh edaphic and climatic conditions.

PRESETTLEMENT FIRE ECOLOGY OF SOUTHEASTERN VIRGINIA. Cecil Frost. North Carolina Plant Conservation Program, NCDA, Raleigh, NC 27611. Typical fire vegetation of the southeastern U.S. originally reached its northern limits in southeastern Virginia, and fire played a role in shaping all but a few of the vegetation types of the region, but today--after nearly 400 years of european land use and with 20th century fire suppression--original vegetation cannot be deduced from remnants alone. In the process of reconstructing presettlement vegetation, using a method that combines soils, historical records, fire ecology and natural remnants, a way was found to create a map of presettlement fire frequency. Each original vegetation type of the region was assigned to one of 8 fire frequency classes, based on observations of fire behavior and of vegetation response to fire and fire suppression in each vegetation type, using 500 stands in Virginia and North Carolina. Fire frequency contours (isopyres) were threaded between historically documented or otherwise inferred occurrences of vegetation in each fire frequency class to make a first approximation presettlement fire frequency map of the region.

STEM ANATOMY AND MEDULLARY BUNDLES OF *CROTON GLANDULOSUS* VAR. *SEPTENTRIONALIS* (EUPHORBIACEAE). Sheila M. Hayden & W. John Hayden, Dept. of Biol., Univ. of Richmond, Richmond, Va. 23173. *Croton glandulosus* var. *septentrionalis* is an annual herb which becomes woody at stem bases. Primary growth consists of a eustele of bicollateral bundles. Sieve areas and slime plugs confirm the presence of sieve tube elements in the internal phloem. Internal phloem differentiates concurrently with protoxylem and is a constitutive element of the vascular bundle, passing uninterrupted with leaf traces into petioles. As the stem matures, cells between the protoxylem and internal phloem proliferate inwards in a cambium-like fashion, crushing some innermost elements of internal phloem and eventually forming well-defined medullary bundles. Old medullary bundles may include fibers and vessel elements that form de novo adjacent to protoxylem and external to the internal phloem. "Normal" secondary xylem develops from a bifacial vascular cambium in the usual fashion. In the wood, vessels are characterized by simple perforation plates, alternate intervacular pits, and short elements; fibers have simple pits; rays are mostly uniseriate and biseriate occurring in the ratio of 2:1; axial parenchyma is rare to absent.

THE EFFECTS OF SELECTED CYTOKININS AND SUGARS ON EPIPHYLLOUS BUD GROWTH IN *KALANCHOE* SPECIES. Sally Hunsucker* and M. C. Mathes*. Dept. of Biology. College of William and Mary. Williamsburg, VA 23187. Many species of *Kalanchoe* have foliar embryos in their leaf notches, which develop into plantlets under certain conditions. Sterile notch explants from the leaves of *Kalanchoe pinnata* were removed and grown *in vitro* on medium supplemented with various of the hormones benzylaminopurine, kinetin, adenine sulfate, and Droop (thidiazuron). All four cytokinins were found to promote shoot growth in the first week, while medium containing Droop showed stunted shoot growth at the end of the experimental period (two weeks). Kinetin promoted shoot formation, and kinetin and adenine sulfate promoted shoot elongation. Explants from other species of *Kalanchoe* showed that the response to cytokinins varies with the species of parent plant. Explants of *K. pinnata* were also grown on medium supplemented with various concentrations of sucrose, fructose, or glucose. A concentration of 2% sucrose was the most effective when both shoot and root growth were considered.

THE VEGETATION AND FLORA OF THE "SEA LEVEL FENS" OF THE DELMARVA PENINSULA. J. Christopher Ludwig and Thomas J. Rawinski, Department of Conservation and Recreation, Division of Natural Heritage, 1500 East Main Street, Suite 312, Richmond, Va. 23219. A new community-type, referred to in a colloquial sense as sea level fen, is described from the Delmarva Peninsula. Fens are naturally open peatlands, sometimes with scattered trees, occurring on minerotrophic (groundwater influenced) sites. While some of the Delmarva sea level fens lack well developed peat, they are floristically united to northern fens by the presence of plants such as Cladium mariscoides, Drosera intermedia, Juncus pelocarpus, and Rhynchospora alba. Southern plant species such as Eriocaulon decanulare, Myrica cerifera, Rhynchospora chalarocephala, and Utricularia juncea distinguish the Delmarva fens as a distinct Association. The fens occupy perennially saturated soils and typically occur along the upland edge of tidal wetlands at zones of pronounced groundwater seepage. Vegetation transects illustrated abrupt transitions from freshwater fen vegetation to brackish estuarine marsh vegetation. The sea level fens support many rare coastal plain plant species, several of which were documented during the study as new state records or range extensions.

REPRESENTATIVE DIATOM COMPOSITION ALONG A SALINITY GRADIENT IN THE JAMES RIVER. Jeffrey Madden & H.G. Marshall. Dept. Biol. Sci., Old Dominion Univ., Norfolk, Va. 23529-0266. The bloom producing and characteristic diatoms in the tidal fresh waters are Skeletonema potamos, Cydotella striata, C.meneghiniana, Cyclostephanos spp., and Melosira spp. These populations persist into oligohaline sections, but are declining in abundance to be replaced by estuarine and neritic species within meso- and polyhaline waters. These species include Skeletonema costatum, Cydotella caspia, Leptocylindrus minimus, and Asterionella glacialis. In a similar fashion, freshwater chlorophytes and cyanobacteria decline downstream and are replaced by increased concentrations of dinoflagellates and cryptomonads. The downstream dominance of tidal fresh populations will vary seasonally and in response to the timing and magnitude of the spring freshet and total river water flow. (Supported by the Virginia State Water Control Board)

AN HERBARIUM COMPACTOR FILING SYSTEM - HOW TO REALLY COM(PRESS) YOUR PLANT SPECIMENS AND SAVE SPACE! Peter M. Mazzeo, Herbarium, U.S. National Arboretum, 3501 New York Ave., N.E., Washington, D.C. 20002. The herbarium of the U.S. National Arboretum recently installed a new state-of-the-art SPACESAVER compactor filing system which substantially reduces the amount of space needed to store the Arboretum's vast herbarium collection of more than 600,00 specimens. This compactor "spacesaving" concept is accomplished by eliminating the need for wasted aisle-space between the standard rows of herbarium cabinets throughout the herbarium. Standard pigeon-holes are arranged in movable carriages that roll on tracks. With the push of the button the compactor system can be opened between any of the carriages to access the specimens. This system increases the storage space by an average of 70-80 % in the National Arboretum system. Safety features prohibit any person from being "pressed" in the system as the carriages open/close. The new system not only frees-up space which can now be used to increase the size of the collection, but it makes it much easier to access the specimens by staff, visiting scientists and students.

PATTERNS OF ALPHA AND BETA DIVERSITY AMONG DOLOMITE WOODLANDS AND RELATED PLANT COMMUNITIES IN VIRGINIA. Thomas J. Rawinski, Va. Dept. of Conservation and Recreation, Div. of Natural Heritage, Main Street Station, 1500 E. Main St., Suite 312, Richmond, Va. 23219. Shallow soils associated with dolomite and limestone outcrops support a variety of plant communities in Virginia. The purpose of this study is to understand patterns of vascular plant species richness within and among these communities. Floristic composition data collected from 17 plots of woodland and scrub vegetation were analyzed for within-plot richness (alpha diversity), and degree of compositional change among plots (beta diversity). Alpha diversity ranged from 25 to 88 species per 100 m², the latter value representing the most species-rich vegetation yet documented in Virginia. Beta diversity was assessed using coefficient of community values. Relatively little compositional change was noted among nearby plots sharing similar site characteristics, e.g. bedrock geology, soils, and aspect. However, significant compositional change was noted among widely separated plots, and among plots which did not share common site characteristics. Dolomite-derived soils, identified by relatively low Ca:Mg ratios, supported a distinct suite of species absent on limestone-derived soils.

SEASONAL PHYTOPLANKTON CONCENTRATIONS IN THE PAGAN RIVER: A NUTRIENT RICH RIVER. David Seaborn & H.G. Marshall. Dept. of Biol. Sci., Old Dominion Univ., Norfolk, Va. 23529-0266. The Pagan River is a nutrient enriched system with total nitrogen and phosphorus levels of 1.0-2.6 and 0.3-1.1 mg/l respectively. The fall and winter phytoplankton were dominated by diatoms and cyanobacteria, with total concentrations of 10⁷ to 10⁸ cells/l. Dominant species included Leptocylindrus minimus and Microcystis incerta. Species diversity increased into winter, as total cell concentrations declined. The upstream station contained the greatest abundance of flora, and was associated with lower salinity. Turbidity levels were high throughout the study with secchi readings ranging from 0.4 to 0.7 m. In comparison to nearby James River stations, the Pagan River had greater cell abundance, higher nutrients, lower secchi readings and less species diversity.

A RELICT LONGLEAF PINE (*PINUS PALUSTRIS* MILLER) OCCURRENCE IN NORTHERN SOUTHAMPTON CO., VIRGINIA. Philip M. Sheridan, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284. Forty-five individuals of Longleaf pine occur in a mixed oak/pine forest on sandy uplands bordering Seacock Swamp. This population and the Zuni pine barrens represent the northern limit for this species in Virginia. Average tree circumference is 34 inches with extremes at 12 and 63 inches. Sixteen trees are producing cones and no cones were observed on the rest of the population. No seedlings have been found. Average age of the Longleaf pine population is 73 years. Old, undecayed, resinous pine stumps with axe marks indicate turpentine operations once occurred on the site. Original old growth Longleaf is shown to be replaced by loblolly pines through fire exclusion and timber harvest practices.

A UNIQUE HABITAT FOR *DROSEROTA ROTUNDIFOLIA* L. (DROSERACEAE) ON THE BLACKWATER RIVER, VIRGINIA. Philip M. Sheridan, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284. *D. rotundifolia* occurs at two locations on vertical, clay seepages near Milk and Sandy Landings on the Blackwater River. Thirty miles of river exploration between Walters and Battle Beach revealed that large, exposed, vertical, clay seepages are rare and occur in bends in the river where sand deposits of 4-7 feet overlay an impermeable clay layer. When these conditions occur spring water is released at the contact point between sand and clay layers. The resultant seepage over the vertical clay surface provides prime habitat for *D. rotundifolia*. This type of occurrence is unknown elsewhere on the coastal plain of Virginia for this species and represents the only extant stations south of the James River. Associated seepage species include *Alnus serrulata*, *Arundinaria tecta*, *Clethra alnifolia*, *Magnolia virginiana*, *Smilax laurifolia*, *Sphagnum* and *Xyris* species.

THE VIRGINIA PITCHER PLANT BOGS, PART ONE: POO RUN. Philip M. Sheridan, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284. Poo Run was a floristically significant seepage wetland located southeast of Petersburg on a headwater two miles from the Appomattox R. It contained the largest and most vigorous populations of the yellow pitcher plant, *Sarracenia flava*, in Virginia. There were 28 wetland species listed by the Va. Dept. of Conservation and Recreation as rare to uncommon or extremely rare at this site, many at their northern limit. Historical sources indicate the area was known by colonial botanists and that at least one type specimen, *Cleistes divaricata*, came from this wetland. Burning of the region by native Americans and European settlers is shown to have been important in maintaining Poo Run in an early successional state. Effects of the battle of Petersburg and the steam train also favored this wetland in the 1930's. A cultural shift away from steam trains and to fire prevention led to encroachment by woody vegetation during the 1940's and 1950's. The site was finally destroyed by scraping and filling during the construction of I-95.

VASCULAR FLORA OF THE POTOMAC RIVER DRAINAGE OF KING GEORGE CO., VIRGINIA. Mark P. Simmons, Dept of Biol., Univ. of Richmond, Richmond, Va. 23173, D.M.E. Ware, Dept. of Biol., Col. of William and Mary, Williamsburg, Va. 23187, & W.J. Hayden, Dept. of Biol., Univ. of Richmond, Richmond, Va. 23173. The results of two floristic studies of King George County, the most westward county of the Northern Neck, are reported. Field work was initiated in 1984 with a study of Caledon Natural Area and collecting continued in 1991 and 1992 throughout the portion of the county drained by the Potomac River. The study area includes a wide variety of habitats including dry upland woods, mesic ravines, low elevation river flats, a shell midden, beaches, swamps, marshes, and creeks, the tidal portions of which may be brackish or freshwater. The Potomac River drainage of King George County harbors a diverse assemblage of vascular plants; the checklist documents 917 species and subspecies of vascular plants based on our collections and those at GMUF. This total includes 414 of our specimens that at the time of collection were county records.

SPATIAL PATTERNS OF A RED TIDE BLOOM IN THE LOWER CHESAPEAKE BAY. Karen Soucek & H.G. Marshall. Dept. of Biol. Sci., Old Dominion Univ., Norfolk, Va. 23529-0266. A succession of bloom producing dinoflagellates dominated the phytoplankton in the lower Chesapeake Bay from early July to mid-September 1992. In sequence, Ceratium furca, Cochlodinium heterolobatum, Gymnodinium splendens (G. nelsonii), Noctiluca scintillans, and Gyrodinium aureolum occurred in bloom concentrations. On July 20, 1992 C. furca had a bloom of over 272 km², being concentrated along tidal fronts, with mean concentrations 10⁵ to 10⁶ cells/l. Cochlodinium heterolobatum had an extended bloom from mid-August to mid-September, over 215 km² along the western margin of the Bay, at concentrations of 10⁵ to 10⁶ cells/l. C. heterolobatum was carried southward into North Carolina coastal waters. The other blooms were of short duration and limited in area. No fish kills were associated with the summer blooms. (Supported by the Virginia State Water Control Board)

HEALTH AND VIGOR OF A LIVE OAK (Quercus virginiana) GROWING AT 700 METERS ELEVATION AT BLACKSBURG, VA. R. Jay Stipes and S. Wayne Bingham, Dept. Plant Pathol., Physiol. & Weed Sci., Va Tech, Blacksburg, VA 24061-0331. Live oak (Quercus virginiana) is one of the most characteristic plants in the lower coastal plain of the southeastern USA, and is found from southeastern VA to TX, southward to the FL Keys, and also in western Cuba. The previously recorded westernmost specimen in VA was in Richmond. However, in 1967, Bingham obtained a 1-in. caliper balled/burlapped specimen from Southside Nurseries near Chesterfield, VA, and planted it at his home (702 Broce Drive) where the elevation is ca. 700 m (ca. 2,100 ft.). Currently, it is a lovely flourishing specimen, with a DBH (diam. breast ht.) of 20.1 in., a height of 42 ft., and an average branch spread of 41 ft. Stipes has noted severe cold injury and chestnut blight (Cryphonectria parasitica) cankers on mature specimens in Tidewater, VA, but neither has been noted on this tree, even though it is growing this far out of its natural range and where Cryphonectria inoculum abounds. Defoliation of this tree generally commences about mid-March to early April, with reforescence following closely or about simultaneously. Mast production is relatively light each year. This tree might be a source of cold-hardy live oak.

COMPARATIVE SUPPRESSIVE GROWTH EFFECTS ON 'Roma' TOMATO OF FIVE STEROL-INHIBITING FUNGICIDES. R. Jay Stipes, F. D. Smith, J. L. Ratliff and H. L. Witt. Dept. Plant Pathol., Physiol. & Weed Sci., VA Tech, Blacksburg, VA 24061-0331. Fungal sterol-inhibiting (SI) fungicides are new chemical species that offer exciting options in managing fungal plant disease. In addition to antimycotic activity, however, some are remarkable plant growth regulators (PGRs). We examined: diniconazole (D), fenbuconazole (F), myclobutanil (M), propiconazole (P) and tebuconazole (T). 'Roma' tomato seedlings grown in Weblite (expanded shale) under ambient greenhouse conditions over a 11-wk period (Oct.1992-Jan. 1993) were root-drenched four times with concns. of 0.01 to 1,000 $\mu\text{g}/\text{mL}$ at \log_{10} dosages. Plant growth data taken were shoot height and entire plant dry wt. Patterns of shoot ht. and dry wt. were similar. The estimated dose of fungicide for 50% inhibition of seedling ht. was 11, 76, 122, 275 and 277 $\mu\text{g}/\text{mL}$ for D, P, T, F & M, respectively. The estimated dose of fungicide for 50% inhibition of seedling wt. was 18, 19, 21, 110 and 124 $\mu\text{g}/\text{mL}$ for T, D, P, F and M, respectively. The use of tomato seedlings as bioindicators of PGR activity showed that D was the most active, followed by P and T; PGR activity by F and M was detected only at high concentrations.

EFFECTS OF STEROL-INHIBITING FUNGICIDES ON SEED GERMINATION AND SEEDLING GROWTH OF AMERICAN ELM, TOMATO, RYE AND RYEGRASS. R. C. Thompson, D. B. Vann, R. Shield, J. Duncker and R. J. Stipes. Dept. Plant Pathol., Physiol. & Weed Sci., VA Tech, Blacksburg, VA 24061-0331.

We first four authors assumed this project as an independent study with Dr. Stipes, in the 2-year Agricultural Technology Curriculum so that we could learn how to perform research and to manipulate chemicals. While sterol-inhibiting (SI) fungicides are effective inhibitors of many plant pathogens, they are often effective plant growth regulators, a feature that can be both troublesome (lower crop yields) and beneficial (dwarfing excessive growth of ornamentals or turfgrasses). In concns. of 0.01 to 1,000 $\mu\text{g}/\text{mL}$, two propiconazole formulations tended to suppress germination of rye and American elm seeds but not tomato. Seedling heights of all of these spp. were likewise suppressed as dosages increased. In addition, we evaluated myclobutanil, diniconazole, tebuconazole and triadimefon at the same concns. on seed germination and seedling growth of rye, ryegrass, American elm and tomato. Results were variable in this pilot study, but generally higher concns. of the SIs were suppressive on germination and seedling growth.

THE DISTRIBUTION AND STATUS OF *CLEMATIS ADDISONII* BRITTON (RANUNCULACEAE), A WESTERN VIRGINIA ENDEMIC LEATHERFLOWER. Nancy E. Van Alstine, Va. Dept. of Conservation and Recreation, Div. of Natural Heritage, 1500 E. Main St., Suite 312, Richmond, VA. 23219. *Clematis addisonii* is a Virginia endemic found on calcareous slopes and historically known only from 14-15 locations in the western counties of Montgomery, Roanoke, Botetourt, and Rockbridge. A status survey was conducted in 1992 to assess the known populations and to search for historical records and new populations of this species, considered to be a candidate, category 2, for Federal listing by the U.S. Fish and Wildlife Service. A strategy for targeting new survey areas was developed based on characteristics common to the known populations, including soil type, aspect, slope and vegetation cover; this strategy proved to be too limiting. Five of the 14-15 occurrences could be relocated and surveys of 14 slopes resulted in 5 new occurrences. Populations were found in a range of habitats including west-facing mesic forests, south-facing woodlands, xeric rock outcrops, roadbanks, and powerline right-of-ways. The distribution of *Clematis addisonii* may be limited more by the bedrock influencing soil chemistry than by other habitat characteristics; tangential ecological studies suggest that *Clematis addisonii* is restricted to soils derived from Elbrook Formation dolomite.

ASCORBIC ACID INTERVENTION IN THE MANAGEMENT OF FUSARIUM WILT OF 'Bonny Best' TOMATO. David D. Vann (Agric. Technol. Student) and R. Jay Stipes, Dept. Plant Pathol., Physiol. and Weed Sci., VA Tech, Blacksburg, VA 24061-0331. Most, if not all, disease processes in animals and plants likely produce oxidative stress resulting from the release of destructive free radicals. Ascorbate (ascorbic acid=Vitamin C), among other compounds, scavenges these radicals, thus conceptually providing prophylaxis and/or therapy. We used Fusarium wilt of 'Bonny Best' tomato as a model. L-ascorbic acid (0.0125 M = ca. 2,200 µg/ml, pH 3.1, subphytotoxic level) was used as pre- and post-inoculation root drenches on mechanically root-injured plants inoculated with a spore suspension (ca. 5×10^6 conidia/mL) of *Fusarium oxysporum* f. sp. *lycopersici*. Pre-inoculation plants were treated every other day for 2 wks with ascorbate, while post-inoculation treatments were started 1 wk after inoculation. Disease level/management were monitored by shoot dry wt., and disindexing (0=no disease; 5=plant dead). Pre-treatment of plants with ascorbate moderately reduced wilt symptoms (disease index 3.8, compared to untreated inoculated controls, 4.6), and elevated dry wt. (treated plants, 1.06 gm, compared to untreated inoculated controls, 0.53 gm). Ascorbic acid thus might be a potential chemoprophylactant for this disease under some scheme.

PRIMARY PRODUCTIVITY OF BENTHIC MICROALGAE IN THE LOWER CHESAPEAKE BAY. Susanne Wendker and Harold G. Marshall, Dept. of Biology, Old Dominion University, Norfolk, Va. 23529-0266.

Mudflats are found throughout the Chesapeake Bay, most extensively within inlets and at the mouths of the tributaries. This study included five sites within the lower Chesapeake Bay. These were located within the Lynnhaven Inlet in the southernmost part of the Bay, close to the mouths of the York- and Rappahannock-River on the western shore, and near the towns of Cape Charles and Onancock on the Eastern Shore. Salinity ranged from 15-26 ppt. Sampling was carried out monthly at low tide between April 1992 and October 1992. The radiocarbon method was used to measure primary production. Primary production was highest in August with mean values from 17-90 mgC m²hr⁻¹ depending on the site. In April primary production ranged between 1 and 19 mgC m²hr⁻¹, in October values from 3-50 mgC m²hr⁻¹ were found. Cell counts were also highest in August with $1.3-7.8 \times 10^6$ cells/cm². The sites at the Lynnhaven Inlet and at Cape Charles contained the most productive mudflats. The microalgal communities were dominated by diatoms.

PHYTOPLANKTON DYNAMICS DURING A RED TIDE BLOOM ALONG THE NORTH CAROLINA COAST. Tracy West & H.G. Marshall. Dept. of Biol. Sci., Old Dominion Univ., Norfolk, Va., 23529-0266. The response of various phytoplankton categories to an extensive *Ptychodiscus brevis* bloom was studied. This bloom resulted in finfish and shellfish mortality. However, regardless of the concentrations of the bloom species, the total phytoplankton abundance increased over the study period. In general, diatoms, dinoflagellates, cyanobacteria, cryptomonads, cocolithophores and the autotrophic picoplankton were not inhibited by this bloom event. These cells were apparently stimulated to grow during the same time period as was *Ptychodiscus brevis*. When *P. brevis* declined in abundance, the other phytoplankton components generally continued to be abundant. The various phytoplankton species that were present during this period were characteristic of these waters.

IS THE FALL LINE THE BOUNDARY BETWEEN COASTAL PLAIN AND PIEDMONT VEGETATION? Elizabeth A. Wolff and Stewart Ware, Col. of Wm. and Mary, Williamsburg, VA 23187. Forests of the Coastal Plain and Piedmont differ, but is the vegetational boundary at the physiographic boundary (the Fall Line)? We sampled canopy, understory, sapling, and seedling layers at 30 Piedmont sites in Pocahontas State Park, just west of the Fall Line. Quercus alba was the most abundant tree, but co-dominants in various sites included the characteristically Piedmont species Q. rubra and the characteristically Coastal Plain species Q. falcata and Fagus grandifolia (second only to Q. alba in abundance). Typically Coastal Plain Ilex opaca was abundant in the understory, sapling, and seedling layers, as were Fagus grandifolia and Liquidambar styraciflua. Except for Q. rubra, vegetation is Coastal Plain-like, so the vegetational boundary (or transitional zone) must be west of the Fall Line.

Chemistry

LANTHANUM(III)-TEMPLATED SYNTHESIS OF PHENYL-FUNCTIONALIZED SIX-NITROGEN-DONOR MACROCYCLIC COMPLEXES, A. Adeyiga and L. M. Vallarino; Department of Chemistry, Virginia Commonwealth University, Richmond, VA 23284.

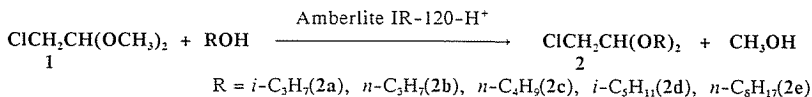
The [S] isomers of two aromatic-substituted ethylenediamines, $H_2N-CH(C_6H_5)-CH_2-NH_2$ and $H_2N-CH(CH_2C_6H_5)-CH_2-NH_2$, were synthesized by changing the corresponding aminoacids to amides and reducing these with borane/tetrahydrofuran. The Schiff-base condensation of each diamine with 2,6-diacetylpyridine, using lanthanum(III) acetate as the template, produced the La(III) complex of a six-nitrogen-donor macrocyclic ligand with peripheral aromatic substituents, $C_{22}H_{24}N_6(X)_2$, where $X = -C_6H_5$ or $-CH_2C_6H_5$. Symmetrically disubstituted macrocyclic complexes of this type may exist as two constitutional isomers, depending on whether the $-X$ substituents are adjacent to the same pyridine (positions [5,14]) or to opposite pyridines (positions [5,15]). With $X = -CH_2C_6H_5$, both isomers were isolated in pure form and were identified by their distinctive proton NMR spectra.

ELECTROCHEMICAL REACTIONS OF METHYLATED 3,4-DIHYDROXYBENZOHYDROXAMIC ACIDS NEAR PHYSIOLOGICAL pH. Carthene Bazemore, Katina Hall, and George C. Grant, Chemistry Dept, Norfolk State University, Norfolk, VA 23504. DIDOX, the unmethylated compound is one of a series of potent ribonucleotide reductase inhibitors with anti-tumor activity. The monomethylated compounds are metabolites and simpler models (one less acidic proton) for DIDOX, which is now under investigation as a chemotherapeutic agent. The electrochemical oxidation of these compounds was investigated primarily by cyclic voltammetry with carbon paste and Pt electrodes using a BAS 100E electroanalytical instrument under computer control, using Good's Buffers were used near physiological conditions, but a total range from pH 0 to 11 was covered. Two successive oxidations were observed. DIDOX was oxidized in a reversible electron transfer for the first step, only under strongly acid conditions due to fast follow-up chemical reactions. The second wave was totally irreversible at all pHs. As conditions approach physiological pH, the potentials shift cathodically and the reverse waves disappear even at faster sweep rates. Follow-up chemical reactions for the methylated compounds are at least an order of magnitude faster at all pH's (as evidenced by the effect of sweep rate) probably through elimination of methanol from a semiquinoid intermediate after the first electron transfer.

POLYMER SYNTHESIS IN ZERO GRAVITY. Kenneth G. Brown, Karen Burns, Dept. of Chem. and Biochem., Old Dominion Univ., Norfolk, VA 23529 & Billy T. Upchurch*, George M. Wood*, IRD, NASA-Langley Res. Ctr. Hampton, VA 23665. Physical homogeneity in polymeric materials is difficult if not impossible to attain when the synthesis of such materials is carried out under normal conditions. One of the reasons for the nonhomogeneity is the presence of gravity induced density gradients as the polymer chains grow. Conducting the polymer synthesis in Low Earth Orbit would remove the effect of gravity and possibly enable the production of more homogeneous materials. Such materials may exhibit significant improvements in gas permeability characteristics. This improvement in gas permeability is of importance to the contact lens and gas separation industries. In early June of 1993 the first space shuttle flight (STS-57) of an experimental package designed to test the effect of microgravity on bulk polymerization processes will occur. This talk will describe some of the preparations and experimental considerations that determined the design of the experimental package.

A STUDY OF THE REACTION ENTHALPY FOR THE α -D-GLUCOSE AND β -D-GLUCOSE EQUILIBRIUM BY USE OF NMR. LaVerne Brown and Charles Bell, Jr., Department of Chemistry and Biochemistry, Old Dominion Univ., Norfolk, VA 23529. Pure α -D-glucose was dissolved in D₂O and allowed to come to equilibrium at 20°C. Non-Nuclear overhauser pulse program allowed nearly quantitative determination or the relative amounts of α -D- and β -D-glucose. The same information was gathered at 30°C and at 40°C and the ΔH was determined from the plot of $\ln K$ vs. $1/T$. Future studies using β -D-glucose are described.

TRANSACETALIZATION: A FACILE METHOD FOR PRODUCING CHLOROACETALDEHYDE DIALKYL ACETALS. Miguel Burch and Wayne M. Stalick, Chem. Dept., George Mason University, Fairfax, VA 22030. Chloroacetaldehyde diethyl acetal was shown to be a precursor to the useful intermediate ethoxyacetylene. A later expansion of this reaction showed that other 1-ethoxy-1-alkynes could be easily made using a one-pot synthesis. Further reactions showed that acetals with more complex alcohols also reacted to produce a wide variety of alkoxy alkynes and alkylnols. This latter reaction required the development of a general synthesis for a variety of chloroacetaldehyde dialkyl acetals 2. A literature search showed few ways of readily making these compounds as the reported methods of synthesis either required multistep processes, rigorous experimental conditions, or only gave moderate yields of product. The present work describes a versatile, high-yielding synthesis of 2 using an acid resin catalyst for transacetalization of the readily available, inexpensive chloroacetaldehyde dimethyl acetal 1, as summarized in the following equation:



CONSTITUENTS OF *BROSIMUM LATESCENS* (MORACEAE). Jean-Michel Campagne and Albert T. Sneden, Department of Chemistry, Virginia Commonwealth University, Richmond, VA 23284-2006.

Plants from the Moraceae family have a history of use for various purposes in native cultures of the world. Well-known members of this family include fig trees and mulberry bushes. A large genus of this family in South America is the *Brosimum* genus, which includes approximately 50 species. Usually found as trees in the sub-tropical and tropical regions, several species have reputed pharmacological effects in humans. Of particular interest to us is *Brosimum latescens*, which was collected in the Amazon region of Peru, and which is reputed to have anticancer, anthelmintic, and aphrodisiac properties among the natives of the region. An ethanolic extract of the bark demonstrated inhibition of protein kinase C activity *in vitro*, suggesting that there may be a basis for the reputed anticancer activity. Fractionation of the extract of *B. latescens*, as well as an ethanolic extract of the related species, *Brosimum rubescens*, has led to the isolation of several compounds with potential biological activity. The results of these investigations will be presented.

SPECTROSCOPIC INVESTIGATION OF ORGANOMETALLIC REACTIONS OCCURRING MCD PROCESSES: I. THE REACTION BETWEEN TRIS(2,4-PENTANEDIANATO) ALUMINUM AND WATER VAPOR. Melissa A. Crouch and T.C. DeVore, Department of Chemistry, James Madison University, Harrisonburg, Va. 22807. Recently it was suggested that metal acetylacetonates can be used to transport metal atoms into the reaction zone during chemical vapor deposition processes. In this study, the thermal decomposition of tris(2,4-pentanedianato) aluminum in the presence of water vapor was investigated using Evolved gas analysis Fourier transform infrared spectroscopy to learn more about the chemical reaction which could be used to produce aluminum oxide films on glass surfaces. At least two processes occur during the decomposition. Alumina is produced from a surface catalyzed reaction with water vapor and by the direct pyrolysis of tris(2,4-pentanedianato) aluminum.

IN VITRO ANTI HUMAN IMMUNODEFICIENCY VIRUS ACTIVITY OF POLY(MALEIC ACID-ALT-CYCLOHEXYL-1,3-DIOXEPIN-5-ENE).

Jian-Ling Ding and R. M. Ottenbrite, Department of Chemistry, Virginia Commonwealth University, Richmond, VA 23284

Poly(maleic acid-alt-2-cyclohexyl-1,3-dioxepin-5-ene) was prepared by free radical copolymerization. Polymers with specific average molecular weight and narrow polydispersity were obtained through solution fractionation. The polymer fractions with average molecular weight of 2,500 and 5,400 were tested biologically against human immunodeficiency virus (HIV) *in vitro*. It was found that these fractions were active against HIV in both cell viability assay and HIV reverse transcriptase screen.

ISOFLAVANOIDS FROM *SWARTZIA POLYPHYLLA* (LEGUMINOSAE). Jennifer L. DuBois and Albert T. Sneden, Department of Chemistry, Virginia Commonwealth University, Richmond, VA 23284-2006.

The Swartziae subfamily of the Leguminosae family of plants consists of ten woody genera, the largest being *Swartzia* which contains 100-150 species. The other genera contain approximately 50 species. *Swartzia* is the only genus of this family that exists in both the Old and New World tropics. South American *Swartzia* species have exhibited activity as antihelmintics or vermifuges and as fish poisons, and have important medicinal possibilities for treatment of hepatitis, malaria, and cancer. *Swartzia polyphylla* ADC (Leguminosae) was collected in 1990 from the Amazon region of Peru. Folklore from the Peruvian Amazon suggests that this plant is an aphrodisiac. This species has not been previously investigated by other researchers, although other *Swartzia* species have been investigated and yielded steroidal saponins and pterocarpanes. An ethanolic extract of the dried, ground heartwood of *Swartzia polyphylla* exhibited biological activity in several bioassay systems including antibacterial and antifungal activity and inhibition of protein kinase C. The extract was fractionated further by standard solvent partitioning and chromatographic techniques. Six flavonoids, including one new isoflavanoid, were isolated from this work and identified by spectroscopic techniques. The isolation and spectroscopic identification of these flavonoids is the topic of this talk.

AUTOMATED INTERPRETATION OF INFRARED SPECTRA USING AN ARRAY OF NEURAL NETWORKS. Jeffrey E. Edwards, John P. Ashenfelter* Frank A. Palocsay, Dept. of Chemistry, James Madison U, Harrisonburg, VA 22801 and Kelley Hancock*, Dept. of Chemistry, VPI&SU, Blacksburg, VA 24063. Neural networks were used to classify infrared spectra into 20 functional group categories. The backpropagation algorithm and training sets selected from a database of infrared spectra were used to train several three layer networks. The effects of adding an additional link between the input and output layers were investigated. Also the consequence of varying the training time and the number of hidden nodes was examined on these new networks. Comparison of results obtained with and without the input to output link indicated significant performance improvement in most networks.

SEPARATION OF QUEUINE CONTAINING TRANSFER RNA ISOACCEPTORS BY C-4 REVERSE PHASE HYDROPHOBIC INTERACTION HPLC. Mark S. Elliott, Miguel Santos*, and Christine Witte*. Dept. of Chemistry and Biochemistry, Old Dominion Univ., Norfolk, Va. 23529. Queuosine modification of purified tRNAs is usually determined by RPC-5 HPLC or by guanine exchange reactions catalyzed by purified tRNA-guanine ribosyltransferase. An alternative method of queuosine analysis has been developed using wide-pore (300 angstrom) C-4 HPLC columns in a hydrophobic interaction mode. Descending salt gradients of ammonium sulfate from 1.0 to 0.0 M in 0.1 M sodium phosphate buffer (pH 7.0) allow for separation of bulk tRNA isolates into numerous specific isoacceptor rich fractions. Unlike RPC-5, this separation technique allows for the baseline separation of the four queuosine containing tRNA isoacceptors. Furthermore, shifts in retention times indicate the relative queuosine levels in these tRNAs. This new application permits simultaneous separation and queuosine quantification of the four tRNAs, and can be used to isolate these isoacceptors from cell or tissue isolates and diagnose the level of queuosine deficiency commonly associated with cancerous cells.

CONTROL OVER QUEUINE MODIFICATION OF TRANSFER RNA BY PROTEIN KINASE C AND PROTEIN PHOSPHATASE. Mark S. Elliott, Bonnie Brooks*, Panayota Eriotou*, Sandeep Sagar*, and Rana Morris*. Department of Chemistry and Biochemistry, Old Dominion Univ., Norfolk, Va. 23529. Queuosine modified tRNAs, appear to play a significant role in growth control, differentiation and neoplastic progression, with a loss of queuosine promoting a more transformed phenotype. The antagonistic actions of protein kinase C and protein phosphatases appear to regulate the efficiency of the queuosine modification mechanisms. Protein kinase C promotes both more efficient uptake of the base queuine into cultured human cells, and increases the activity of the enzyme that incorporates queuine into tRNA. Inhibition of protein kinase C down regulates the efficiency of the uptake mechanism. Inhibition of protein phosphatase activity in cultured human cells also results in increased activity of uptake and incorporation of queuine into tRNA. Together, this indicates that elevated phosphorylation levels are important for increasing the efficiency of tRNA modification with queuosine.

DETERMINATION OF SELENIUM IN PLASMA AND ERYTHROCYTES FROM TYPE I DIABETIC CHILDREN IN DIABETIC KETOACIDOSIS. Pi-Hsia Fan & Patricia Pleban, Dept. Chem. & Biochem., Old Dominion Univ., Norfolk, VA 23529, & Reuben Rohn, Dept. Pediatrics, Eastern Virginia Medical School, Norfolk, VA 23507. Selenium, an essential trace element in human nutrition, is known to play an important role in preventing oxidative damage. Animal studies have suggested that streptozocin-induced diabetes mellitus causes an alteration in selenium metabolism and, possibly, selenium deficiency. Other animal studies have indicated that selenium deficiency may enhance the severity of ketoacidosis during starvation.

Using polarized Zeeman-effect graphite furnace atomic absorption spectroscopy, we have measured selenium concentrations in the plasma and erythrocytes in the plasma and erythrocytes from Type I diabetic children. Selenium concentrations in both blood components were followed longitudinally from the development of ketoacidosis for up to one year. At least one year after onset, children with Type I diabetes had significantly higher plasma selenium levels. Furthermore, during the development of diabetic ketoacidosis, plasma selenium levels were significantly lower in patients with Type I diabetes mellitus regardless of the duration of the illness. Red cell levels decreased significantly one to five months after ketoacidosis.

USING COMMERCIAL SOFTWARE TO ELUCIDATE SOME PROPERTIES OF THE FOURIER TRANSFORMATION. Bingbing Feng¹, Tamara S. Kelsey and James J. Leary, Department of Chemistry, James Madison University, Harrisonburg, VA 22807.

Fourier Transformation was simulated by using the commercial software package MathCad[®]. Two approaches—integration and summation—were used to extract the frequency information about a signal source. In both approaches, real and imaginary parts of the complex transform were studied, and usually gave mathematically predictable frequency information. Both tabular and diagrammatic representations were produced, but in general, computer-generated diagrams can more rapidly be interpreted. Peak positions, amplitudes and shapes reflect the predicated mathematical representations. The appearance of extraneous peaks, as predicated by the Nyquist Theorem, was also easily observed, when the summation approach was used. However, in the integral approach the extraneous peaks that did not conform with Nyquist Theorem, were often observed.

THE THERMAL DECOMPOSITION OF COBALT(II) ACETATE TETRAHYDRATE.

M.R. France and T.C. DeVore, Department of Chemistry, James Madison University, Harrisonburg, Va. 22807

The thermal decomposition of cobalt(II) acetate tetrahydrate has been investigated using evolved gas analysis- Fourier transform infrared spectroscopy. This decomposition occurs in six distinct steps. Following an initial loss of water to form cobalt(II) acetate dihydrate, the decompositions occur through the loss of water, acetic acid, acetone, and ketene. The final decomposition product is cobalt oxide. The intermediate solid phases have not been identified and mechanisms for the intermediate reaction steps are still being established. The results obtained indicate that the formation of acetic acid is characterized by a first order reaction rate and that the production of acetone follows a mechanism of contracting area.

EPR STUDIES OF BIOCHEMICALLY-GENERATED ARYLOXYL RADICALS: AN EXPERIMENT FOR THE UNDERGRADUATE PHYSICAL CHEMISTRY LABORATORY, Robert J. Geiger, T. Wade Johnson, and Herbert J. Sipe, Jr., Department of Chemistry, Hampden-Sydney College, Hampden-Sydney, VA 23943. We report procedures for the production and observation by EPR spectroscopy of aryloxy radicals of 3,5-di-tert-butyl-4-hydroxyanisole [DTBHA[•]] produced by oxidation of the parent compound by H₂O₂ and horse radish peroxidase [HRP].

The observation of this radical and the related radicals of the food additives BHT and BHA, if spectrometer sensitivity permits, complement traditional undergraduate EPR experiments with the stable radical DPPH, moderately stable Fremy's salt (potassium nitrosodisulfonate), and the cation radicals of polycyclic hydrocarbons produced in concentrated H₂SO₄. The reported experiment provides student experience with biochemical systems, buffer systems, and variable-volume pipet techniques, as well as EPR spectroscopy. Optimal solution concentrations for the production of DTBHA[•] with H₂O₂/HRP, the approximate time-dependence of DTBHA[•], and the sampling arrangement are discussed.

DEVELOPMENT OF A RAPID-SAMPLING SYSTEM FOR EPR SPECTROSCOPY,

Dennis M. Goldin, Christopher St. John, and Herbert J. Sipe, Jr., Department of Chemistry, Hampden-Sydney College, Hampden-Sydney, VA 23943. We report the design, assembly, and evaluation of a custom-constructed rapid sampling system for use in EPR spectroscopy to remove the experimental bottleneck occurring when aqueous samples are studied. Because of their dielectric loss at microwave frequencies, aqueous samples are studied in special, thin rectangular "flat" cells that must be carefully positioned in the spectrometer cavity for optimum sensitivity. Correct positioning of the cell and spectrometer tuning may require 10-20 minutes. The ability to change sample solutions without disturbing the correctly-positioned flat cell is crucial when studying short-lived samples, and our rapid sampler provides that capability. Liquid samples are transferred by aspiration from the sample preparation vial through a stainless steel cannula, into the flat cell, and ultimately, from the flat cell into a waste reservoir. The volume of solution aspirated is controlled by an electrically-operated solenoid valve that is opened for a period of time controlled by an electronic circuit using the ubiquitous 555 timer integrated circuit. Diagrams of the aspiration apparatus and solenoid valve controller are presented, and operation of the assembly is discussed. We believe this relatively low-cost device to be easily adaptable to other applications, such as UV/visible spectrometry.

COMPARITIVE STUDIES OF PROSTACYCLIN PRODUCTION IN CULTURED CELLS. Jeterfonnee Jones and *Nandita Banerjee, Dept of Che., Hampton Univ., Hampton, Va. 23668. One of the ways some fatty acids metabolize is by making physiologically active prostaglandins. Prostacyclin is one of them and it inhibits blood clotting. In addition to arachidonic acid (20:4 ω 6), eicosapentaenoic acid (20:5 ω 3) can produce potent prostacyclin. This study compared prostacyclin production in fibroblast, endothelial and retinal cells using ^{14}C -20:4 ω 6, ^{14}C -20:5 ω 3 and ^{14}C -eicosatrienoic acid (20:3 ω 6). Cellular microsomes, obtained by sonication and ultracentrifugation, were incubated at 37 $^{\circ}\text{C}$ for 15 minutes with ^{14}C - fatty acid in presence of epinephrine. After extraction, the prostacyclin fraction was isolated by TLC. It was determined that prostacyclin production from 20:3 ω 6 and 20:4 ω 6 was higher in retinal cells than in fibroblasts and endothelial cells whereas, endothelial and retinal cells showed higher production from 20:5 ω 3. To see the effect of other fatty acids the microsomes were incubated with ^{14}C -20:4 ω 6 in the presence of other nonradioactive fatty acids, eg. 20:5 ω 3, 20:3 ω 6, docosatetraenoic acid (22:4 ω 6) and elaidic acid (t18: ω 9). It was observed that prostacyclin formation from ^{14}C -20:4 ω 6 was least inhibited by 20:5 ω 3 in fibroblast, however in endothelial cells all the fatty acids tested inhibited the same way. In retinal cells, inhibition was maximum by 22:4 ω 6 and minimum by t18: ω 9. Results suggest that retinal cells are more effective in prostacyclin formation. (Supported by National Institute of Health, Grant # GM08245).

STUDIES OF BORON-CONTAINING POLYMERS. Wendelyn B. Kraus and R. L. Kiefer, Dept. of Chem., Col. of William and Mary, Williamsburg, VA 23187. Neutrons are one of the products formed when high energy particles interact with materials. An effective shield for such neutrons would contain hydrogen to reduce the energy of the neutrons and boron to absorb neutrons of reduced energy. For this reason, films of two polymeric materials, a polyetherimide and a polysulfone, were made with varying amounts of submicron boron powder. Both materials were made in pure form and with up to 20% by weight of boron powder. The neutron absorbing ability of each material was determined by surrounding a foil of indium metal with the polymer film, irradiating with thermal neutrons, and measuring the radioactivity induced in the indium foil. The glass transition temperature and Young's modulus of the materials did not change with the addition of boron powder. Preliminary observations show that the presence of boron powder in the polymer films does not alter the effects of irradiation with 1 MeV electrons. Synthesis of a polysulfone with boron chemically incorporated as a carborane is in the initial stages.

A STUDY OF THE PROTON AFFINITIES OF CHLORINATED DERIVATIVES OF AMMONIA AND GLYCINE USING MNDO+. Edward P. Locke and Robert Ake, Dept. of Chemistry/Biochemistry, Old Dominion Univ., Norfolk, Va. 23529. Heat of formation and charge density data from semi-empirical Hartree-Fock calculations are used to determine proton affinities of ammonia and glycine as a function of chlorination. The effects and implications, as they pertain to proton affinity, of chlorine and alkyl substituents on nitrogen are discussed with respect to electronic induction. Results suggest a trend in the relative acidities of protonated chloramines and chloramino acids.

SEMI-EMPIRICAL MOLECULAR ORBITAL INVESTIGATION OF THE ENERGETICS OF PROTONATING MODEL ETHERS, ALCOHOLS, AND AMINES. Toby E. Lucy & Robert L. Ake, Dept. of Chem., Old Dominion Univ., Norfolk VA 23529. Semi-empirical molecular orbital calculations have been used to determine the energetics of protonation of model ethers, alcohols, and amines. The neutral and protonated forms of the molecules were stretched along a reaction coordinate to a predetermined length beyond the equilibrium bond length. Results obtained by this study include: heats of formation, molecular geometries, molecular orbital energy levels, and the electron charge densities of the atoms involved. The alcohols studied were: methyl, ethyl, isopropyl, and tert-butyl. The results show that the trend in carbocation stability is in decreasing order from tertiary to primary and methyl. The protonation of ammonia and methylamine were compared. The effect of protonating dimethyl ether is compared with the results from the alcohols.

SYNTHESIS AND PROPERTIES OF A LIQUID CRYSTALLINE POLYESTER. Josephine A. Magbanua, Joseph J. Malin, and Robert A. Orwoll, Depts. of Chem. and Phys., Col. William and Mary, Williamsburg, Va. 23187. A polyester with alternating rod-like and semi-flexible units was prepared from 4,4'-dichloroformyl- α,ω -diphenoxyundecane and 4,4'-dihydroxy- α,ω -diphenoxyundecane. Liquid crystallinity was detected between 160 and 185°C using differential scanning calorimetry and thermal mechanical analysis. Rotational-isomeric-state calculations were used to interpret even-odd oscillations in the mesomorphic-isotropic transition temperatures of this polyester and other homologs in which the length of the polymethylene spacers varied.

COMPARISON OF MATRIX MODIFIERS CONTAINING NICKEL AND PALLADIUM FOR THE DETERMINATION OF SELENIUM IN HUMAN URINE. Dawn McGuire & Patricia Pleban, Dept. Chem. & Biochem., Old Dominion Univ., Norfolk, VA 23529. Selenium is reported to be excreted in human urine primarily as SeO_3^{2-} and $(\text{CH}_3)_3\text{Se}^+$. Recent studies on the measurement of total urinary arsenic have shown that arsenobetaine which is excreted after seafood ingestion was incompletely recovered using either nickel or palladium matrix modifiers alone. Potassium persulfate was added to the modifier to facilitate in situ digestion of the matrix.

We have applied this technique to the assay of another metalloid, selenium, in human urine. We compared the use of chloride salts of nickel and palladium, the nitrate salts of nickel and palladium, addition of persulfate to both nickel and palladium modifiers with respect to recovery and precision of the analyses using selenocysteine, selenomethione and sodium selenite. We found the best recoveries and precision using the palladium chloride modifier. The presence of oxidizing agents reduced recoveries.

SYNTHESIS, ISOLATION AND IDENTIFICATION OF THE ISOMERIC PENTADECYLPYRIDINES. Joe Murray and Wayne M. Stalick, Department of Chemistry, George Mason University, Fairfax, VA 22030. Alkylpyridines have been identified as major constituents of oil shale and lower rank bituminous and lignite coals. In order to develop a better understanding of the decomposition pathways of these materials, a study of the pyrolysis reactions of alkylpyridines is undergoing investigation. The model starting materials for these thermolysis reactions are the three isomeric *n*-pentadecylpyridines. Many of the smaller alkyl- and alkenylpyridines that are breakdown products of the pyrolysis reactions have been synthesized successfully in high yields by a modified Brown and Murphey synthesis using sodium amide in liquid ammonia. When this method was extended to the pentadecylpyridines, disappointing yields were realized. Modifications to the general procedure including drying the ammonia over CaH_2 , adding cosolvents along with the alkyl halide, and changing the extraction solvents have resulted in the production of the desired products in yields comparable to those obtained for the smaller chain homologs. The techniques developed to synthesize these materials should apply generally to any high molecular weight alkylpyridine. Product identities have been confirmed by ir, nmr, ms and elemental analyses.

DETERMINATION OF pKa's OF METHYLATED 3,4-DIHYDROXYBENZOHYDROXAMIC ACIDS BY UV SPECTROPHOTOMETRY AND POTENTIOMETRY. Sabrina Myrick and George C. Grant, Chemistry Dept, Norfolk State University, Norfolk, VA 23504. The Chemical properties of DIDOX and related compounds are under investigation to elucidate the role of fundamental properties in the biological activity of these compounds, which are potent ribonucleotide reductase inhibitors with antitumor activity. The chemical species existing in solution near physiological pH is governed by multiple pKa's due to several ring hydroxy groups and the hydroxamic acid group for the DIDOX family. These pKa's were investigated by UV spectrophotometry using 1.000 cm cells in a Beckman DU7 spectrophotometer connected to a PC through the RS 232 port. Spectra were then processed, compared, or plotted through SlideWrite Plus. UV spectroscopy results were complicated by the similarity of pKa values and the base catalysed decomposition of the parent compounds, which typically became significant above pH 10. Accordingly, solutions were carefully mixed directly in the cells immediately before spectra were recorded. Good's Buffers (MES, MOPS, HEPES, BES, and PIPES) were used because they are electrochemically and biologically inactive and do not absorb substantially in the UV region. In order to more fully decouple the multiple acid dissociation equilibria, the pKa's are also being measured through potentiometric titrations using a Metrohm 702 titrator. Grans plots will be used to extrapolate the titration data through the region where multiple pH equilibria prevail.

SYNTHESIS AND CHARACTERIZATION OF POLYMERS. Suanne B. Nash, Margaret K. Grogan^{*} and James J. Leary, Department of Chemistry, James Madison University, Harrisonburg, VA 22807. Polymers may be characterized by their transition temperatures, vibrational energies, and molecular weights. After performing quick and simple synthesis techniques, polystyrene, poly(methyl methacrylate), poly(methyl acrylate) and other polymers were analyzed by Differential Scanning Calorimetry (DSC), Attenuated Total Reflectance (ATR), and Gel Permeation Chromatography (GPC). Results of these analyses were used to enhance the Polymer Chemistry Laboratory at James Madison University.

DRIFTS STUDY OF THE CATALYTIC OXIDATION OF CO. Julie C. Patrick & Kenneth G. Brown, Dept. of Chem./Biochem., Old Dominion Univ., Norfolk, Va. 23529 & Billy T. Upchurch & David R. Schryer, NASA Langley Research Center, Hampton, Va. 23665. Diffuse Reflectance Infrared Fourier Transform Spectroscopy has been used to analyze monolith supported CO oxidation catalysts at temperatures that are at or near room temperature. The catalysts which are coated on a ceramic monolith contain platinum and SnO_2 , in combination with other metals. Infrared spectra of the catalysts have been acquired during both reductive pretreatment and active reaction with a stoichiometric mixture of CO and O_2 . The effects of various catalyst parameters, including; the presence of promoters, pretreatment conditions, catalyst processing, and reaction temperature have been investigated. Surface adsorbed CO is observed at different frequencies under different conditions which indicates the presence of multiple adsorption sites, the nature of which will be discussed.

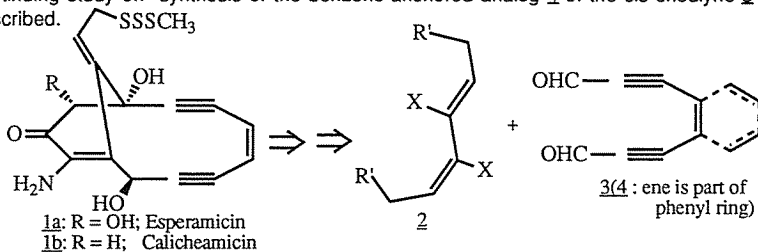
AN OVERVIEW OF THE PRESENT STATUS OF THE WINE AND HEALTH FIELD OF RESEARCH.

Jacques Recht, Old Dominion University Enological Research Facility, Department of Chemistry/Biochemistry, Old Dominion University, Norfolk, VA 23529. This paper will trace the course of the field of wine and health over the past two hundred years with an emphasis on the most recent scientific data related to the positive health factors associated with moderate wine consumption. Various hypotheses will be considered to explain the French Paradox and the results of the French and other European researchers. The paper will also describe relevant findings arising from research at the Enological Research Facility at Old Dominion University with regard to anti-aging, antiretroviral and the free radical scavenging ability of wine and its polyphenolic components.

CONSTITUTIONAL AND STERIC ISOMERISM IN SYMMETRICALLY DISUBSTITUTED SIX-NITROGEN-DONOR MACROCYCLIC COMPLEXES OF LARGE METAL IONS, K. M. Samaria, K. K. Fonda and L. M. Vallarino; Department of Chemistry, Virginia Commonwealth University, Richmond, VA 23284.

Complexes containing La(III) or Pb(II) bound to the cavity of a methyl-disubstituted six-nitrogen-donor macrocyclic ligand, $C_{22}H_{24}N_6(CH_3)_2$, were synthesized by metal-templated condensation of 2,6-diacetylpyridine and 1,2-diaminopropane (both R,S and S forms). These complexes may exist as two constitutional isomers, having the $-CH_3$ substituents in positions [5,14] and [5,15], respectively; stereoisomers are also possible due to the chirality of the diimine side-chains. When the (S)-diamine precursor was used in the metal templated synthesis, the two expected constitutional isomers were both formed. When the (R,S)-diamine precursor was used, only three of the four possible isomers were obtained, one always in minor quantity. Two of the La(III) isomers, one obtained from the (R,S)-diamine and one from the (S)-diamine, were isolated in more than 90% purity.

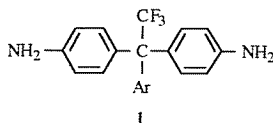
MODEL SYNTHETIC STUDIES TOWARDS THE CIS-ENEDIYNE SEGMENT OF THE ESPERAMICIN/CALICHEAMICIN AGLYCONE. Yuda Shavo, Godson Nwokogu, Department of Chemistry, Hampton University, Hampton, VA 23668. The potency of the recently isolated anti-cancer agents, esperamicin and calicheamicin, is proposed to reside in their common aglycone because of chemical transformations involving its α,β -enone, cis-enediynes and allylic sulfide moieties. Advanced intermediates for assembling the [7,3,1]bicyclic core **1** are **2** and **3**. Results from continuing study on synthesis of the benzene-anchored analog **4** of the cis-enediynes **3** will be described.



LABELING OF THE ACTIVE SITE IN THE GUANINE-7-METHYLTRANSFERASE. Darrin R. Sorokti, Emily Streaker and Thomas O. Sitz, Department of Biochemistry, Virginia Tech, Blacksburg, VA 24061-0308. Previous kinetic studies have defined three domains in the active site of the guanine-7-methyltransferase: the S-adenosylmethionine (SAM) region, the cap region (GpppG-), and a RNA (-pNpNpNpNpN-) binding domain. We have been successful in labeling the combined cap-RNA binding domain (Gppp-GpNpNpNpNpN-) with a ^{32}P -labeled capped RNA synthesized in an *in vitro* transcription system. The size and sequence of the RNA was determined by nearest neighbor transfer and was found to be: GpppGpUpApApApUpUpUpApApC*pCp, the primary sequence being 11 nucleotides long with ^{32}P -pCp label on the 3'-end. The RNA was incubated with enzyme and a large excess of bovine serum albumin (BSA) at 37° and then exposed to a UV-lamp for 45 min on ice. The samples were applied to SDS-polyacrylamide gels for analysis. After staining, the gels were subjected to radioautography to visualize the radioactive bands. Various parameters were examined to optimize the labeling, such as time of exposure to UV-light, temperature, concentration of RNA, etc.

ARYLTRIFLUOROETHYLIDENE (3F) LINKED DIAMINES FOR HIGH PERFORMANCE POLYIMIDES. Gregory A. Sotzing and Roy F. Gratz, Dept. of Chemistry and Geology, Mary Washington College, Fredericksburg, VA 22401-5358.

An improved synthesis involving the inverse addition of an aryllithium reagent to ethyl trifluoroacetate was used to prepare three aryl trifluoromethyl ketones, which, in turn, were reacted with aniline in the presence of aniline hydrochloride at $140\text{-}150^\circ\text{C}$ to give the corresponding aryltrifluoroethylidene (3F) linked diamines, **1**. The diamines were reacted with pyromellitic dianhydride (PMDA) in the presence of phthalic anhydride (PA) to form three new phthalic end-capped, soluble polyimides. The new polymers exhibited good thermo-oxidative stability.



Ar = 4-Phenylphenyl, 4-Phenoxyphenyl, 2-Naphthyl

ISOLATION AND IDENTIFICATION OF LIPIDS FROM JELLYFISH. Robert Thompson and Charles Bell, Jr., Department of Chemistry and Biochemistry, Old Dominion Univ., Norfolk, VA 23529. Jellyfish, Chrysaora quinquecirrha, collected from the Elizabeth River were extracted with chloroform-methanol and separated using 2-dimensional Thin Layer Chromatography and Gas Chromatography. Preliminary data presented indicate the presence of sterols, including cholesterol. Tentative identification of other components by GC is presented.

THE USE OF CHITOSAN AS A CHELATING AGENT IN TRACE METAL EXTRACTION.

I.T. Urasa and J. Quaye, Department of Chemistry, Hampton University, Hampton, VA 23668

While solid phase extraction employing synthetic ligands has gained considerable popularity in the analysis of environmental samples, the application of naturally occurring chelating polymers in this area has received very little attention.

The research reported in this paper is based on the characterization of chitosan for use in the extraction of trace heavy metals in water samples. This polymer forms stable complexes with several heavy metals including lead, cadmium, copper, mercury, manganese, and others.

The research has examined the factors which influence the effectiveness of this material as a complexing agent, and the optimum experimental conditions for its application in environmental analyses. Influential factors include sample acidity, extent to which the sample is interacted with the material, and the amount of material used.

SOLID PHASE EXTRACTION OF TRACE HEAVY METALS IN WATER. I.T. Urasa and W. M. El-Maaty, Department of Chemistry, Hampton University, Hampton, VA 23668

Solid Phase Extraction (SPE) has gained considerable popularity in the separation and analysis of volatile organic compounds in environmental samples. However, while it has potential for a wide array of applications in trace metal analysis, its use in this area has not been as common.

The research reported in this paper is based on the characterization of solid phase extraction materials for use in the extraction of trace heavy metals in water samples. C-18 solid phase extraction tubes coupled with dithizone were employed to extract lead, copper, cadmium, and mercury from water.

Factors which influence the effectiveness of these materials for the extraction of metals have been examined and characterized. The optimum experimental conditions for their application in environmental analyses have been found to depend on solution pH, solvent properties, and interaction time.

GLUTATHIONE CONTENT OF FRESH OYSTER TISSUE. Patrick D. Walker and Mary M. Bechtold, Department of Chemistry, Hampton University, Hampton, VA 23668. Glutathione is an important component of living tissue and one of its biological functions is to maintain other tissue components in their reduced form. It helps to maintain the sulfhydryl groups of proteins in the reduced state, the iron of heme in the ferrous state, and it can also be used in removing toxic peroxides that may form in tissues. This study is concerned with assessing the levels of glutathione in the tissues of the American oyster. The glutathione levels in tissue are reported based on spectrophotometric techniques. The determination is carried out on the protein-free supernatant of homogenized tissue and the glutathione is presented as mmoles present per gram of fresh tissue. (Supported by NIH (MBRS) 5S06GM08245-04)

PRODUCTION OF MONOCLONAL ANTIBODIES TO PANCREATIC AND SALIVARY AMYLASES AND THEIR APPLICATION FOR ENZYME IMMUNOASSAY.

Sandra B. Ward and James H. Yuan, Dept. of Chem. & Biochem., Old Dominion Univ., Norfolk, Va. 23529. Human pancreatic and salivary amylases were inoculated into two separate 5 week old BALB/c By J mice intrasplenic at a concentration of 200 $\mu\text{g/ml}$ in a volume of 100 μl . They were boosted at 11 and 13 days via their tail vein with the antigen at 2 mg/ml in a volume of 25 μl . Titers were obtained on day 14. Cell fusions were performed utilizing the spleen cells of the immunized mice and NS1 cells. Clones were picked on day 10. Clones were later screened for antibody production and tested for cross-reactivity. The best clones were injected into 8 week pristane primed BALB/c mice. The ascites fluid obtained was purified using Protein A Sepharose to purify the IgG. Microwells coated with the specific antibody can be used to quantify the specific amylase by ELISA or its activity if the active site of the enzyme is not blocked by the antibody.

SOLID-PHASE COMPETITIVE ENZYME IMMUNOASSAY OF ORGANOPHOSPHORUS PESTICIDES.

Kuo-Lan Wen and James H. Yuan, Dept. of Chem. & Biochem., Old Dominion Univ., Norfolk, Va. 23529. Microwells and microtubes were utilized as the solid-phase matrices for the development of an enzyme immunoassay for organophosphorus compounds. A sensitive and simple microtube based competition enzyme immunoassay for the quantitative determination of organophosphorus pesticides was developed. Malathion (phosphorodithioate), parathion (phosphorothionate), mevinphos (phosphate ester) and tamaron (phosphorothiolate) were chosen as the antigens for the antibody production. Gamma globulins were isolated from whole anti-sera by DEAE-cellulose chromatography. A carbodiimide coupling method was utilized to prepare the organophosphorus compound-horseradish peroxidase (OP-HRPO) conjugates. Microtubes coated with purified antibody were incubated with analyte and OP-HRPO conjugate. The assay was performed within 20 minutes at room temperature, utilizing the competitive reaction of the analyte and the analyte-horseradish peroxidase, which produces more color the less analyte presents. The method has a coefficient variation of 31.6% at 1 ng/mL and 10.3% at 100 ng/mL.

PURIFICATION AND CHARACTERIZATION OF CATALASE FROM THE AMERICAN OYSTER.

Angela W. Williams, & M.M.Bechtold, Dept. of Chemistry, Hampton Univ., Hampton, Va. 23668. Studies with the American oyster, *Crassostrea virginica* are in progress to characterize the oyster as an animal model in which to study lipid peroxidation and the protective systems which curtail deleterious oxidative processes in cells. Catalase promotes the disproportionation of hydrogen peroxide, a highly reactive oxidizing species, to oxygen and water, and is an important cellular defense against oxidant damage. To study this process in oysters, the enzyme has been identified, assayed, purified, and molecular weight studied. The enzyme is present in oyster tissue and has been partially purified by ammonium sulfate fractionation, gel permeation and ion exchange chromatography. Studies of molecular weight using SDS-PAGE electrophoresis are in progress.(Supported by NIH (MBRS) 5 SO6 GM08245-06)

THE DEVELOPMENT AND MISSION OF THE ENOLOGICAL RESEARCH FACILITY AT OLD DOMINION UNIVERSITY, R. L. Williams, The Old Dominion University Enological Research Facility, Department of Chemistry/Biochemistry, Old Dominion University, Norfolk, VA 23529. In 1992 the Department of Chemistry/Biochemistry was given the opportunity to develop an Enological Research Facility within the College of Sciences. The purpose of this Facility is to assist the development of the Virginia Wine Industry through the use of the University faculty's expertise in a wide range of fields and disciplines. The organization, goals and achievements of the Facility will be reviewed in this presentation.

WINE AND HEALTH: THE POSSIBLE ROLE OF CERTAIN PHYTOCHEMICALS IN WINE AND GRAPE SEEDS AS POTENTIAL ANTI-AGING AND ANTIRETROVIRAL AGENTS. R. L. Williams, Jacques Recht, Laura Moen, Mark Elliott and Joseph Reddy. Old Dominion University Enological Research Facility, Department of Chemistry/Biochemistry, Old Dominion University, Norfolk, VA 23529. Several polyphenolic agents found in wine and in grape seeds have been evaluated in for their potential to serve as free radical scavengers and as anti-aging agents as well as potential antiretroviral agents. The anti-aging studies have been carried out with human fibroblast cells in culture where we see a definite inhibition of normal cell growth at moderate doses of the polyphenolic fractions from grape seeds. The analytical methods associated with the separation and isolation of the components will be discussed together with the details of the cell culture research.

7,7'-DIPYRIDYL-TETRAHYDROIMIDAZOPIPERIDINES: A NEW CLASS OF CNS STIMULANTS. R. L. Williams and Alice Tsapayi, Department of Chemistry/Biochemistry, Old Dominion University, Norfolk, VA 23529. The above mentioned compound has been shown to exhibit a variety of biological activities including its ability to induce dramatic seizures or "explosive motor behavior" (EMB) in laboratory animals. This convulsive activity has limited the potential use of this agent in other pharmacological areas. This paper will describe the synthesis of an acetyl derivative of this compound which has been shown to be devoid of EMB activity and thus of greater pharmacological interest. The method of synthesis, structural analysis and evaluation of the new acetamido derivative will be described.

A CONVENIENT CHEMICAL SYNTHESIS OF OLIGO- AND POLYPEPTIDES. Jian-Zhong Yang, Min Wang, and Raphael M. Ottenbrite, Dept. of Chem., Va. Commonwealth Univ., Richmond, Va. 23284. A convenient chemical synthesis of oligo- and polypeptides is described. Direct polycondensations of α -amino acids using diphenyl phosphoryl azide (DPPA) as condensation agent were carried out in the presence of triethylamine (TEA) as a base. The amino acids used were β -benzyl-L-aspartate (Asp.Bz), γ -benzyl-L-glutamate (Glu.Bz), L-phenylalanine (Phe), and O-benzyl-L-tyrosine (Tyr.OBz). In most cases, a bimodal molecular weight distribution was observed for the products. High weight-average molecular (up to 28,000) polypeptides were obtained in reasonable yields along with low molecular weight (about 1200) oligopeptides. These two fractions were easily separated by fractionation precipitation. The conformational behavior of the polypeptides obtained was studied. The polymerization using DPPA seems to be a racemization-free procedure. DPPA method is a viable approach for oligo- and polypeptides synthesis.

IMMOBILIZATION OF POLYACRYLIC ACID ON GLASS BEADS (I) IR SPECTRA OF POLYMER COATED GLASS BEADS. R. Yin, R. M. Ottenbrite, Dept. of Chem., Va. Commonwealth Univ., Richmond, Va 23284. & J. A. Siddiqui, ICI Film, Bermuda Hundred, Hopewell, Va 23860. In order to enhance the compatibility of glass beads (filler) with PET polyester (matrix), several types of water-soluble polymer coated glass beads have been prepared in our lab, such as carboxylic acid polymer. IR spectra showed that P2 glass beads contain so few silanol groups that it is not easy to have chemical reaction occur at this site. The etching of sodium hydroxide may result in more silanol groups on surface of glass via cleaving Si-O-Si bands and some components of glass can be etched out by HNO₃. Etching affects the surface environment and adsorptive capacity of glass bead. Acid and salt of polycarboxylic acid can coat on surface of glass beads, but it not appear to be chemisorbed.

BIOCHEMICAL INVESTIGATION OF GOUT AND ITS FAMILIAL INCIDENCE. James H. Yuan, Jenny C.L. Hsu, Simon T.F. Chi, and Amy Charlesworth, Dept. Chem. & Biochem., Old Dominion Univ., Norfolk, VA. 23529. Gout is a chronic metabolic disorder caused by deposition of uric acid on the joint. It has been reported that gout could be polygenic or multifactorial inheritance and has high family incidence. In this study, the possible relationship of uric acid, xanthine, hypoxanthine and xanthine oxidase in gout families was investigated. The results indicate that mean plasma hypoxanthine, xanthine and uric acid levels of non-gout members (n=145) of the gout family are significantly lower than those of gout members (n=69) of the gout family, but are significantly higher than those of normal healthy control subjects (n=34). In the study of 27 gout families which consist of 214 people, the annual family incidence from 1981 to 1991 yielded a rate of ranging from 0.6% to 5.5%. The subjects of gout families shown to be with earlier gout onset than the subjects of normal population. Consequently, gout has a high familial incidence and is related to the plasma hypoxanthine and xanthine levels.

AVIDIN-BIOTIN COMPLEX ELISA SYSTEM FOR QUANTIFYING IMMUNOGLOBULIN G AND ITS ISOTYPES. James H. Yuan, Kuo-Lan Wen, Christine M. Yuan, Simon T. F. Chi, and Sandra B. Ward, Dept. of Chem. & Biochem., Old Dominion Univ., Norfolk, Va. 23529. The quantification of mouse monoclonal antibody was performed by three different techniques: the enzyme-linked immunosorbent assay (ELISA); direct avidin-biotin complex (ABC) assay, antibody-antigen-biotinylated-anti-antibody (Fc specific)-avidin-biotinylated peroxidase; and indirect ABC assay, antibody-antigen-biotinylated-anti-antibody (Fc specific)-(avidin-biotinylated peroxidase)_n. The indirect ABC assay has enhanced the sensitivity in antibody assay in comparison of direct ABC assay and ELISA, with the detection limit of 10 pg/mL range for the indirect ABC technique compared to that of 100 pg/mL range for the direct ABC technique and 1000 pg/mL range for the ELISA. The indirect ABC system takes advantage of the high affinity of biotin for avidin, a glycoprotein having an apparent molecular weight of 68,000 daltons and four biotin-binding sites. Therefore, the higher concentration of biotinylated-peroxidase was incubated with avidin to form a multiple-bridged avidin-(biotinylated peroxidase)_n complex and provided higher intensified color development, which provided high sensitivity and precision.

SYNTHESIS AND CHARACTERIZATION OF POLY(MALEIC ANHYDRIDE-CO-2-PROPENYL BENZENE-3,4-DIACETATE). S. Imran Zaidi and R. M. Ottenbrite, Department of Chemistry, Virginia Commonwealth University, Richmond, Va 23284-2006. A controlled molecular weight polymer, Poly(maleic anhydride-co-2-propenyl benzene-3,4-diacetate), was synthesized and the molecular weight was estimated by GPC-HPLC. Several hydrophobic groups were grafted onto the polymer to improve the cell membrane affinity. The degree of the grafting and the polymer structure was determined by $^1\text{H-NMR}$.

Computer Science

CS IN CZ—COMPUTING AT CHARLES UNIVERSITY, PRAGUE, CZECH REPUBLIC. Greg C. Cook, Information Technologies, Tidewater Community College, Norfolk, Va. 23501. Since the Velvet Revolution in the fall of 1989, the Czechs have made great progress in the use of computers and networking for higher education. At Charles University, one of the oldest universities in Europe, all seventeen of the faculties (schools) have microcomputer labs for students. Six of the faculties are in the process of setting up in-house local area networks (LANS) with 386 and 486-based servers running Novell Netware or 3-Com, while two have LANS running on DEC 5000/200 servers using UNIX. The Rectorate (administration) of the university has a Macintosh network using AppleTalk and ethernet. Individual workstations at the faculties are generally AT, 286 and 386 MS-DOS compatibles with a number of Macintosh computers available in many of the faculties. Eleven of the faculties are connected to a wide area network (WAN) that connects the university to other facilities in Prague, including Czech Technical University. Most of the WAN utilizes dedicated lines at 64 kbps, with a few at 19.2 kbps. The WAN is part of CESNET, the academic network of the Czech and Slovak Republics, and has access to the Internet via 64 kbps lines to Linz, Austria and the Netherlands. Mainframe computing is handled by two IBM 4380-series mainframes located at Czech Tech that are shared by both universities.

A LANGUAGE FOR SPECIFYING SYNTACTIC TRANSFORMATIONS. Shade Jenifer and Larry Morell,* Hampton University, Hampton, Va. 23668. Syntax-directed tools (SDT) are an important subclass of software tools which function in the production of higher quality software at minimal cost. These tools, which include pretty printers and database interfaces, process information according to the structure of the input they receive. One revolutionary tool which is used in the production of SDT's is the parser generator. Unfortunately, the complexity of this important tool has reduced its use almost exclusively to experts of parsing theory and its applications exclusively to programming language processors. OPTIMAL (Optimized Parse Tree Independent MANipulation Language) is a language under development whose goal is to extend the use of parser generators to users with minimal knowledge of parsers. OPTIMAL is a semantic specification language which is operational; that is, it acts as a high-level programming language which, when interpreted, facilitates the rapid prototyping of syntax-directed tools, which, in turn, increases programmer productivity.

A COMPUTER SCIENCE COURSE ADVISOR: A LITTLE ON THE SENSITIVE SIDE. Lindsay A. Mast and Rita M. D'Arcangelis, Dept. of Computer Science, Mary Washington Col., Fredericksburg, VA 22401. Factors other than 'have passed the prerequisites' and 'must take because it is required' often influence student course selection. Using VP-Expert development software, a prototype interactive student advisor was constructed to assist computer science students in selecting which and how many mathematics and computer science courses to take in the next semester. The goal was to make the system sensitive to non-academic factors such as full/part-time employment obligations and family responsibilities, as well as academic factors such as overall gpa. Data gathered from a questionnaire was used to identify factors critical in selecting courses. These factors formed the basis for questions to be answered interactively by the system user as follows: Each user first enters his course history, and then is asked a series of questions concerning the relative importance of the identified factors. The ranking values supplied by the user are converted into confidence factors for certain rule antecedents. The student's gpa is used as a threshold by the rule selector to determine whether particular rules should be fired. The result is a list of recommended courses tailored to the student's academic needs as well as non-academic obligations.

AN EXPERIMENT IN PARALLEL PROCESSING. WENDY PAIGE ORR and Professor John H. Reynolds, Dept. of Computer Science, Mary Washington Col., Fredericksburg, VA 22401. The software building block is the process, the unit of code that performs a number of actions, and then either stops without completing or terminates complete. A system is designed in terms of an interconnected set of processes. Each process communicates with other processes by unbuffered, uni-directional point-to-point connections called channels. A transputer is a microcomputer with its own local memory and has links for connecting one transputer to another transputer. Occam, a programming language designed for transputers, implements this idea of channels for parallel processing. Occam, by design, simplifies the writing of parallel processes by taking most of the burden of synchronization away from the programmer. However, writing parallel code has unique complications and restrictions that the sequential programmer does not encounter. We introduce occam and the transputer, discuss some features of parallel programming, and demonstrate some complications for the amateur parallel programmer.

Education

OVERVIEW AND CURRENT PROGRESS OF PROJECT *SCIENCE* (SCIENTIFIC INTERDISCIPLINARY EXPERIENCES NECESSARY FOR A COMPREHENSIVE EDUCATION) AT DSLCC. H. S. Adams and J. S. Barnes, D. S. Lancaster Cmnty. Col., Clifton Forge, VA 24422. As stated in its general education objectives, DSLCC expects graduates to have "developed a responsibility toward the global environment by understanding the uses of science and technology, their impact on the environment, and one's personal responsibility toward protecting the environment." Assessment showed that students fall short in areas of science knowledge, positive attitudes toward science, and critical thinking. Therefore, this project was designed to help correct these deficiencies through development and use of modules within several academic disciplines which address questions concerning: (a) the contribution of science to a particular discipline; (b) that discipline's contribution to science; and (c) use of the scientific method (predicated on the ability to think critically and impartially about issues). Integrated into other classroom activities were instructional modules that were developed this academic year for the following disciplines: biology, sociology, mathematics, psychology, computer information systems, and English. Additionally, in the fall a film series was presented, and in the spring five speakers presented related programs. The participating students of this interdisciplinary study have not yet been post-tested. (Supported in part by funds provided by the State Council on Higher Education in Virginia.)

A PLANT PROPOSAL - INTEGRATING SCIENCE, TECHNOLOGY, AND THE WORLD OF WORK. Robin M. Carey, West Point Elementary Sch., West Point, VA. 23181. Science education can no longer be a lone entity. The integration of science, technology, and the world of work is absolutely necessary if Virginia's students are to succeed. The plant proposal provides an avenue for such skills to be learned.

The student in this project takes on the role of a team member who is trying to get a job with a company that grows and harvests plants. In order for the student to present his findings and to obtain a job from the company, he must complete all of the following: design an experiment involving the manipulation of a tropism, perform the experiment, obtain data, draw conclusions, and create a proposal using a desktop publishing program on the computer. The student must work in a cooperative group to simulate the world of work.

By doing this project, students become aware of the relationship between skills taught in school and those required in the "real" world. This is specifically seen in science, a topic often thought of as not being applicable to "real" world experiences.

CHESAPEAKE BAY PROGRAMS AT THE VIRGINIA MARINE SCIENCE MUSEUM.

Lynn B. Clements, Virginia Marine Science Museum, Virginia Beach, VA 23451. The mission of the museum is to increase the public's knowledge of Virginia's marine environment. Visitors and local residents alike can discover why the Chesapeake Bay is one of the country's most valuable natural resources. Along with hands-on exhibits and a 50,000 gallon aquarium, visitors can explore Bay habitats through programs. Program offerings range from Sleep-with-the-Fish overnights to Fishy Fun for Pre-schoolers. The museum's proposed expansion plan will also be presented.

ON BECOMING A SCIENCE TEACHER: CONSTRUCTING IDENTITIES. George E.

Glasson, Sch. of Education, Va Polytechnic Inst. & State Univ., Blacksburg, VA 24061-0313. In this study, the development of a beginning teacher's identity as a middle school science teacher is described. As part of a graduate teacher education program designed to promote dialogue and reciprocal learning about teaching practice within a school community, a student teaching intern was engaged in journal writing and open-ended conversations about her teaching with her cooperating teacher and university supervisors. In the beginning, the teaching intern struggled to define her role as a teacher in the classroom. She was concerned with teaching inquiry-oriented science to students from diverse backgrounds. As she engaged in dialogue about her practice, she began to assume more responsibility for planning and teaching. Toward the end of the semester, she developed her identity as a valued science teaching partner with her cooperating teacher, and she gained acceptance by the students for her contributions to their own science learning.

SCIENTISTS AND TEACHERS: PARTNERS FOR STUDENT CENTERED, HANDS-ON, MINDS-ON DISCOVERY AND ASSESSMENT IN SCIENCE. Elizabeth S. Klein, IPSET, Curry School of Education, Univ. of VA, Charlottesville, VA 22903-2495. The Terry-Klein-Terrell Inventory (TKT) is a hands-on/minds-on assessment tool. The performance based instrument measures physical science concept and problem solving skills of elementary teachers. The TKT was designed and developed by two elementary teachers and one high school physical science teacher with input from a chemist, a physicist, a geologist, two educational researchers, and two science educators. The twenty-nine elementary teachers that participated in the pilot have assisted in the evaluation and revision processes. The partnerships between scientists and teachers in the design, development, implementation, and evaluation of the TKT Inventory is analogous to what the partnerships for science education need to be. In order to insure excellence in science, scientists and teachers must work together to provide the student centered, hands-on, minds-on discovery learning opportunities to today's students.

INVOLVING HIGH SCHOOL BIOLOGY STUDENTS IN LANDFILL RESTORATION. Bea Taylor and George E. Glasson, Sch. of Education, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061-0313. Being a part of a community involves the identification of community problems and negotiating solutions that contribute to the public good. The proposed closing of the Roanoke Regional Landfill and its integration into Virginia's Explore Park constitutes such a community problem. Students at Patrick Henry H.S. and the Governor's School in Roanoke are participating in a study in which they are learning the problems of opening, maintaining and closing landfills. The students will generate their own experiments that may include investigating intra- and interspecific competition and degree of erosion control ability. These investigations will be conducted using native vegetation. The effect of leachate on streams and ponds located downhill from the landfill will also be conducted. Once students have arrived at conclusions for appropriate revegetation of the landfill, it is hoped they will have the opportunity to share this information through community channels. This is a preliminary study, began in the spring of 1993 will investigate how high school biology students, when given a life context problem, proceed to formulate a solution.

MAKE THE CONNECTION THROUGH AEROSPACE: THE VIRGINIA SPACE GRANT CONSORTIUM. Mary L. Sandy, Director, Virginia Space Grant Consortium, Old Dominion University Peninsula Center, 2713-D Magruder Blvd., Hampton, VA 23666. The Virginia Space Grant Consortium is a 14-member coalition of universities, NASA, the Virginia Department of Education, The State Council of Higher Education for Virginia, science centers and other member institutions with educational and workforce missions in the Commonwealth. The Consortium seeks to enhance math, science and technology education in Virginia using aerospace as a theme and an innovative tool for motivating students. The Consortium engages in a number of programs, projects and partnerships, including THE SPACE CONNECTION—an electronic teacher resource center for Virginia educators, national educational teleconferences, real world research opportunities for students, and workshops for educators. The Consortium also awards scholarships and fellowships to students at Virginia's five Space Grant Colleges. Among Space Grant goals are the encouragement of girls and underrepresented minorities to pursue studies and consider careers in science and technology fields and the fostering of interdisciplinary educational approaches. The Consortium is a partner in educational reform through V-QUEST. This presentation will provide an overview of the Consortium and its mission and goals, and will highlight the programs and resources offered by the Consortium.

A COMPARISON OF THE EFFECTS OF ANIMAL DISSECTION AND AN INTERACTIVE VIDEODISC SIMULATION OF DISSECTION ON STUDENTS' KNOWLEDGE OF ANATOMY AND ATTITUDES TOWARD DISSECTION. Richard T. Strauss, Norfolk Public Schools, Norfolk, VA 23510, & Ertle Thompson, Univ. of Va., Charlottesville, VA 22903. Animal dissection has become very controversial. Comparisons were made on cognitive and affective measures related to frog anatomy and animal dissection between an interactive videodisc simulation of frog dissection and traditional frog dissection. Students' sex and biology achievement level were included as independent variables. There were no significant differences in achievement or attitudes between the subjects who used the simulation and those who performed the dissection. The interactions between instructional method and sex, and instructional method and achievement level were not significant for achievement or attitudes. There was no difference in achievement based on sex but males expressed significantly more positive attitudes toward animal dissection than did females. These results support the contention that effective alternatives to dissection exist and that IVD technology is an excellent medium for such alternatives.

COMPARING CONCEPTS OF SCIENTIFIC LITERACY Thomas G. Teates and Jerian Abel, Div. of Curriculum and Instruction, Va. Polytechnic Institute and State Univ., Blacksburg, VA 24061 - 0313. Recent works by various authors (e.g. Hazen & Trefil, 1992) have suggested that there is little progress toward the achievement of scientific literacy by most of the American populace. Serious doubts are raised about how thoroughly high school and college preparation in science address the desired goal of a reasonable level of general literacy in science, even among professional scientists. This paper will address some of the findings of recent assessments of scientific literacy among such groups as high school students, college science majors preparing to teach secondary science, in-service middle school teachers of math and science, and university professors of science.

CHARLES DRYER'S PHILOSOPHY OF SCIENCE EDUCATION. Pamela C. Turpin, C&I, Va. Polytechnic Inst. and State Univ., Blacksburg, Va. 24061-0313. In 1888, *The Academy* magazine ran a contest on "Science in Secondary Schools." First prize, fifty dollars, was won by Charles R. Dryer of Fort Wayne, Indiana. Dryer was a professor of geography at Indiana State Normal School. His ideas about teaching science reveal a type of instruction that foreshadows many of the ideas expressed today. In a time period, when science instruction was little and most likely to be textbook oriented, Dryer presents a view of science education entirely different from what most literature cited science instruction to be like in the late-nineteenth century. His philosophy of science education in the secondary schools merits attention in today's period of reform. A look at Dryer's philosophy, gives us a view of what was suggested about science instruction one hundred years ago. It may also give us thoughts about where we are now.

COMPUTER TECHNOLOGY TO ENCOURAGE COLLABORATIVE LEARNING OF QUALITATIVE REASONING IN SCIENCE. Jane C. Webb and George R. Webb, Randall Caton and Fred Hartline. Dept. of Physics and Computer Science, Christopher Newport University, Newport News, VA 23606. Louis Abrahamson,* Better Education, Inc., Yorktown.

Students who are not majoring in science or engineering frequently encounter situations where making qualitative judgments about the behavior of physical systems is important. One of the goals for an introductory college physics course designed for these students is to develop that skill. Since these students often have misconceptions about the behavior of such systems and know scientific facts that are not tied to basic principles, the achieving of the goal involves a replacement of these misconceptions as well as the teaching of concepts. The use of a classroom communications system that allows students to enter answers at their desks, that stores and analyses the answers immediately, and that can project a histogram of the entire class response encourages students to collaborate on the solution of problems in class. This collaborative approach follows the students in their discussions outside of class. The discussions, informed by immediate feedback in class, provide an effective means for dealing with the misconceptions and encouraging qualitative reasoning.

Environmental Science

AN ECOLOGICAL STUDY OF LITTLE CREEK HARBOR: A SYSTEMS APPROACH. Lewis F. Affronti, Jr., Environmental Quality Division, Naval Amphibious Base, Little Creek, Norfolk, Virginia 23521. Preliminary water and sediment quality investigations have been performed within Little Creek Harbor, Norfolk, Virginia by the U.S. Naval Amphibious Base, Little Creek's Environmental Quality Division. Initial findings revealed varied concentrations of heavy metals and semi-volatile organic compounds within harbor sediments and surface waters. Future study objectives will be discussed.

COMPARISON OF THE RESPONSES OF PERIPHYTON COMMUNITIES TO COPPER DELIVERED EITHER THROUGH THE WATER COLUMN OR VIA CHEMICAL-RELEASING SUBSTRATES. M.E. Arnegard, J. Cairns, Jr., E.E. Schiedt*, and J.M. McMunigal*, Dept. of Biol., Va. Tech, Blacksburg, Va. 24061. Current methods for investigating the adverse effects of pollutants on stream communities lack control and replication and are environmentally harmful. Chemical-releasing substrates allow the delivery of toxic chemicals to replicate microbial communities *in situ* while minimizing the total amount of toxicant released. Periphyton responses to copper released from the novel substrates were compared to those generated using a standard toxicity testing protocol in artificial streams. Community responses to copper differed in the summer and winter, and recovery two weeks after removal of stress may have been delayed due to the retention of copper. More importantly, the method of toxicant delivery did not significantly affect any of the measured endpoints. Copper toxicity tests conducted with chemical-releasing substrates are readily interpretable and hold great potential for application in the field.

PREDATION BY FLATHEAD CATFISH (*PYLODICTUS OLIVARIS*) ON BLACK BASS AND SUNFISH POPULATIONS IN A NEW RIVER IMPOUNDMENT. Brian R. Barr and John J. Ney, Dept. Fisheries & Wildlife Sciences, Va. Polytechnic Inst. & State Univ., Blacksburg, Va. 24061-0321. Introduction of flathead catfish (*Pylodictus olivaris*) across the country has proceeded without quantifying the effects of this species' piscivory. Impact of flathead catfish predation on centrarchids (black bass and sunfish), important recreational fishes, in Byllesby Reservoir, New River, Virginia was estimated by comparing annual consumption estimates of flathead catfish with centrarchid abundance. Diet composition, growth, and abundance of Byllesby Reservoir flathead catfish, coupled with physiological parameters for the species, were used to estimate annual consumption via bioenergetic modeling simulations. Centrarchid abundance was estimated by mark-recapture experiments. Stomach content analysis revealed that Byllesby Reservoir flathead catfish ate predominantly centrarchids. Modeling efforts estimated approximately 20 to 35% of the roughly 14,000 centrarchids in the reservoir are consumed by flathead catfish in Byllesby Reservoir annually. The large consumptive capacity of flathead catfish populations and the abundances and importance of their prey base should be taken into account before stocking this species into a body of water.

METAL UPTAKE BY WETLAND MACROPHYTES IN SURFACE MINED AREAS OF SOUTHWESTERN VIRGINIA. R.N. Brent, R.B. Atkinson, and J. Cairns, Jr., Univ. Ctr. for Environmental and Hazardous Materials Studies, VA Tech, Blacksburg, VA 24061-0415. Wetland soils from surface mined lands have been found to contain high levels of metals, solubilized by natural weathering processes. Soil and plant tissue samples (including roots, stems, seeds, and leaves) of 10 wetland species were taken from 10 sites in Wise County, VA. Tissues were dried and ashed, and extracts were analyzed for total Fe, Mn, Zn, Ni, and Cu concentrations using atomic absorption spectrophotometry. At each site, mean aboveground tissues were found to have accumulated Mn to levels exceeding already high soil concentrations. Mn concentrations as high as 10,872 mg/kg and 18,798 mg/kg were found in leaves of Typha latifolia and Polygonum persicaria, respectively. Although Fe, Zn, Ni, and Cu were not accumulated above soil concentrations at most sites, elevated levels of these metals were present in wetland plant species. These results indicate that attention must be given to the fate of metals accumulated in wetland macrophytes when wetland habitats are considered for part of a post mining land use.

THE EFFECTS OF A DAIRY ON STREAM ECOLOGY. Jennifer M. Colomb, Dept. of Biol., Sweet Briar College, Sweet Briar, Va. 24595. Sweet Briar College has a 3300 acre campus that includes a dairy with 430 head of cattle and an agricultural program. Water chemistry, fecal coliform levels and macroinvertebrate diversity were monitored over two months at six stream sites. Streams downslope of a calf feedlot and the milking parlor, and sites within grazing pastures, all had elevated fecal coliform levels. The effects on stream chemistry and invertebrate diversity varied from site to site.

SURVIVAL AND REPRODUCTION BY BOSMINA LONGIROSTRIS FED TWO SPECIES OF GREEN ALGAE. Theresa E. Connor & R. C. Jones, Dept. of Biol., George Mason Univ., Fairfax, Va. 22030. Survival and reproduction by Bosmina longirostris isolated from the Gunston Cove area of the tidal freshwater Potomac River were investigated through feeding experiments with two green algae. Bosmina longirostris was fed the green algae Ankistrodesmus falcatus and Chlamydomonas reinhardtii. Survival and reproduction of B. longirostris when fed Ankistrodesmus falcatus were lower than those fed Chlamydomonas reinhardtii. B. longirostris had a higher survival and reproductive rate in medium-high concentrations of food than low food concentrations.

ENVIRONMENTAL HISTORY OF A NORTHERN VIRGINIA COASTAL PLAIN CREEK. Stephen P. Getlein, Topographic Engineering Center, Corps of Engineers, and George Mason University, and Francis Heliotis, Department of Biology, George Mason University, Fairfax, Virginia 22030. Dogue Creek in Fairfax County, Virginia has been affected by human land-use practices for at least 10,000 years. Historical accounts, maps, historical and current imagery and other sources are used to describe the effects of various land uses on the watershed. "Natural" environmental restoration in the watershed is illustrated by comparing historical photography with current conditions. Factors involved in restoration in the watershed are discussed. Finally, several possible watershed futures are presented.

EFFECTS OF SUMMER HABITAT LIMITATION ON TROUT IN LAKE MOOMAW, VIRGINIA. I. M. Hampton and J. J. Ney. Dept. of Fish & Wildl. Sci., VA. Poly. Instit. & State Univ., Blacksburg, VA 24061-0321. Dissolved oxygen and temperature limitations restrict the distribution of brown and rainbow trout in the 1000-ha reservoir during late summer and early fall. From mid-August through early October 1992, trout were confined to strata outside their preferred temperature range (14-18°C) and D.O. concentrations less than 5 mg/L. During this period, trout were isolated from their primary forage, alewife. Daily consumption and indices of condition for both species declined markedly. A bioenergetics model was used to estimate the amount of growth foregone as the result of prolonged restriction of usable habitat.

SEASONAL COMPARISONS OF AUTOTROPHIC PICOPLANKTON ABUNDANCE IN THE LOWER CHESAPEAKE BAY AND FOUR TRIBUTARIES. Kristin Hatcher, Jeffrey Madden & H.G. Marshall. Dept. of Biol. Sci. Old Dominion Univ., Norfolk, Va., 23529-0266. The autotrophic picoplankton concentrations in the lower Chesapeake Bay were characterized as having a single major period of growth (during June, July, August), with highest concentrations of 10^9 cells/l. There was a pattern of decreasing cell abundance in the lower Bay north to south, and west to east. Winter abundance averaged 10^6 cells/l. Similar growth pulses were associated with picoplankton above and below the pycnocline, with higher concentrations above the pycnocline. Cell abundance levels were also generally lower during 1991, which was considered a "dry" year (compared to mean values) due to a reduction of stream flow into the Chesapeake Bay. (Supported by the Virginia State Water Control Board)

EVALUATION OF PLANT RESPONSE TO AID IN REVEGETATION OF HAZARDOUS CHEMICAL WASTE SITES by Stephanie R. Hill and John Cairns, Jr. Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. Heavy metal pollutants from a variety of man-made sources degrade the landscape. Plant cover is required to control erosion and thereby prevent the spread of contamination. Direct seeding is a fast, economical revegetation method. Plant species response to metal stress is not predictable, however. Growth bioassays of several species, Robinia pseudoacacia, Asclepias syriaca, Andropogon gerardi, Lolium multiflorum, Setaria italica, Festuca rubra, Rudbeckia hirta, Echinacea purpurea, Solidago nemoralis, and Trifolium repens latum, were performed in small pots in a plant growth chamber for 7 days in 0, 0.3, 1.0, 3.0, 10.0, and 30.0 mg cupric chloride/kg natural soil. LC50s and EC50s were determined for germination and root length, as well as NOECs and LOECs to evaluate and compare early establishment of the plant species. Germination was not significantly affected by Cu concentrations for most species ($p=0.07-0.6$). A significant difference from control for germination occurred only in 30.0 mg/kg for R. hirta, F. Rubra, and I. repens latum. Significant differences from control in root length occurred for all species ($p=0.0112-0.0001$) except R. pseudoacacia. Setaria italica had the highest EC50 at 10.86 mg/kg while EC50s for remaining plant species ranged from 3.74 to 7.51 mg/kg. Three types of root responses to increasing Cu concentrations were noted as initial decline, initial stimulation, and threshold.

THE DISTRIBUTION OF WETLAND MACROPHYTES IN ACCIDENTAL WETLANDS ON SURFACE MINED LAND IN SOUTHWEST VIRGINIA. D.H. Jones, R.B. Atkinson, and J. Cairns, Jr., Univ. Ctr. for Environmental and Hazardous Materials Studies, VA Tech, Blacksburg, VA 24061-0415. Surface mining practices have altered landscapes of the mountainous Allegheny Plateau. The area is characterized by well drained slopes except where "accidental" wetlands have formed on old surface mine benches. Macrophyte inventories were made in June and August 1992. Cover and frequency were estimated in square meter plots randomly located at 5-m intervals along transects. Additional data were collected for water chemistry, hydrology, soil, age, size, and morphometry. Identifications were made of 94 taxa. The average per site was 18 species, with a maximum of 34 and a minimum of 7. Importance values were calculated and used to rank the species. Species with the highest importance value in June were Typha spp., Scirpus cyperinus, Juncus acuminatus, J. effusus, and Solidago spp; and in August were S. cyperinus, Typha spp., J. acuminatus, J. effusus, and Potamogeton americanus.

VALIDATION OF THE SAGE II UPPER TROPOSPHERIC WATER VAPOR DATA. J.C. Larsen, Dept. of Mechanical Engineering and Mechanics, Old Dominion Univ., Norfolk, Va. 23529 & S.N. Tiwari, Dept. of Mechanical Engineering and Mechanics, Old Dominion Univ., Norfolk, Va. 23529 & W.P. Chif, Aerosol Research Branch, NASA Langley Research Center, Hampton, Va. 23681. The Stratospheric Aerosol and Gas Experiment II(SAGE II) is a multiwavelength spectrometer which infers the vertical distribution of atmospheric water vapor from limb absorption solar occultation measurements at .94 microns. Global observations from cloud top into the stratosphere have been routinely obtained since October 1984. In this paper, upper tropospheric SAGE II water vapor observations are compared to correlative radiosonde observations and radiosonde based climatologies as a final test of the inverted data. Radiosonde data from the National Climate Data Center were searched for coincident observations and a critical review of the radiosonde measurement capability was carried out to establish the operating range and accuracy in the upper troposphere. Profile pairs and annual zonal means derived from the profile pairs are compared. Resolving the radiosonde database by hygrometer type finds best agreement with the Vaisala Humicap, currently the most accurate and responsive hygrometer in operational use. The results of the correlative comparisons explain much of the observed differences between the SAGE II monthly zonal mean climatology and the Global Atmospheric Circulation Statistics climatology.

WATERBORNE RADON CONCENTRATIONS IN PRINCE WILLIAM COUNTY, VA. Douglas G. Mose and George W. Mushrush, Dept. of Chem., George Mason Univ., Fairfax, VA 22030. The US-EPA Maximum Contamination Level (pending) is 300 pCi/l. Most wells in Virginia exceed this MCL; many exceed 3000 pCi/l. In the Piedmont, granite tends to have the highest waterborne radon, quartzite the lowest, and others such as schist and sandstone are intermediate. For a municipal system, 10-20% of the radon is lost by decay in the storage tanks and pipes between the tanks and the homes. Our experiments with large tanks of activated charcoal show 90% radon removal, when the charcoal is newly installed, followed by 50% removal after 1 year and 10-20% removal after 2 years. Our experiments with aeration show 90% removal of radon using an air bubble dispersal system and a splash box, and 60-70% removal using either method alone. Similar results can be obtained using similar but smaller installations in individual homes.

COMPARISON OF PRODUCTIVITY OF THE JAMES, YORK AND RAPPAHANNOCK RIVER SYSTEMS. Nesius Kneeland and Harold Marshall, Department of Biology, Old Dominion University, Norfolk, Va. 23529. Productivity on the nine tidal stations was seasonal consisting of three major peaks - spring, summer, fall. The seasonal pattern varied with location on the river system. Stations located in tidal fresh and oligohaline consisted of a distinct seasonal pattern; whereas, stations located in polyhaline had a constant pattern. These variations correlated with seasonal changes of estuarine and neritic phytoplankters. Annual productivity on the James River was twice the of the York and Rappahannock Rivers.

PRIMARY PRODUCTIVITY MEASURED AS PEAK ABOVEGROUND BIOMASS IN ACCIDENTAL WETLANDS ON SURFACE MINED AREAS OF SOUTHWESTERN VIRGINIA. G.B. Noe, R.B. Atkinson, and J. Cairns, Jr., Univ. Ctr. for Environmental and Hazardous Materials Studies, VA Tech, Blacksburg, VA 24061-0415. The peak aboveground live biomass of macrophytes was measured in 10 wetlands in Wise County, VA. The dominant communities in each wetland were sampled by collecting 0.25 m² plots of all live aboveground macrophyte tissue at the peak of the growing season, September 1992. The samples were separated by species, dried in ovens, and weighed to determine their biomass. The two communities with the highest importance value and biomass were dominated by either Typha spp. or Scirpus cyperinus. Plots with the highest mean biomass for genus Typha spp. (700 g/m²) occurred at a mean depth of 40-50 cm, while Scirpus cyperinus maximum biomass (840 g/m²) occurred at 10-20 cm. Results of the study will be used to predict colonization dynamics and to help design constructed wetlands for wildlife habitat to improve surface mine reclamation.

INFLUENCE OF TRIAZOLE FUNGICIDES ON NON-TARGET ORGANISMS (ALGAE). Darlene Graham, Dept. of Biol., Hampton Univ., Hampton, Va. 23666, D. M. Orcutt, N. R. Hopkins* & J. Fanelli*, Plant Pathology, Physiology & Weed Sci., Virginia Tech, Blacksburg, Va 24060. Sterol-inhibiting fungicides (SIF's) are used extensively to control diseases of grain, fruit and turf grass. Purportedly selective for inhibiting sterol (ergosterol) synthesis in fungi, algal species are known to synthesize sterols via numerous different pathways and potentially could be inhibited by SIF's. Five sterol-inhibiting fungicides were tested relative to their effects on growth and sterol synthesis in algae representing genera in the Chlorophyceae (Chlorella & Oocystis) and Bacillariophyceae (Phaeodactylum). In most instances concentrations ranging from 5-10 ppm of active ingredient caused growth reductions from 80-100% of those of the control. In all instances sterol synthesis was inhibited resulting in an accumulation of sterol precursors as determined by gas chromatography and mass spectroscopy. The five fungicides tested appear to inhibit sterol synthesis in a similar manner when tested on a specific organism.

SEASONAL ABUNDANCE OF MAJOR MICROZOOPLANKTON CATEGORIES IN THE CHESAPEAKE BAY AND FOUR TRIBUTARIES. Guynq-Soo Park & H.G. Marshall. Dept. of Biol. Sci., Old Dominion Univ., Norfolk, Va. 23529-0266. During the 1992 summer and fall, a broad survey of microzooplankton (<150 microns) composition was conducted. This community was dominated by ciliates (non-loricated), tintinnids, nauplii, rotifers, cladocerans, and polychete larvae. The loricated and non-loricated ciliates were most abundant, with mean counts for the non-loricated ciliates in summer and fall for the rivers 5725 and 3302 cells/l respectively, and 5771 and 4098 cells/l for the Bay. The tintinnid mean abundance for summer and fall in the rivers was 2542 and 1229 cells/l respectively, and 1925 and 629 for the lower Bay. Rotifer and cladoceran concentrations were less in the Bay, with polychete and nauplii larvae abundance greater. Sarcodina species were rarely noted in the Bay. (Supported by the Virginia State Water Control Board)

DISTRIBUTION, ABUNDANCE, AND ACTIVITY OF INDIGENOUS AND APPLIED GYPSY MOTH VIRUS IN THE ENVIRONMENT. M.P. Taverner, Piedmont Va. Cmnty. Col., Charlottesville, Va. 22901, & E.F. Connor', Dept. of Envir. Sci., Univ. of Va., Charlottesville, Va. 22903. We sampled forest substrates from an area which received different Gypchek applications to determine the distribution and abundance of gypsy moth virus over the course of host development. Of 18 30-acre blocks established, six received a single treatment of virus, six received two virus applications, and six received no additional virus. Bark, leaf litter, and soil samples were removed from each block at biweekly intervals. Samples were washed to remove virus inclusion bodies, which were stained and counted microscopically. The wash supernatants were bioassayed to determine virus activity.

Although virus abundance did not increase immediately after Gypchek application, a marked rise in abundance was noted across all of the substrates and for all of the treatments by the end of June. A repeated measures analysis of variance showed significant treatment differences, with two applications resulting in the highest virus concentration on all substrates. Significant substrate differences were also noted, with bark exhibiting the highest virus concentration. The activity of the recovered virus increased over the sampling period. Later in the season, the activity level surpassed that predicted by a laboratory control curve, indicating an increase in virus virulence. The number of gypsy moth egg masses present declined for all treatments. An ANOVA on the percent reduction in egg mass density showed that there were treatment differences associated with the egg mass reductions.

POPULATION DYNAMICS OF EURYTEMORA AFFINIS IN THE TIDAL FRESHWATER POTOMAC RIVER. Allyson Via-Norton and R.Christian Jones, Dept. of Biol., George Mason Univ., Fairfax, Va. 22030. Eurytemora affinis is the dominant mesozooplankton in Gunston Cove, a highly eutrophic, tidal freshwater embayment of the Potomac River. Mesozooplankton were collected at five sites using a 202u mesh plankton net. Nauplii were collected with a submersible pump and hose and a 44u mesh filter. Samples were preserved with 10% formalin and enumerated using a Sedgwick-Rafter counting cell. Biweekly averages of E. affinis adults and copepodids show a strong seasonal trend. E. affinis is most abundant in late winter and early spring. This is followed by rapid exponential decline into summer. Nauplii show a much weaker seasonal trend. When plotted together, numbers of nauplii and numbers of adults appear to be related during the late winter-early spring period of high density and unrelated during summer and fall. Several copepod species are found in Gunston Cove in the summer and the proportion of E. affinis nauplii versus other species is currently unknown. This may account for the lack of congruence in adult and naupliar densities during the summer months.

SEASONAL COMPARISONS OF PHYTOPLANKTON ABUNDANCE IN THE LOWER CHESAPEAKE BAY. Mollie Weinstein, Karen Soucek, & H.G. Marshall. Dept. of Biol. Sci., Old Dominion Univ., Norfolk, Va. 23529-0266. There occurred seasonal and annual differences in growth among the algae during 1990-1991. In general, there was greater cell abundance in 1990 compared to 1991. In 1991, there was less development of the spring bloom, with lower concentrations in summer and fall. Annual stream flow also differed over the two years, with 1990 considered an average year and 1991 a "dry" year, with annual mean stream flow reduced 30%. Diatoms (Asterionella glacialis, Skeletonema costatum, Cyclotella caspia) dominated the western bay and the spring bloom, with diatoms and dinoflagellates (Heterocapsa triquetra, Katodinium rotundatum) dominant along the central and eastern regions. The most productive regions were associated with the river plumes along the west side of the Bay. (Supported by the Virginia State Water Control Board)

Geography

SOVIET RESETTLEMENT IN ROCKINGHAM COUNTY, VIRGINIA. Travis Bradshaw and Mary B. Kimsey, Dept. of Geol. and Geog., James Madison University, Harrisonburg, Va. 22807. When President Gorbachev relaxed emigration regulations in the Soviet Union in 1989, thousands fled the country, many of them entering the United States as refugees. Since 1989, over three hundred refugees from the Ukraine and Byelorussia have settled in Rockingham County, Virginia. This study investigates the "push" and "pull" factors involved in the migration of these individuals to Virginia. Results of the study indicate that the Soviets who have relocated in Rockingham County, Virginia left the former Soviet Union primarily because of religious persecution. They were drawn to Rockingham County for four reasons: 1) relatives already in the area awaiting them, 2) a local refugee resettlement program to assist in their relocation, 3) a large Mennonite population to sponsor them, and/or 4) job opportunities in the growing poultry industry of the county.

THE EFFECTS OF THE NORTH AMERICAN FREE TRADE AGREEMENT ON MEXICO. Laura S. Culp* and Dr. Mary B. Kimsey, Dept. of Geog. and Geol., James Madison University, Harrisonburg, Va. 22807. If approved the North American Free Trade Agreement (NAFTA) will be initiated January, 1994. NAFTA would link the economies of Canada, Mexico and the United States creating one of the world's largest trading blocs. This agreement would eliminate and reduce tariffs and nontariffs and set the guidelines for NAFTA's establishment. It was the study's intent to determine if there was any agreement as to the impacts that NAFTA might have on Mexico. The presumption was there would be a general consensus within the states involved and within the individual disciplines. The study concluded that there is no general consensus as to the impacts of NAFTA on Mexico. U.S. economists, politicians, environmentalists and human rights groups do not agree with Mexican economists and politicians nor do these groups on one side or another of the border necessarily agree among themselves. Some of the proposed benefits are the acceleration of democratization, the enforcement of environmental laws, and an increase of foreign capital. Proposed costs are preservation of authoritarian rule, promotion of capital and chemical intensive agri-businesses, an increase in rural unemployment and the perpetuation of low wages.

RECENT CHANGES IN WETLAND DISTRIBUTION ON CHINCOTEAGUE ISLAND, VIRGINIA. Scott Eaton and Mary B. Kimsey, Dept. of Geol. and Geog., James Madison University, Harrisonburg, Va. 22807. Between 1956 and 1977 approximately 63,000 acres of wetlands were destroyed in Virginia. Annually, over 3000 acres were lost in the period of two decades. Virginia's wetlands continue to be destroyed at a rapid rate. In this study, a preliminary investigation is made concerning the changes in wetland distribution on Chincoteague Island in recent years. Interviews with Corps of Engineers officials and field surveys reveal that wetlands on the island are being destroyed against government regulations. Coastal wetlands are being destroyed through both the construction of riprap and backfilling of sediments in marshy areas. Size of the impacted areas varies from several acres to a few square meters. Island residents deny the existence of wetlands on the island and blatantly defy the Corps of Engineers, threatening the existence of wetlands on the island.

UNDERSTANDING CLIMATE: ONE EASY LESSON. John R. Gentile, Dept. of Geology and Geography, James Madison Univ., Harrisonburg, Va. 22807. This paper does not present any new information. Rather, it provides a new method to organize our knowledge of climate in such a way as to enhance teaching and understanding. It recognizes that there are five (5) factors that drive the climate process: I. Pressure Systems and Surface Winds, II. The Coriolis Effect, III. Differential Heating, Marine/Continental Effect, IV. Adiabatic Cooling, and V. Dew Point. The organizational method insures that after one lecture most students will be able to map world climate types to a high degree of accuracy. This ability builds confidence and stimulates enthusiasm in class. It also helps illuminate the importance of climate to the study of World Geography and helps students when analyzing conditions and situations in different regions of the world.

USING GPS TO MAP WILDERNESS TRAILS. John R. Gentile, Erik Cole, Tom Howze, David Elam, Timothy Connell, Jon Boland, Dept of Geology and Geography, James Madison Univ., Harrisonburg, Va. 22807. A TRIMBLE Geographic Positioning System (GPS) was used to assess the feasibility and effectiveness of its use for mapping wilderness trails. Two wilderness areas in Virginia were chosen, St. Mary's and Ramsey's Draft. Two basic problems were encountered; the steep terrain, and the thickly vegetated over-story both hinder the ability to engage satellites. Because of this it was impossible to map any trails in Ramsey's Draft. By contrast, approximately ten miles of trail were mapped in St. Mary's Wilderness, but only after the Gypsy Moth defoliation occurred. The study indicated that GPS mapping can provide high quality data in areas where normal field mapping techniques are difficult to conduct. Future efforts should be limited to winter seasons. (Supported by a grant from the George Washington National Forest).

PLANNING IN THE GERMAN CAPITAL: BERLIN IN THE 1990's. Peter Schulz, Dept. of Urban Studies and Planning, Va. Commonwealth Univ., Richmond, Va. 23284-2008. As one of Europe's capitals Berlin has a rather brief, but turbulent history. Founded in the 12th century as a small fishing village and trading place, the city grew slowly as a local and regional administrative center. In 1701 Berlin was selected as royal capital of Prussia. Growth was rapid during the industrial revolution and the city emerged as the first national capital of the German Reich. Berlin retained its capital functions through the abdication of the Kaiser in 1918, the Weimar Republic, and The Third Reich until 1945. The victorious allies divided Germany and Berlin into four zones and sectors and Berlin lost most of its capital functions with the founding of the Federal Republic of Germany and the German Democratic Republic in 1949. The political and economic division of the country and Berlin became even more critical with the construction of the Berlin Wall in 1961. Favorable events in Eastern Europe brought about the fall of the Wall in 1989 and after many parliamentary debates and several elections the eventual unification of the two Germanies and the selection of Berlin as the "new" capital. Planning for a divided city was almost impossible in the past. Planning for a vibrant re-united, and rapidly growing capital is clearly necessary and taking place.

WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*) IN AN URBAN PARK IN SOUTHEASTERN VIRGINIA. Ginger K. Watkins, Dept. of Geography, Old Dominion Univ., Norfolk, VA 23529. White-tailed deer were studied in 1,106 acres of Newport News Park in Newport News, VA. Visual and pellet counts estimated the population at 129 deer or more. The population is made up of 31% last years fawns. Necropsies were done on eight deer, checking fat indexes and visual parasitic worm loads. Health varied from emaciated to very good, with low worm loads in all. A habitat assessment showed the entire area to have good to excellent range with browse damage slight to moderate in most areas but heavy in some. A residential questionnaire revealed that deer presence and damage have steadily increased in the past ten years. Continued urbanization and habitat reduction with decreasing control measures have kept the deer population of this urban park, like other parks in the southeast, at or above carrying capacity. Further study of the population trends, movement patterns, and health is advised.

Geology

TRENDS IN FLOW AND CHEMISTRY OF THE RAPPAHANNOCK RIVER. T. E. Baker* and W. C. Sherwood, Dept. of Geol. and Geog., James Madison Univ., Harrisonburg, Va. 22807. The Rappahannock River basin extends from the Blue Ridge Mountains to the Chesapeake Bay in northeastern Virginia. Prior to 1970 only 46 mi² or about 1.0% of the 2715 mi² basin was urbanized, and approximately half of the basin was forested. However, in recent decades portions of the basin have experienced explosive population growth, and acid rain and changes in land use have accelerated. In order to determine the impact of these changes discharge, chloride concentration, and sulfate concentration data from a USGS monitoring station near Fredericksburg were analyzed for the period of 1967 to 1991. WQSTAT (a water quality statistics software package) was used to test the data for temporal trends, using Kendall Tau nonparametric statistics. The results were as follows: 1) Discharge showed a small decrease of 0.5% per year, but the trend was not significant at the 90% confidence level. Chloride and sulfate both showed statistically significant increases of 1.0% and 0.8% per year respectively. However, the mean values of chloride and sulfate were only 4 and 6 ppm respectively. These low values indicate that the Rappahannock is still in a relatively pristine condition and has not been seriously adversely impacted by human activities at this time.

THE NEED EXISTS FOR ENHANCED HYDROGEOLOGIC INVESTIGATION AND SCIENTIFIC INPUT TO GROUNDWATER RESOURCE POLICY IN VIRGINIA. Patrick A. Burkhart, The College of William and Mary, Geology Dept., P.O. Box 8795, Williamsburg, VA 23187-8795. Review of groundwater resource utilization and policy in Virginia, especially recent developments leading to the 1992 regulations, leaves the impression that the scientific community needs to enhance its contribution to the formulation of public policy in this regard. In her pivotal work, *The Last Oasis*, Sandra Postel of the Worldwatch Institute underscored the need to maintain *equity, efficiency, and ecological integrity* in the utilization of renewable resources. For inclusion in this realm, groundwater must be viewed as renewable *in the long-term*. The mad scramble to establish rights to groundwater in the last couple of years has imperiled the equitable distribution of the resource for the foreseeable future. Insufficient understanding of hydrogeologic systems, an underinventoried resource base (are our aquifer yields really known?), obsolete pricing, and a failure to define "reasonable use" have left past and present groundwater usage marred with inefficiencies. Although the 1992 regulations have moved closer to insuring ecological integrity, many instances of imperiled ecosystems exist and progress must continue in this regard. This review has left me convinced that the scientific community should commit to greater involvement in educating citizens, and their elected and appointed officials, on the workings of hydrogeologic systems and the optimal management of groundwater resources.

STRUCTURAL ELEMENTS ALONG THE HAYESVILLE FAULT, HAYWOOD AND JACKSON COUNTIES, NORTH CAROLINA. James F. Coble, Dept. of Geophysical Sciences Tidewater Community College, Va. Beach, VA. 23456.

The Hayesville Fault, a major structural feature and probable terrain boundary extends northeast-southwest along the eastern Blue Ridge Geologic Province in North Carolina and Virginia. Mesoscopic structural elements provide a record of deformational history of the Hayesville Fault. These structures include sedimentary bedding and primary foliation (S0/S1), secondary enclosing foliation (S2), F1 recumbent folds, F2 upright folds, mylonitic shear zones (S5 and S6) and F3 crenulation folds. Sedimentary bedding predates fault emplacement. All other mesoscopic structures formed during a pre- to syn-peak metamorphic, ductile D1 deformational event related to the emplacement of the Hayesville Fault. The timing of the Hayesville Fault is pre-metamorphic constraining the emplacement of the fault to the Penobscottian or early Taconian Orogeny. (Supported by a Chevron Corp. Fellowship and the University of Kentucky MacFarland Fund.)

DISTRIBUTION AND ORIGIN OF MOLLISOLS IN THE SHENANDOAH VALLEY, VIRGINIA. L. S. Eaton and W. C. Sherwood, Dept. of Geol. and Geog., James Madison Univ., Harrisonburg, VA 22807. Soils of the order Mollisols are concentrated in subhumid to semiarid climates and are characterized by a soft, crumb-like structure, high base saturation, and dark color resulting from high levels of organic matter. Soils mapping in the Shenandoah Valley of Virginia in the 1960's and 1970's identified only a single Mollisol series; however, the recently published soils survey of Shenandoah County (1991) shows six series mapped as Mollisols. This significant increase in Mollisols mapped likely indicates that these soils are indeed common in the Valley, but were largely overlooked in previous surveys. Study of these Valley Mollisols shows that they occur over alluvial deposits along streams draining carbonate terraines. Frequently, these streams are supersaturated with calcium bicarbonate and significantly affect soil development by providing a high soil pH which leads to a preservation of organic matter. The origin of the Valley Mollisols suggests that low rainfall (<1m/yr) and carbonate-rich surface and groundwater conditions may be critical factors.

CLAY MINERALOGY OF TERRACE SOILS ALONG THE NORTH RIVER, AUGUSTA COUNTY, VIRGINIA. Jennifer L. Eigenbrode, Dept. of Geol., James Madison Univ., Harrisonburg, Va. 22807. A set of three well defined terraces extend along the south bank of the North River, northeast of Weyers Cave, in Augusta County, Virginia. The fluvial deposits are transported sediments from the Allegheny Mountains to the west. Each terrace incorporates a different soil series. The clay fractions extracted from horizon soils of each terrace were qualitatively and quantitatively analyzed using x-ray diffraction and Newmod 2 remodeling computer program. Kaolinite, illite, divermiculite-illite mixed-layer, and perhaps some smectite-illite mixed-layer are present in all specimens. Fine grained quartz is present in the younger horizons. Sharp diffraction peaks are observed for A horizon clays in each terrace. Illite decreases and divermiculite-illite mixed-layer increases with depth and with increasing terrace age. This correlation is explained by the alteration process of illite to divermiculite.

A FOSSILIFEROUS MIDDLE PLEISTOCENE PALEOVALLEY ON THE RAPPAHANNOCK RIVER VA. G.H. Johnson, F.M. Bell, T. Hurst Kelley, M.A. Beane*, J.B. Hunt*, J.C. Upton*, G.L. Calder*, R.S. Proctor*, Christchurch School, Christchurch, VA 23031-9999.

A paleovalley, filled with a basal gravelly sand and overlying peats and organic-rich sand, crops out on the S. bank of the Rappahannock River about 3.0 km downstream from the Rbt. E. Norris Bridge. The valley is cut into the Eastover and Yorktown Formations and the valley fill is overlain by the middle Pleistocene Shirley Form. The valley fill sequence is comprised of a lower gravelly sand (at least 3.6 m below sea level) that grades upward into a fibrous peat. The peat grades upward into an organic-rich sand and an overlying peat. Abundant cypress stumps and logs up to 2m in diameter occurs in the peat and overlying organic-rich sediments. The upper peat lies below a gravelly sand at the base of the fluvial-estuarine Shirley Formation. The paleovalley was cut during a low stand of sea level before the deposition of the Shirley. Rise of sea level before Shirley time resulted in trapping of fluvial sediments and the formation of swamp condition analogous to those along the present Rappahannock River. The upper part of the peat was eroded when the basal gravel of the Shirley was deposited by shoreline erosion of the paleobluffs. The shoreline retreated to the position of the Kingsmill scarp 1.0 Km south of the present Rapp. River beach. Prelim. study of the plant remains show a climate similar to now.

THE GEOMORPHOLOGY AND HYDROGEOLOGY OF THE GREEN POND AREA, AUGUSTA COUNTY, VIRGINIA. James R. Lawrence, Applied Marine Research Lab., and G. Richard Whittecar, Dept. of Geol. Sci. Old Dominion University, Norfolk Va. 23529. We analyzed the geomorphology and hydrogeology of a topogenous *Sphagnum* bog in George Washington National Forest by conducting a detailed topographic survey and generating a computer model of groundwater flow of the area. Situated at 976 m in elevation, Green Pond formed on nearly flat-lying Antietam Quartzite, and perhaps by dissolution of quartzite. The pond lies in an elongate rimmed drainage basin approximately 0.5 ha in extent. The rim is discontinuous north of the pond where water can exit as overland flow during and after precipitation. Groundwater flow is restricted to the shallow (less than 2 m) residual soils, mostly near the bedrock-soil contact, and much of it may discharge to the north at a spring in the headwaters of Cole's Run. Precipitation recharges Green Pond directly and through groundwater flow and thus fluctuations in precipitation and evapotranspiration directly control pond levels. Groundwater modeling of the study area suggests that areas within the pond and immediate surroundings have a net loss of water during the summer months resulting from greater rates of evapotranspiration and pond evaporation.

DUNE STABILIZATION PROJECT USING CHRISTMAS TREES IN SEASHORE STATE PARK, CAPE HENRY, VIRGINIA. Michael E. Lyle, Tidewater Cmnty. Col., Geophysical Sciences Dept., 1700 College Crescent, Virginia Beach, Va. 23456. The recycling of Christmas trees is becoming more widely used to assist in erosion control along the coast. From 1988 to 1993, five student groups participated in a on-going study using recycled Christmas trees to repair a dune blowout at Seashore State Park. Within three years, the dune line was re-established. After five years, 520 cubic yards of sand has accumulated along the surveyed transect. There was negligible sand accumulation in the slack behind the primary dune line.

INFLUENCE OF SAPROLITE COMPOSITION AND STRUCTURE ON GROUNDWATER FLOW IN THE PIEDMONT PROVINCE, HENRY CO., VIRGINIA. J.T. Russell* and G.R. Whittecar, Dept. of Geol. Sciences, Old Dominion Univ., Norfolk, Va. 23529. Fabrics and textures of two crystalline formations in Henry County, Virginia control the hydraulic properties of their saprolites. The Fort Mountain biotite gneiss (FMG) is a medium-to-coarse grained unit with nearly vertical foliation bands. The Leatherwood granite (LG) is medium-to-coarse grained with weak foliation. Both units weather to form saprolite up to 25 meters thick. Slug tests conducted in 9 uncased boreholes provide estimates of horizontal hydraulic conductivity (K_H). Pump tests performed with orthogonal sets of monitoring wells permit calculation of K_H values both with and across foliation trends. Falling head permeameter analyses of split spoon samples were used to calculate vertical hydraulic conductivity (K_V). In saprolites, inherited foliation and textures inhibit flow crossing clay-rich bands while they facilitate flow along coarse-grained foliation. Average K_V values (10^{-4} cm/sec) exceed K_H values by an order of magnitude for both saprolite bodies suggesting that the high-angle foliation provides a strong influence upon conductivity. The FMG often contains enough coarse-grained bands to make the average K_H higher than in the granite. High-angle clay-rich bands retard vertical flow through FMG split spoon samples more than the weakly oriented minerals in the LG; thus average K_V values for the LG exceed those from the FMG at equal levels in the weathered regolith profile. Pump tests suggest that flow in megapores can increase K_H values by an order of magnitude.

PALEOPEDOLOGY AND PEDOGENIC CARBONATE DEPOSITION OF THE MACCRADY FORMATION (MISSISSIPPIAN), GREENBRIER COUNTY, WEST VIRGINIA. Andrew Stefaniak, Geol. Dept., Col. of William and Mary, VA 23187. The morphology of three paleosols exposed in an outcrop of the Mississippian Maccrady Formation and the stable isotope geochemistry of the pedogenic carbonates contained within these paleosols preserve a record of the physical and geochemical conditions present during soil formation. The outcrop is a sequence of alternating siltstones and mudstones that were deposited in a delta plain associated with a fluvial system. The paleosols exhibit well-developed pedogenic slickensides, large arcuate pseudo-anticlines and pedogenic carbonate. Two of the paleosols display a red hackly soil structure, where as the other is dominated by a strongly gleyed and mottled fabric. The macro features indicate that the paleosols are analogous to vertisols, which form in tropical to warm temperate climates that have four to eight dry months each year.

The paleosol carbonate is characterized by three morphologic and petrographic phases. The red paleosols contain carbonate in the form of sub-angular disorithic nodules that are primarily composed of calcite, quartz silt, and clays. The nodules occur in two textural forms: (1) small fine-grained carbonate micronodules in a matrix of clay, Fe/Mg oxides, and carbonate pseudomorphs of evaporite minerals and (2) pedogenic rhizoliths partially replaced by microcodium in a clay matrix. Carbonate of the gleyed paleosol occurs as a thick dolomitic calcrete layer and is composed of fine-grained dolomite texture with relic micronodules and rhizolith structures. Carbon and oxygen isotope compositions of the carbonate samples from the red paleosols range from -6.07 to -9.04 ‰ (PDB) for $\delta^{13}C$ and -2.06 to -4.470 ‰ for $\delta^{18}O$ [textural form 1] and -7.19 to -10.14 ‰ for $\delta^{13}C$ and 2.30 to -7.32 ‰ for $\delta^{18}O$ [textural form 2]. Carbon and oxygen isotope compositions of the carbonate samples from the gleyed paleosol range from -5.705 to -8.68 ‰ for $\delta^{13}C$ and 7.43 to 6.10 ‰ for $\delta^{18}O$.

Textural and stable isotope compositions indicate that the carbonate of the red paleosols (micronodules and rhizoliths) is characteristic of pedogenic carbonates that form as the result of vertic processes. The texture and higher oxygen isotope values for the carbonate of the gleyed paleosol suggest that the carbonate was first precipitated as calcite (pedogenic carbonate) and then penecontemporaneously dolomitized as a result of evaporation of possibly a mixed fresh/saline groundwater.

LOWER MIOCENE MOLLUSKS FROM THE KIRKWOOD FORMATION OF DELAWARE: FIRST KNOWN COLLECTION. Lauck W. Ward, Virginia Museum of Natural History, Martinsville, VA 24112.

In 1841, James Booth, State Geologist of Delaware, mentioned the presence of molluscan molds and casts in the creek cuts between Smyrna and Dover, Delaware. Until 1991, there were no collections from the Miocene of that state. The excavations associated with the building of a new interstate exposed a richly fossiliferous section just north of Cheswold.

Exposed was a complex series of deltaic, near-beach, back-barrier, and channel-fill shelly sands, which contained a large molluscan fauna. The assemblage, dated at 18 MYA, is equivalent to ones previously reported from the Shiloh and Jericho, New Jersey, area and belongs to the Kirkwood Formation. The strata are the lateral equivalent of Bed 3-A of the Fairhaven Member of the Calvert Formation. They fall within Diatom Zone 1 of Andrews (1988) and the lower part of Mollusk Zone 13 of Ward (1992). The assemblage is transitional between that of the Belgrade Formation (upper Oligocene/lower Miocene) and Bed 10 of the Calvert Formation.

The collection of mollusks, now housed in the VMNH, consists of several hundred thousand picked specimens, involving over 125 species. The assemblage is a mixture of cool, subtropical, and tropical marine species. Fresh-water, brackish-water, back-barrier, and open-shelf taxa are present, concentrated in cross bedded channel deposits. The collection contains numerous taxa that appear for the first time and many that make their last appearance. Most interesting is the presence of a number of taxa that do not appear again in the middle Atlantic Coastal Plain until the late Pliocene.

EASTERN MARGIN OF BLUE RIDGE GEOMORPHIC PROVINCE NEAR CULPEPER, VIRGINIA WAS DEFINED BY LATE TERTIARY FAULTING. Robert E. Weems, Mail Stop 928, U.S. Geological Survey, Reston, VA 22092.

Geologic mapping of the Culpeper East 7.5-minute quadrangle has revealed two NNE-SSW-trending parallel faults about a mile apart which cut the basin obliquely and also mark the eastern edge of the Blue Ridge physiographic province. Landforms within the basin east of these faults are uniformly low, in contrast with the high hills and mountainous monadnocks that occur within the basin west of these faults. Erosion probably would destroy such topographic contrasts within ten million years, so significant Late Tertiary differential vertical movement along one or both of these faults is likely. Terrace deposits along the Rapidan River, not obviously offset by these faults, are traceable down river eastward into the mid-Pliocene Yorktown Formation. These data appear to constrain the timing of uplift of the eastern edge of the modern Blue Ridge province to the Late Miocene or early Pliocene, relative to the Piedmont to its east.

BEDROCK WEATHERING, SOIL DEVELOPMENT AND GEOMORPHIC EVOLUTION OF THE OLD HICKORY MINING DISTRICT, DINWIDDIE COUNTY, VIRGINIA. G.R. Whittecar and S.R. Emy*, Dept. of Geol. Sciences, Old Dominion Univ., Norfolk, Va. 23529, W.L. Daniels* and R.L. Hodges*, Dept. of Crop and Soil Science, Va. Polytechnic & State Univ., Blacksburg, Va. 24061. In the Old Hickory mining district, heavy mineral placer sands lie in Coastal Plain terraces on both sides of the Orangeburg Scarp. Terraces east of this wave-cut scarp are relatively low and broad-topped; to the west, narrow interfluvial deposits dominate. Records from nearly 2400 boreholes made by Renison Goldfields Consolidated (RGC) include depth to bedrock values and bedrock samples from several hundred sites. RGC maps indicate that west of the scarp, bedrock topography contains many depressions and pinnacles with local relief exceeding 60 feet but east of the scarp, bedrock relief typically is 10-15 feet. Samples from boreholes and limited outcrops suggest no lithologic contacts exist along the scarp in the mining district that may have influenced the geomorphic location of the scarp. Almost all samples of basement material collected west of the scarp were heavily weathered; of the 365 borehole samples that were sufficiently unweathered to be collected and lithologically classified, 98% came from east of the scarp. Soil series mapped west of the scarp include several Paleudults with unusually thick argillic horizons and one series that often contains *in situ* plinthite. Soil series east of the scarp are mostly Hapludults but also include soils with rounded plinthite nodules transported prior to soil formation. These observations indicate that the surficial deposits and the bedrock surfaces are much more weathered and older to the west of the Orangeburg Scarp.

Materials Science

CONTACT ANGLE MEASUREMENTS AND ALTERNATIVE METHODS OF ANALYSIS. R.E. Barker, Jr. and G.A. Reitz, Dept. of Materials Science and Engineering, University of VA 22903. The extent to which a liquid can wet a solid is a matter of considerable technological importance as well as a useful probe for characterizing the effects of surface modification. Classical techniques include the direct measurement of contact angles, θ , and graphical methods such as the Zisman plot and the Antonoff plot to extrapolate to the critical surface energy of a solid substrate. $\cos\theta_c=+1$ corresponds to the highest surface tension liquid that will still completely wet the solid. Non-wetting corresponds to $\cos\theta=-1$. A new equation is presented so that the experimentally determined quantity is the height to cord ratio, (h/c) , of a small drop. It is shown that $\cos\theta=(1-4q)/(1+4q)$, where $q=(h/c)^2$. The advantages of this approach are discussed and illustrated with some experimental data for ethanol-water mixtures on polycarbonate. Some considerations related to solutions of liquid crystalline type materials on oriented substrates are presented.

ANALYSIS OF RIPPLE-LOAD CRACKING IN THREE ALLOY SYSTEMS.

Robert A. Bayles, Peter S. Pao, Steven J. Gill, Code 6320, Naval Research Laboratory, Washington DC 20375, & George R. Yoder, Code 1131, Office of Naval Research, 800 N. Quicy St, Arlington VA 22217. Designs which assume no crack growth below K_{Isc} may not be conservative if a small cyclic "ripple" load is experienced by the structure but arbitrarily disregarded by the designer or operator. Experiments are described in which a ripple load effect was observed in a steel, a titanium alloy, and an aluminum alloy. A method is described which predicts the results of long-term ripple load experiments using data from relatively quick corrosion-fatigue experiments. It is shown that materials which are relatively more resistant to stress corrosion are more vulnerable to the ripple load effect.

ANALYSIS OF SOLUTIONS FROM CREVICES ON ALLOY C276 IN NATURAL

SEAWATER. Frederic D. Bogar, Edward McCafferty, and Paul Natishan, Code 6322, Naval Research Laboratory, Washington, D.C., 20375-5343, and E. Dail Thomas, Naval Research Laboratory, P.O. Box 1739, Key West, FL, 33041-1739. Thin layer chromatographic techniques were used to analyze the composition of solutions contained within crevices on alloy C276 exposed to natural sea water in Key West, FL, for 180 days. The composition of these crevice solutions is compared to solutions found within crevices on Inconel 625. XPS analysis of the corroded alloys indicates that minor alloying elements such as niobium, and tungsten play a major role in determining nature of surface films remaining after crevice corrosion.

CONSTITUTIVE RELATIONSHIPS FOR SHAPE MEMORY ALLOYS. T.E. Buchheit and J.A. Wert, Dept. of Materials Science, Univ. of Virginia, Charlottesville, VA, 22903. Shape memory alloys (SMA) have the ability to "remember" their original shape after experiencing strains as large as 6%-10%; this ability to "remember" is commonly called the shape memory effect (SME). A reversible martensitic transformation allows these alloys to recover their original shape after removing the applied stress, or by a combination of removing the applied stress and heating the alloy. The crystallography and thermodynamics of the martensitic transformation are topics which have been thoroughly researched by previous investigators. The objective of the present research is to develop constitutive relations combining theoretical and experimental results from these different topics with measurements of crystallographic texture. Normalized transformation surfaces for NiTi have been developed by applying theories related to restricted slip yield loci and crystallography of martensitic transformations. The transformation surfaces have been used to model stress-strain curves for NiTi wires. (Sponsored by Academic Enhancement Program, Univ. of Virginia)

THE EFFECT OF INDIUM ON THE MECHANICAL PROPERTIES OF AL-CU-LI ALLOYS. D.L. Gilmore & E.A. Starke, Jr., Dept. of Materials Sci., Univ. of Va., Charlottesville, VA 22903. The high stiffness-to-density ratios of aluminum-lithium alloys make them very attractive for aerospace uses. However, this alloy system has traditionally been plagued by poor fracture toughness. Numerous studies have been made in order to more fully understand the deformation and fracture mechanisms. Building upon the previous work in the field, we have examined the effect of trace indium additions on the precipitation processes and mechanical properties of 2020 Al-Li-Cu alloy. Our results confirm observations of accelerated aging in a related 2090 alloy. This effect may allow higher yield strengths in fabricated parts which can not be stretched prior to aging. Transmission electron microscopy will be used to establish the mechanism behind this effect and to resolve why it is not observed at all aging temperatures.

FIBER FRACTURE DURING THE CONSOLIDATION OF METAL MATRIX COMPOSITES. James E. Groves* & H. N. G. Wadley, Dept. of Materials Science & Engineering, Univ. of Va., Charlottesville, Va. 22903. There is a growing interest in producing continuous fiber reinforced metal and intermetallic matrix composites by hot isostatic / vacuum hot pressing of plasma-sprayed monotape lay-ups. The monotapes are produced by infiltrating a colinear array of fibers with plasma melted droplets. They consist of a single layer of parallel evenly spaced fibers enclosed in matrix having one rough surface (the last to solidify) and one smooth surface (the one upon which the fibers were placed). Experimental study has identified the existence of significant fiber fracture in Ti-14Al-21Nb (wt%) / SCS-6 silicon carbide fiber composites after consolidation of monotape lay-ups. The damage is found to vary inversely with consolidation temperature and directly with consolidation pressure and rate. Metallographic observations indicate the dominant mechanism of fiber fracture is bending at surface asperities on the monotapes. A micromechanical model has been used to compute the bending stress in a fiber as the asperities deform (and the lay-up densifies) by plasticity or power-law creep. This stress can be compared with the experimentally determined Weibull distributed fiber strengths to predict the probability of fiber fracture. The model predicts well the observed trends between fiber fracture and consolidation conditions and suggests approaches to processing that minimize the fiber fracture problem.

CRACK INITIATION AND GROWTH IN Al-Cu-Mg BASED ALLOYS. Michael J. Haynes and R.P. Gangloff, Dept. of Materials Science, Univ. of Va., Charlottesville, Va., 22903. Stable crack growth in Aluminum Alloy 2024 1/8" sheet was characterized with J-integral vs. crack growth (J- Δa) resistance curves in accordance with ASTM standard E1152-87. Experiments employed a slow rising load, in conjunction with Direct Current Potential Drop (DCPD) crack growth monitoring, to evaluate crack initiation and the subsequent J- Δa curve. Criteria for crack initiation included both J_{IC} as specified in ASTM E813 and J_c ; defined by a distinct change in potential drop behavior. When these criteria are converted to an analogous plane strain initiation toughness in a structure under small scale yielding, it is found that K_{JIC} is an upper bound on K_{IC} , while K_{Jc} is a lower bound. K_{JIC} corresponds more closely to the average value of K_{IC} .

ELEVATED TEMPERATURE FRACTURE TOUGHNESS OF RS/PM Al 8009. S.S. Kim and R.P. Gangloff, Dept. of Materials Science and Engineering, University of Virginia, Charlottesville, Va 22903. Fracture behavior of rapidly solidified, powder metallurgy processed Al 8009 (Al-8.5Fe-1.3V-1.7Si) was examined within the temperature range of 25 to 300°C, employing a J-integral crack growth resistance method. Regardless of product form, the initiation and growth fracture toughnesses for Al 8009 decrease significantly with increasing temperature and decreasing crack tip strain rate. Modified Al 8009, processed in dry inert gas, exhibited reduced fracture toughness at elevated temperatures. These results suggest that prior particle oxide distribution does not critically affect toughness. TEM studies on tensile deformed Al 8009 indicate a possible transition from dislocation-silicide interactions to climb with increasing temperature.

CHARACTERIZATION OF THE PASSIVITY OF HIGH STRENGTH TITANIUM ALLOYS. D.G. Kolman and J.R. Scully, Dept. of Materials Science, Univ. of Virginia, Charlottesville, VA 22903. In an effort to elucidate the mechanism for environmentally assisted cracking of high strength β -titanium alloys in room temperature aqueous chloride containing environments, characterization of the passivity was undertaken. Analysis of Ti - 15 V - 3 Cr - 3 Sn - 3 Al and Ti - 15 Mo - 3 Nb - 3 Al were each examined in both peak aged (PA) and solutionized conditions. Commercially pure Ti and Ti - 5 Al - 2.5 Sn, which models the α precipitates in the PA alloys, were also examined. DC polarization studies indicate that there is little difference between the electrochemical behaviors of the alloys in neutral and pH 1 adjusted 0.6M NaCl. Auger electron spectroscopy and X-ray photoelectron spectroscopy revealed predominantly TiO₂ oxides on the materials which may explain the similar behaviors. Peak dissolution rates were too low to solely account for observed crack growth rates (L. Young, R.P. Gangloff). Therefore, the passive film must be mechanically destabilized in order to account for these crack growth rates. (Sponsored by the Office of Naval Research and the Virginia Center for Innovative Technology.)

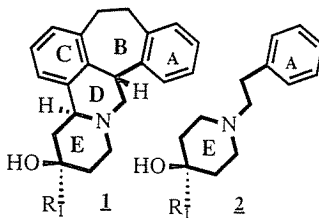
ENVIRONMENTAL EFFECTS IN FATIGUE LIFE PREDICTION: MODELING CRACK PROPAGATION IN LIGHT AEROSPACE ALLOYS. M.E. Mason and R.P. Gangloff, Dept. of Materials Science, Univ. of Va., Charlottesville, VA 22903. Fatigue crack propagation (FCP) data and growth rate models are central elements of computerized codes used to predict remaining service lives of components containing flaws. However, such information is to date focused on crack growth in relatively benign moist air. The linear elastic fracture mechanics approach, based on stress intensity range (ΔK) similitude with growth rates (da/dN), provides the basis for these data. Since FCP rates in structural alloys are accelerated by many gaseous, aqueous and thermal environments, it is of crucial importance to understand and incorporate environment alloy-based interactions into $da/dN-\Delta K$ data and the life prediction method for aerospace components. The objective of this research is to establish a model for predicting environment-sensitive FCP kinetics for light aerospace structural alloys, particularly high strength aluminum alloys.

FORCES ON DISLOCATIONS IN EPITAXIAL LAYERS. Chimin H. Simpson and William A. Jesser, Dept. of Materials Science and Engineering, Charlottesville, VA 22903. Forces on Dislocations in Epitaxial layers with diamond or zinc blend structure have been calculated by using Peach-Koehler equation ($F_g = \underline{g} : \underline{b} \otimes \underline{r}$). The orientations with the largest probability of eliminating dislocations and with the largest number of the mobile dislocations in the epitaxial layer have been calculated in the present work. It is assumed that the thickness of the epitaxial layer exceeds the critical thickness. Perfect dislocations and partial dislocations are considered in this work. Friction force is also taken into account in this work.

EVALUATION OF CONTINUUM FRACTURE MODELS APPLIED TO A DR MMC. B.P. Somerday and R.P. Gangloff, Dept. of Materials Science, Univ. of Va., Charlottesville, VA 22903. A previously developed critical plastic strain-controlled continuum micromechanical model was applied to predict the fracture initiation toughness of 2009/SiC/20p-T6 over the temperature range 25 to 316°C. Complications associated with independently determining the critical microstructural fracture distance, l^* , and intrinsic crack tip process zone plastic fracture strain, $\bar{\epsilon}_f^p$, model parameters, as well as the overall applicability of such continuum models to a ductile metal containing a high volume fraction of elastic particles, are emphasized. It is concluded that the continuum approach is a viable means for modelling the elevated temperature trends of initiation toughness for DR MMCs.

Medical Science

DESIGN, SYNTHESIS AND BINDING OF NOVEL SIGMA RECEPTOR LIGANDS DERIVED FROM BUTACLAMOL. S. Y. Ablordepey*, J. B. Fischer*, R. A. Glennon, Dept. of Med. Chem., MCV/VCU, Richmond, VA 23298-0540. A previous 3D QSAR analysis of sigma receptor ligand binding using CoMFA has led to the development of a highly predictive model ($R^2_{\text{cross}} = 0.84$, $R^2_{\text{nocross}} = 0.98$). Using the steric map obtained from CoMFA studies we are now able to explain why certain rigid structures such as butaclamol (**1**) ($R_1 = t\text{-Bu}$) were not well predicted. Furthermore, analysis of the CoMFA steric map suggested modifications in these structures that might increase affinity. The synthesis and binding affinities of the resulting agents has confirmed the CoMFA predictions. For example, **2** ($R_1 = \text{Ph}$) was predicted to bind at sigma receptors with $K_i = 7.5$ nM (observed $K_i = 5.8$ nM). Further synthetic modifications have now allowed a better visualization between the pharmacophore in butaclamol relative to the standard sigma ligand haloperidol.



THE ELECTRONIC PROPERTIES OF DIAPHRAGM AND ABDOMINAL MUSCLE MEMBRANES OBTAINED FROM NORMAL AND DYSTROPHIC MICE. Milton J. Allen, Biophysical Laboratory, Departments of Chemistry and Biology, Virginia Commonwealth University, Richmond, Virginia 23284-2006. As a preamble to investigating the effects of various biotoxins, drugs, and hormonal agents such as Amphenone on the semiconductive properties of mouse diaphragm muscle membranes, it was decided to also include abdominal muscle membranes in these studies. Experiments using the phenotypically 'normal' diaphragm membrane from female 129/ReJ (?/+) differed considerably in its behavior from the dystrophic's (dy/dy) and was consistent with previous data observed with the male 129/ReJ strain. In examining the behavior of the abdominal muscle membranes, no significant differences were noted in the semiconductive properties between the (?/+) and the (dy/dy). However the determination of the activation energy (E_a) related to electron release showed that there was indeed notable differences in behavior between the (?/+) and (dy/dy) abdominal muscle membranes. In investigating the effects of Amphenone on both the diaphragm and abdominal musculature of the male CD1 strain, significant differences in semiconductive properties were noted between the controls and the membranes pretreated with Amphenone.

TUMOR GROWTH CAUSES SUPPRESSION OF AUTOREACTIVE T-CELL PROLIFERATION BY DISRUPTING MACROPHAGE RESPONSIVENESS TO INTERFERON- γ David G. Alleve and Klaus D. Elgert, Dept. Biology, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061-0406. Tumor growth causes syngeneic macrophages ($M\phi$) to suppress autoreactive T-cell proliferation by decreasing $M\phi$ class II expression and increasing $M\phi$ production of the suppressor molecule prostaglandin E_2 (PGE_2). Because interferon- γ ($IFN-\gamma$) is a potent $M\phi$ activation molecule which regulates both $M\phi$ PGE_2 and class II expression, we investigated the effects of $IFN-\gamma$ on tumor-induced suppression of autoreactive T-cell proliferation. Exogenous $IFN-\gamma$ increased normal host (NH) $CD4^+$ autoreactive T-cell proliferation stimulated by syngeneic NH $M\phi$ but decreased proliferation stimulated by tumor-bearing host (TBH) $M\phi$. Antibody (Ab) neutralization of endogenous $IFN-\gamma$ activity reduced TBH $M\phi$ -mediated suppression. Kinetic studies showed that endogenous $IFN-\gamma$ suppressor activity was not exclusive during T-cell activation. Indomethacin treatment blocked $IFN-\gamma$ -induced suppression in TBH $M\phi$ -T cell cultures. TBH $M\phi$ -T cell cultures contained significantly more PGE_2 than those containing NH $M\phi$. Exogenous $IFN-\gamma$ increased early PGE_2 production in TBH $M\phi$ cultures but decreased production in NH $M\phi$ cultures. The Ab-mediated neutralization of endogenous transforming growth factor- β or tumor necrosis factor- α reduced TBH $M\phi$ -mediated suppression and also blocked $IFN-\gamma$ -induced suppression. Short-term treatment of $M\phi$ with $IFN-\gamma$ before their addition to T cells caused TBH $M\phi$ to stimulate T-cell proliferation, which suggests that early suppressor molecule production by TBH $M\phi$ inhibits synthesis or activity of $IFN-\gamma$ -induced stimulatory monokines. These results show that tumor growth causes $M\phi$ to suppress autoreactive T cell responses by allowing $IFN-\gamma$ to induce $M\phi$ suppressor molecules, which block production or activity of stimulatory monokines.

DEVELOPMENTAL EXPRESSION OF CANNABINOID RECEPTOR mRNA. Amy E. Bateman, Colleen R. McLaughlin, and Mary E. Abood, Dept. of Pharmacology and Toxicology, Va. Commonwealth Univ., Box 524 MCV Station, Richmond, VA 23298. Cloning of the cannabinoid receptor affords the opportunity to examine its developmental expression. Cannabinoid receptor mRNA expression was assessed in rat pups postnatal days 3, 5, 8, 10, 12, 15, 18, and 21. Rat brains were dissected into cerebellum/brainstem (CBM) and forebrain (FBN). Total RNA was extracted using a modified acid phenol extraction technique. Northern blot hybridization and polymerase chain reaction (PCR) techniques were used to analyze the cannabinoid receptor mRNA expression. Oligonucleotide primers based on bp 1-21 and bp 824-843 were used for PCR. The Northern blot hybridization probe, which was cloned in our lab, was a full length cDNA corresponding to the rat cannabinoid receptor. PCR results indicate that the receptor is present in every age and in both brain regions studied. Northern hybridization results confirm that cannabinoid receptor mRNA is present in both CBM and FBN regions. Furthermore, its expression appears to increase in the CBM area. Our results indicate, therefore, that cannabinoid receptor mRNA is present in very young rats in the CBM and FBN regions, and its expression increases in the CBM until postnatal day 21. The observed differences in expression of receptor mRNA in the CBM may parallel cerebellar proliferation and organization. This research was supported by DA 05274 and DA 01647.

MICROFLUOROMETRIC CHARACTERIZATION OF CANNABINOID CHANGES IN INTRACELLULAR CALCIUM. Irma S. Bateman, Sandra P. Welch and Billy R. Martin, Dept. of Pharmacology and Toxicology, Med. Col. of Va./Va. Commonwealth Univ., Richmond, Va. 23298. Recent evidence implicates calcium as a transduction mechanism producing some of the pharmacological effects of cannabinoids. The purpose of this study is to test the hypothesis that cannabinoid administration modulates intracellular free calcium ($[Ca^{2+}]_i$). Primary cerebellar granule neurons were selected to study the effects of cannabinoids on $[Ca^{2+}]_i$. Cells in culture for twelve days or more were loaded with the fluorescent calcium indicator, fura-2. Shifts in fura-2 absorbance resulting from changes in $[Ca^{2+}]_i$ were analyzed with a calcium imaging system. Potassium chloride addition (5 mM to 75 mM) caused a rapid and transient increase of 160% in $[Ca^{2+}]_i$. Administration of morphine (10 μ M) blocked the potassium-induced rise in $[Ca^{2+}]_i$; morphine was used as a positive control since it inhibits calcium entry through voltage-sensitive channels. The cannabinoid CP-55,940 at a concentration of 5 μ M attenuated potassium-increased calcium levels by 75%. However, CP-55,940 (5 μ M) alone produced a gradual increase of 80%. Ethanol, the vehicle for CP-55,940, had no effect on $[Ca^{2+}]_i$ changes. In conclusion, potassium-induced changes in $[Ca^{2+}]_i$ may help elucidate the mechanisms of cannabinoid-induced calcium inhibition. (Supported by grant DA 03672)

ACTIVATION OF NATURAL KILLER CELLS MEDIATED CYTOTOXICITY THROUGH ADHESION MOLECULE CD44 AND GP90(MEL-14) CELLS. M. Bradley Lisa Gote and Mitzi Nagarkatti Dept. of Biology, Virginia Tech, Blacksburg, VA24061. Natural Killer (NK) cells play an important role in defense against cancer cells. These cells lack the T cell receptor and mediate MHC-unrestricted lysis of tumor targets. The mechanism by which NK cells mediate cytotoxicity is not well understood. In the current study, we investigate the role played by adhesion/homing molecules in mediating cytotoxicity of a variety of tumor targets. We observed that NK cells cultured with IL-2 expressed high levels of CD44 and gp-90^{mel-14}, molecules involved in lymphocyte homing and adhesion. In the presence of mAbs against CD44 and gp-90^{mel-14}, the NK cells could mediate efficient lysis of FcR + NK-resistant tumor targets. Furthermore, this cytotoxicity was not mediated by T cells because mAbs against CD3/TCR complex failed to trigger lytic activity. Also, NK cells isolated from nude mice could be activated via their adhesion molecules to mediate lysis of NK-resistant targets. Together our studies demonstrate that CD44 and gp-90^{mel-14} are involved in signalling of lytic activity by NK cells. Inasmuch as endothelial cells express ligands for either homing/adhesion molecules, our data suggest that activated NK cells may be involved in endothelial cell damage as seen at sites of inflammation.

EVALUATION OF SERUM AND TISSUE LEVELS OF BETA-CAROTENE. ^aR.B. Brandt, ^bG.E. Kaugars, ^cS. Silverman, ^dJ.G. Lovas, ^eQ. Dao, ^fB.E. Dezzutti and ^gW.T. Riley, ^aDept. of Biochemistry, MCV/VCU, Box 614, Richmond, VA 23298-0614; ^bDept. Oral Pathology, MCV/VCU; ^cDiv. Oral Medicine, UCSF; ^dDiv. Oral Pathology, Dalhousie Univ., Canada; ^eDept. Psychiatry, MCV/VCU.

Interest in β -carotene (BC) has increased over the last ten years because of studies showing that low dietary and serum BC were associated with increased risk of certain types of cancers. In patients with oral dysphagia, serum and tissue samples were taken before supplementation and at six and nine months following 30 mg BC/day. Analysis by HPLC showed correlation ($R^2 = 0.48$) between tissue BC, serum and sex.

Tissue BC = $0.13 + 0.08$ (serum BC) + 1.21 (sex), where sex is coded as male = 0, female = 1. Other NS variables were BMI, dietary carotenoid or vitamin A, smoking, smokeless tobacco or alcohol use. Following supplementation, correlation ($R^2 = 0.65$) is found for a curvilinear equation. Tissue BC = $1.15 + 0.00006$ (serum BC²) + 3.91 (sex).

Women have higher serum and tissue levels during supplementation. Because of the ease of serum analysis, tissue sampling may be eliminated. (Supported in part by NIH DE 09523-02 and Hoffmann-LaRoch.)

THE 5-HT₄ RECEPTOR MEDIATES 5-HYDROXYTRYPTAMINE (5-HT) INDUCED CHLORIDE (Cl⁻) SECRETION IN THE HUMAN JEJUNUM *IN VITRO*. M.R. Budhoo, L. Wolfe and J.M. Kellum. Dept. of Surg., Med. Col. Virginia, Richmond, VA 23298. In the rat distal colon 5-HT-induced Cl⁻ secretion is seen as a rise in short circuit current (I_{sc}). We studied the role of 5-HT₄ receptor in inducing Cl⁻ secretion in the human jejunum. Jejunum stripped of muscle was mounted in flux chambers and short circuited. Cumulative 5-HT dose responses were measured in the presence or absence of 0.05 (n=4), and 1 μ M (n=4) ICS 205-930 (5-HT₃ and 5-HT₄ receptor antagonist with pA₂ 8 and 6.4 respectively), or 0.1 μ M of new specific 5-HT₄ antagonist SC 53606A (pA₂ 7.8). A non-cumulative method was also used for 5-HT in the presence or absence of 1 μ M ICS 205 930 (n=4). The 5-HT₄ agonist 5-Methoxytryptamine (5-MeOT), was used cumulatively in the presence or absence of 1 μ M ICS 205 930 (n=4). Changes in I_{sc} (μ A/cm²) were recorded. Data were analyzed by ANOVA, p<0.05 significant. Results: Both 5-HT (EC₅₀ 1 \pm 0.1 μ M) and 5-MeOT (EC₅₀ 2.9 \pm 1.3 μ M) produced a dose response curve. 0.05 μ M ICS 205 930 had no effect on the 5-HT concentration curve (EC₅₀ 1 μ M) but there was a significant dextral shift of 5-HT EC₅₀ (from 1.1 \pm 0.1 to 2.9 \pm 0.4 μ M) and 5-MeOT EC₅₀ (from 2.9 \pm 1.3 to 13.5 \pm 3 μ M) using 1 μ M ICS 205 930 with calculated pA₂ of 6.2 and 6.6 respectively. By the non cumulative method, a similar significant shift in 5-HT EC₅₀ (from 2.5 to 8 μ M) was observed with a calculated pA₂ of 6.3. SC 53606A shifted 5-HT response curve dextrally (EC₅₀ from 1 to 5.5 μ M) with a pA₂ of 7.7 Conclusion; The pA₂ values are consistent with the antagonists acting at a 5-HT₄ receptor. 5-HT is acting via 5-HT₄ receptor pathway to induce ΔI_{sc} reflecting Cl⁻ secretion.

DHEAS INDUCED ENHANCEMENT OF THE GERMINAL CENTER RESPONSES IN OLD MICE. R.E. Caffrey, ¹Z.F. Kapasi, ²S.T. Haley, ¹J.G. Tew, and A.K. Szakal. ¹ Dept. of Anatomy/Immunobiology¹ and Dept. Microbiology/Immunology,² MCV/VCU, Richmond, VA, 23225. The germinal center (GC) response is depressed in old mice. Dehydroepiandrosterone (DHEA) and its sulfate (DHEAS) had a stimulatory effect on the murine immune system. The objective of this study was to ascertain the effects of these steroids on GC development in old mice. GC development was monitored in popliteal, axillary, and brachial lymph nodes of 6-8 week and 21-mo-old horseradish peroxidase (HRP) immune C57BL/6 mice. Three hours prior to injection of HRP, mice were injected with 0.1 ml plain DMSO or 0.1 ml DMSO containing 100 μ g of DHEA(S) in the nape of the neck. At six days after HRP injection, serial vibratome sections were processed for peroxidase positive FDC-reticulum by DAB development and the peanut agglutinin (PNA) positive GC by PNA-HRP conjugate staining. Analysis showed the following: 1) DHEAS treated old mice had significantly greater numbers of GC than old control or DHEA treated mice. 2) Mean GC compartment size was significantly larger in DHEAS treated old mice as compared to control and DHEA treated groups. 3) Mean size of each GC was significantly larger in the DHEAS treated old mice than in the control or DHEA treated mice. 4) GC compartment size in the old DHEAS treated group approached that for young controls. These observations support our hypothesis that the depressed GC response of old mice can be partially restored by DHEAS. (Supported by: AG 05374, AI 17142.)

SPECTROPHOTOMETRIC DATA BASE OF HUMAN ENTERIC PATHOGENS (Salmonella, Listeria, Campylobacter, etc) ALLOWING IMMEDIATE DETECTION AND IDENTIFICATION OF SPECIFIC BACTERIA IN FOOD PRODUCTS. Cermile Colmano, Helen Sutton, John Melia, K Lee, VPI&SU, VMRCVM, Dept Biomed Scis, Blacksburg VA 24060-0442, & BioSpectra Co, 609 Broce Dr NW, Blacksburg VA, 24060-2801. Spectrophotometric scans of protein chromophores in rinses of surface contaminants of food products, can describe the distribution of specific amino acids used by contaminant bacteria. From data bases on presence/absence of specific bacteria (and their combination with other mixed bacteria), we are trying to detect and identify the major human enteric pathogens. So far we characterized differences between Salmonellae (typhimurium, enteritidis, Arizona), and Listeriae (monocytogenes, innocua). We are now ready to compile information on Campylobacter jejuni mixed with non pathogenic bacteria. Examples illustrate relevant differences from pathogenic and non pathogenic strains, and our main technical approach, which, escluding proprietary parts, we consider innovative and worthy of presentation. The Listeria project was partially funded by a USDA grant.

PHARMACOLOGICAL AND BIOCHEMICAL COMPARISON OF TWO NICOTINIC ANTAGONISTS. Mohamad I. Damaj, S.P. Welch, G.S. Patrick & B.R. Martin. Dept. of Pharmacology, Virginia Commonwealth Univ./Medical Coll. of VA, Richmond, VA 23298.

Mecamylamine (MECA) and dihydro- β -erythroidine (DBE), potent nicotinic antagonists with no apparent structural similarities, could be acting on different sites to modulate central nicotine receptors. This study examined the in vivo interaction (using antinociception as a model) of MECA and DBE with calcium and voltage-gated calcium channels. Male ICR mice received MECA or DBE (0.06 μ mol)/mouse intrathecally (i.t.) 5 min before treatment with one of the following drugs given i.t. : calcium, (\pm)-BAYK8644, thapsigargin or A23187. The antinociceptive effect was measured by the tail-flick method. Free intracellular calcium [Ca^{2+}]_i measurements were performed in spinal synaptosomes by spectrofluorescence using fura-2 as an indicator. Pretreatment with MECA completely blocked the antinociceptive response of calcium, (\pm)-BAYK8644 and thapsigargin, while the A23187 effect was reduced to 50% MPE. DBE did not significantly reduce the antinociceptive effect of any agent tested. Furthermore, nicotine (10 μ M) induced a rise in [Ca^{2+}]_i in spinal synaptosomes (41% increase in basal) was not reduced by 10 or 100 μ M of MECA. These findings suggest that MECA modulates a calcium signaling process secondary to nicotine receptor activation, while DBE may interact directly with nicotine receptors. (Supported by PHS grant #DA-05274 and DA-06031).

ENDOGENOUS OPIOIDS RELEASED BY SUSPENDING MICE BY THE TAIL SELECTIVELY POTENTIATE SPINAL MU OPIOID ANALGESIA. D. S. Dombrowski, D. A. Brase, F. L. Smith, and W. L. Dewey. Dept. of Pharmacology, Medical Col. of Virginia, Richmond, VA 23298.

Suspending ICR mice by the tail for 1, 5, or 20 sec, 10 min prior to the tail-flick test potentiated the analgesic response to an intrathecally (i.t.) administered μ (μ) opioid agonist, D-Ala², N-methyl-Phe⁴, Gly⁵-ol]-enkephalin (DAMGO) by 5.3, 7.4 and 23.6-fold compared with mice maintained in a level posture. Rostral flow of [³H]-DAMGO (25 ng, i.t., -30 min) to the brain, its distribution along the neuraxis and its systemic absorption did not change. However, the intracerebroventricular (i.c.v.) administration of β -endorphin-(1-27), an ϵ (ϵ) opioid antagonist, abolished the potentiation of i.t. DAMGO without affecting its basal analgesic potency. Pretreatment with the δ (δ) opioid antagonist naltrindole (2.5 μ g, i.t., -30 min) also blocked this potentiation without significantly affecting DAMGO's basal potency. A 20-sec suspension failed to potentiate i.t. δ and κ (κ) agonists, but did potentiate i.t. morphine. I.t. DAMGO was more potent in C57BL/6J and DBA/2J mouse strains than in C3H/HeJ and ICR mice, but was potentiated by a 20-sec suspension in all strains tested. Thus, suspending mice by the tail evoked a reflex potentiation of spinal μ agonist-induced analgesia, which likely involved both the supraspinal release of β -endorphin (an endogenous ϵ agonist) and subsequent spinal release of an endogenous δ -receptor agonist. [Supported by PHS grant #DA-01647.]

REACTIONS OF ORGANOSILANES WITH SELF-ASSEMBLED MONOLAYER SURFACES

Ashok R. Dongré, Árpád Somogyi, and Vicki H. Wycsocki, Dept. of Chemistry, Va. Commonwealth University, Richmond, Va. 23284-2006. Several ion-surface reactions have recently been observed between small organic ions (such as benzene and pyrazine) and self-assembled monolayer surfaces. Here we describe ion-surface reactions of self-assembled monolayer surfaces with selected silicon-containing ions, e.g., $(\text{CH}_3)_3\text{SiCl}^+$, $[\text{M}-\text{CH}_3]^+$, and $[\text{M}-\text{Cl}]^+$. These reactions should be enhanced, given the preferred (exothermic) formation of the Si-F and Si-O bonds. Silicon-containing ions react with the fluorinated alkanethiolate monolayer. An intense peak is observed at m/z 47 which corresponds to SiF^+ ; the intensity of this ion increases with increasing collision energy. Other ions at m/z 82 (ClSiF^+), m/z 62 (CH_3SiF^+), and m/z 97 ($\text{CH}_3\text{ClSiF}^+$) also indicate ion-surface reactions. Reactions with the 1-hydroxyundecanethiolate surface were also observed, while alkanethiolate surfaces proved to be relatively unreactive. Another interesting aspect of the ion-surface collision spectra is a fragment ion peak at m/z 78 which is, in contrast, of extremely low intensity in the mass spectrum. *Ab initio* calculations support the preferred loss of CH_3 from the molecular ion, and the formation of several reaction products.

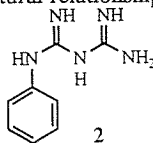
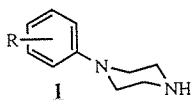
SYNTHESIZING THE CDNA OF A 14 KDA TYPE II PLA2 SECRETORY ENZYME

FROM PLACENTA TISSUE FOR USE IN A EUKARYOTIC EXPRESSION SYSTEM
Glenn Dorsam and Richard Franson, Department of Biochemistry and Molecular Biophysics, Box 614, Virginia Commonwealth University, Richmond, Virginia 23220.

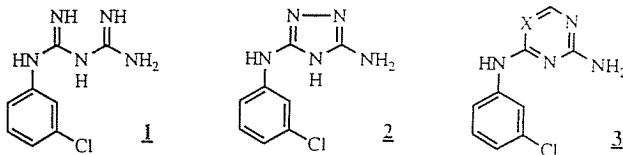
Phospholipases (PLA2) encompass a variety of enzymes which catalyze the hydrolysis of the sn-2 fatty acyl ester bond of phosphoglycerides. These enzymes are in low concentration in nearly every tissue type and are associated with the pathogenesis of inflammatory and stress-related diseases. A 14 KDa Type II PLA2 secretory enzyme is part of this phospholipase family. Our objective was to create a eukaryotic expression system to examine regulation of synthesis and mode of secretion of this 14 KDa enzyme. Total RNA/mRNA was isolated from placenta tissue and treated with reverse transcriptase and random hexamer primers to synthesize all possible first strand cDNA. Taq DNA polymerase and PLA2 sequence specific primers were then used to synthesize second strand cDNA and subsequent amplification of both strands. Trouble shooting strategies for the above protocols will also be discussed.

NOVEL ARYLPIPERAZINES AND ARYLBIGUANIDES AS POTENTIAL 5HT₃

LIGANDS. M. Dukat,^{*} R.B. Westkaemper,^{*} M. Teitler,[†] R.A. Glennon, Department of Medicinal Chemistry, MCV/VCU, Richmond, VA 23298-0540. [†]Albany Medical College, Albany, NY. We have previously examined the structure-affinity relationships (SAFIR) for the binding of arylpiperazines **1** at 5-HT₃ receptors. Due to the structural similarity between the higher affinity, but less selective, arylpiperazines and the more selective but lower affinity metoclopramide ($K_i = 1,000$ nM) and phenylbiguanide (**2**; $K_i = 1,200$ nM), we re-examined arylpiperazine SAFIR and attempted to extrapolate these results to phenylbiguanide in order to develop agents with greater 5-HT₃ affinity and selectivity. Structural features important for the binding of arylpiperazines and arylbiguanides were identified and new SAFIR were formulated. Molecular modeling studies were also conducted in order to examine structural relationships between these two classes of compounds.



SYNTHESIS AND EVALUATION OF CYCLIC ARYLBIGUANIDES AS POTENTIAL 5-HT₃ LIGANDS. A. Abd El-Rahman,^{*} M. Dukat,[‡] M. Teitler,[†] O.A. El-Sayed^{*} and R.A. Glennon, Dept. of Medicinal Chemistry, MCV/VCU, Richmond, VA 23298-0540;[†] Albany Medical College, Albany, N.Y. mCPBG (**1**) has been identified by our, and other, laboratories as a 5-HT₃-selective serotonin ligand (K_i = 17 nM). Due to its structural flexibility, conformationally restricted analogs of **1** can provide us with information regarding receptor-relevant conformations and may also result in more potent agents.



The finding that **2** and **3** (X = N) are inactive (K_i > 10,000 nM) suggests that either their conformations are inappropriate or that an imino NH may be important for binding. The former explanation seems more likely in view of the modest affinity (K_i = 1500 nM) of **3** where X = CH.

REACTIONS OF IMMONIUM IONS WITH SELF-ASSEMBLED MONOLAYER FILMS.

Rebecca L. Franklin, Árpád Somogyi, and Vicki H. Wysocki, Dept. of Chemistry, Va. Commonwealth Univ., Richmond, Va. 23284. Recently, self-assembled monolayer (SAM) films of alkanethiolates on gold were shown^{1,2} to be effective surfaces for the study of ion-surface interactions.³ Here we compare the ion-surface collision products formed by collision of selected even-electron immonium ions (e.g. CH₂=NH₂⁺), and their methylated, deuterated, and cyclic analogues, with fluorinated and alkanethiolate films.

Spectra of the immonium ions studied exhibit chemical sputtering, surface-induced dissociation (SID), and ion-surface reactions as a function of laboratory collision energy and surface film type. SID of CH₂=NH₂⁺ leads to CH₂⁺ and NH₂⁺ with some NH₄⁺ produced. Chemical reactions of the immonium ions investigated include addition of fluorine or CH₃, followed by H and H₂ losses to produce even-electron products (e.g., HCNF⁺ of FCNH⁺).

1. B.E. Winger, R.K. Julian, R.G. Cooks *J. Am. Chem. Soc.* **1991**, *113*, 8967-8969.
2. V.H. Wysocki, J.L. Jones, J.M. Ding *J. Am. Chem. Soc.* **1991**, *113*, 8969-8970.
3. For a review of SID, see: R.G. Cooks, T. Ast, Md.A. Mabud *Int. J. Mass Spectrom. Ion Proc.* **1990**, *100*, 209-265.

REAL-TIME VENTRICULAR FIBRILLATION WAVEFORM ANALYSIS FOR DEFIBRILLATION CONTROL. Sylvia Frerk, Bob Wise*, Peng-Wie Hsia*, Neri Cohen*, Ralph Damiano*, Dept. of Biomed. Eng. and Surgery, Medical College Virginia, Richmond, VA 23298. Previous studies have suggested that the random variations in the underlying ventricular fibrillation (VF) are responsible for the probabilistic nature of defibrillation and that the heart is more vulnerable to defibrillation at a higher absolute VF voltage (AVFV). This study investigated in a canine model if a real-time processing system that analyzes the VF waveform from lead II of the Electrocardiogram, instantaneously determines the optimum time to shock according to the analysis and immediately delivers a fixed energy DC shock could increase the defibrillation success. Programs for the VF waveform analysis were implemented in assembly language to compare the performance of the widely used conventional method of shocking at a fixed time to shocking at a global peak of the waveform when the overall VF voltage was high. The integration of the AVFV waveform was computed over a sample size of 16 msec and 256 msec with a technique called moving average smooth. Once the 16 msec average exceeds 120% of the 256 msec average, the peak area is detected and a shock is delivered at the next upcoming peak. The results of a 2 experiment animal study showed a success rate of 42% for the 19 trials performed with the conventional method and 92.85% for the 14 trials performed with the new method. The mean delivered energy was basically the same (7.68 ± 0.12 vs 7.71 ± 0.09 joules). The data proves that the hardware/software design satisfies the requirements for processing the waveform in real-time. The use of a waveform analysis has potential implications towards improving the defibrillation technique in implantable devices. (Supported in part by A Grant-In-Aid #2-94340, American Heart Association, VA Affiliate)

ISOLATION AND CHARACTERIZATION OF THE GENE ENCODING THE RAT ALPHA_{1B}-ADRENERGIC RECEPTOR. Bin Gao^{*} and George Kunos^{*}, Department of Pharmacology and Toxicology, Virginia Commonwealth University, Richmond, VA 23298.

Using a rat α_{1B} -adrenergic receptor (AR) cDNA probe, we isolated two genomic clones from a rat liver genomic DNA library. Southern blot analysis and nucleotide sequencing indicate that the rat α_{1B} -AR gene has two exons and a single large intron of at least 16 kb. Analysis of the sequence of the 5'-flanking region suggests that this gene has the features of a housekeeping gene: it has neither a TATA box nor a CAAT box, but has multiple transcription start points, multiple Sp1 binding sites, and a high G+C content. The 5'-flanking region also contains consensus sequences for AP1- and AP2-binding sites and putative cyclic AMP, glucocorticoid, and thyroid responsive elements. The 3'-flanking region contains a putative polyadenylation signal (ATTTAA) 492 bp downstream from the stop codon. A comparison of the rat α_{1B} -AR sequence with that of the recently cloned human α_{1B} -AR gene showed that the overall structure of this gene is highly conserved, with some notable differences in the 5'-flanking region. Different fragments of the 5'-flanking region were used to generate CAT constructs for studying the molecular mechanisms involved in the regulation of α_{1B} -AR gene expression by thyroid and glucocorticoid hormones.

ACTIVATION OF T CELLS VIA HOMING RECEPTORS INDUCES INTERLEUKIN-2 GENE EXPRESSION AND CELL PROLIFERATION L. Goté, M. Hassuneh, and M. Nagarkatti. Dept. of Biology, Virginia Tech, Blacksburg, VA 24061. T lymphocytes can be activated by mitogens, antigen and MHC, or by mAbs against CD3/TCR complex to produce IL-2 and divide. Recent studies have shown that activation through certain adhesion molecules can also lead to T cell activation. In the current study, we investigated whether activation of naive T cells via CD44 and gp90^{MEL-14}, molecules involved in lymphocyte adhesion and homing, would lead to activation of T cells. When naive T cells from C57BL/6 mice were incubated with anti-CD44 or anti- gp90^{MEL-14} mAbs, the T cells were found to transcribe and translate the IL-2 gene leading to DNA synthesis and cell proliferation. The T cells, in contrast, failed to produce IL-4. These studies therefore suggested that CD44 and gp90^{MEL-14} can act as signaling molecules involved in T cell activation. Inasmuch as the ligands for CD44 and gp90^{MEL-14} are expressed by endothelial cells, our data suggest that interaction between endothelial cells and T cells may lead to regulation of T cell functions at sites of inflammation.

CHARACTERIZATION OF ABNORMAL DOUBLE-NEGATIVE T CELLS FROM AUTOIMMUNE MRL-LPR/LPR MICE AS CYTOTOXIC T LYMPHOCYTES. Denise M. Hammond and Prakash Nagarkatti, Dept. of Biology, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. The lymphoproliferative mutation designated *lpr* induces in mice, accumulation of large numbers of CD4⁺CD8⁻ (double-negative, DN) T lymphocytes which bear adhesion molecules not characteristic of normal resting T cells. These cells fail to acquire IL-2 receptors, produce IL-2 and proliferate when activated with mitogens or mAbs against the T cell receptor (TCR). Due to these poor functions *in vitro*, they have been compared to anergic T cells whose nature and significance in the autoimmune disease process is not clear. In the current study, we describe a surprising finding that mAbs against CD3 or $\alpha\beta$ TCR complex can strongly trigger the lytic activity of the DN T cells to induce redirected lysis of Fc-receptor (Fc γ R)-positive targets. Similar redirected lysis was also inducible using mAbs against CD44 and gp90^{MEL-14}, molecules involved in binding of lymphocytes to endothelial cells. The spontaneous cytotoxic potential of the DN T cells was further corroborated by demonstrating that the *lpr* DN T cells constitutively transcribed perforin gene but failed to express granzyme A. Together, the current study suggests that DN T cells are activated cytotoxic T cells capable of mediating lysis of autologous cells bearing the specific ligands for adhesion molecules involved in the signaling of cytotoxicity. These findings provide a novel insight into the functional significance of DN T cells in *lpr* mice and their potential role in the pathogenesis of autoimmune disease.

ROLE OF AUTOCRINE GROWTH FACTORS IN TUMORIGENIC TRANSFORMATION OF T CELLS. M. Hassuneh and M. Nagarkatti. Dept. of Biology, Virginia Tech, Blacksburg, VA24061. The development of cancer requires the simultaneous presence of a number of molecular perturbations and autocrine growth factor production is one such factor. Recently, we have isolated several T cell clones which were found to grow independent of exogenous T cell growth factors or stimulation through the T cell receptor (TCR). The autocrine growth of these T cell clones *in vitro*, was inhibited in the presence of mAb against IL-2, IL-2R or IL-2 specific anti-sense oligonucleotides. These data suggested that the *in vitro* transformation of the T cell clones, resulted from continuous endogenous secretion of and responsiveness to IL-2. The transformed T cell clones also demonstrated mRNA for IL-2 constitutively, throughout their *in vitro* growth. These T cells 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 the transformed T cells could be inhibited by using mAb against T cell growth factors. Interestingly, mAb against IL-2 and IL-2R, completely inhibited the tumorigenicity of transformed T cells *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 stimulation and such tumors can be effectively treated by antibodies against the growth factors or their receptors.

THE ROLE OF CORTICOTROPIN-RELEASING FACTOR IN THE ACTIVITY-STRESS PARADIGM. H. Jones; K. G. Lambert; & C. H. Kinsley, Dept. of Psych., University of Richmond, Richmond, VA. 23173. Dept. of Psych., Randolph-Macon College, Ashland, VA. 23005. Corticotropin-releasing factor (CRF) has been found to inhibit gastric acid secretion. Based on past CRF and ulcer research, it was expected that CRF would mitigate ulcer development. Increased corticosteroid production resulting from CRF; however, would be expected to enhance ulceration due to its stimulation of gastric secretions and inhibition of prostaglandin production. Rats exposed to the activity-stress paradigm (A-S), characterized by housing rats in activity wheels and restricting their feeding to one hour a day, develop ulcers resembling those of the human peptic ulcer. The present study investigated the influence of CRF on gastric ulceration and other physiological and behavioral indices of stress on rats exposed to the activity stress paradigm. Cannulas were implanted into the left ventricle of sixteen male rats. The cannulas were connected to osmotic pumps, inserted under the neck, and administered 1 µg of CRF or saline solution per day. Following a four day recovery period, the A-S paradigm commenced. Results revealed no significant differences between the CRF and control groups on the percentage of corpus ulcerated or any of the dependent measures. Additional investigations with various doses of CRF might elucidate how the stress response increases an animal's susceptibility to gastric ulceration.

OPIATE MODULATION OF SEX DIFFERENCES IN ULTRASONIC VOCALIZATIONS IN RATS EXPOSED TO STRESS, IN UTERO. H. Jones; E. Mitchell; R. Rowe & C.H. Kinsley, Dept. of Psych., University of Richmond, Richmond VA. 23173. Prenatal stress (PS) disrupts sexual differentiation and opioid regulation in rats. Recently, we have found differences in the numbers of ultrasonic vocalizations (UV) emitted by PS and control rat pups. The present study investigated the role of opiates in the ultrasonic vocalization (UV) response of prenatally stressed (PS) pups. Timed-mated female rats were exposed to light and restraint stress for 30 minutes three times a day from days 14-21 of pregnancy. Morphine (5.0 mg/kg), naloxone (0.5 mg/kg) or saline (0.25 cc) injections were administered on day one of life to the offspring and they were returned to the nest. After five minutes, pups were removed from the nest and UV's were recorded for five minutes. Results replicated previous findings that the number of vocalizations produced by PS males were similar to control females whereas the number of UV's emitted by PS females resembled those of control males. Further, an interaction between sex and injection was found. Both males and females vocalized more in response to opiate antagonists and decreased vocalizations in response to morphine. Overall, PS animals vocalized less in response to naloxone relative to control animals. Our data suggest that PS disrupts UVs through opioid modification.

FRAGMENTATION OF PROTONATED PEPTIDES: AGREEMENT BETWEEN SURFACE-INDUCED DISSOCIATION SPECTRA AND QUANTUM CHEMICAL PREDICTIONS

Jennifer L. Jones, Ashok R. Dongré, Árpád Somogyi and Vicki H. Wysocki, Dept. of Chemistry, Va. Commonwealth University, Richmond, Va. 23284-2006. It is known that the average internal energy deposited by ion-surface collisions can be varied by changing the kinetic energy of the projectile ion and that this energy is deposited in a relatively narrow internal energy distribution. We employ surface-induced dissociation (SID) to activate protonated peptides formed by liquid secondary-ion mass spectrometry (LSIMS) and electrospray (ESI). The goal of our experiments is to combine these different ionization methods with SID to investigate the energy dependence of peptide fragmentation and to predict the population of different protonated forms (of the same peptide) that fragment under given conditions. Peptides investigated include leucine enkephalin, angiotensin III, bradykinin, and GYLTYKYKASA. The average internal energy of protonated peptides produced by ESI is clearly lower than that associated with LSIMS. MNDO bond orders were calculated for model peptides protonated at various sites and are consistent with many of the main features of the SID spectra and of keV and eV CAD spectra from the literature.

A SYSTEMATIC STUDY OF SURFACE CHARACTERISTICS ASSOCIATED WITH ENHANCEMENT OF BOTH SURFACE-DISSOCIATION (SID) EFFICIENCY AND ENERGY DEPOSITION.

Thomas E. Kane, Árpád Somogyi, and Vicki H. Wysocki, Dept. of Chemistry, Virginia Commonwealth University, Richmond, VA 23284. Ion projectiles are employed to characterize self-assembled monolayer surfaces. Monolayers used include n-alkanethiolates 4 to 18 carbons in length, perdeuterioeicosanethiolate, and 2-(perfluorooctyl)-ethanethiolate. When an ion collides with a monolayer-gold surface, it may (i) transfer a portion of its translational energy to internal energy, resulting in fragmentation (SID), (ii) neutralize, (iii) exchange its charge with material native to the surface and induce fragmentation of the monolayer (chemical sputtering) and (iv) react with material from the surface. Singly and doubly charged atomic ions from groups I, VII and VIII, as well as benzene, acetone and dimethylsulfoxide are used as projectiles. Surface efficiency is determined from the relative ion signal intensities for each monolayer type, as well as from currents measured at the surfaces (small currents are present at the surface as a result of the projectile ion neutralization). The degree to which atomic ions neutralize and/or chemically sputter correlates to their recombination energy, the ionization energy of the monolayer, and the amount of organic contaminants physisorbed onto the monolayer surface (hydrocarbon material from pump oil). The molecular probes react with both the monolayer films and the hydrocarbon adsorbates, which can provide information on the degree of surface order.

A HARDWARE/SOFTWARE INTERFACE TO ALLOW CONTINUOUS CARDIAC MONITORING DURING DEFIBRILLATION.

David H. Keeler, Peng-Wie Hsia*, Bob Wise*, Ralph Damiano*, Dept. of Biomed Eng. and Surgery, Medical College of Virginia, Richmond, VA 23298. Current research conducted at MCV in the areas of ventricular fibrillation (VF) and defibrillation utilizes heart mapping techniques to record activation fronts in myocardium. Investigations are conducted on canine models by inducing VF followed by defibrillation. A commercial, digital heart mapping system is used to simultaneously record activation fronts at multiple sites before, during and after defibrillation. The heart mapping system input stage is protected from the defibrillation shock but the input stage's amplifiers become saturated. Saturation of the amplifiers makes it impossible to record activation fronts for as long as five seconds after the termination of the defibrillation shock. Investigators required the ability to record data immediately following termination of the shock. An external interface was designed to attenuate (1000:1) the 128 incoming signals during defibrillation. Design criteria considered included switching devices, speed, power dissipation, timing, isolation, etc.. The interface provides attenuation for variable lengths of time that correspond to the duration of the defibrillation shock. Devices tested for use in switching the attenuation network in-line and out included latching relays and optocouplers. Optocouplers were chosen for the final design with rise and fall times of 5.4 ± 0.058 and 3.56 ± 0.076 microseconds respectively. Power dissipation was 11.47mW. Clinical testing of the interface will include verification of single-channel operation on a rabbit model. This device will aid investigators studying the mechanisms of VF and defibrillation by allowing recording of activation front development immediately following defibrillation. (Supported in part by A Grant-In-Aid #2-94340, American Heart Association, VA Affiliate)

IDENTIFICATION AND CHARACTERIZATION OF DISTINCT RECEPTORS AND SIGNALLING PATHWAYS FOR NEUROPEPTIDE Y (NPY) AND RELATED PEPTIDES IN SMOOTH MUSCLE CELLS ISOLATED FROM THE GASTROINTESTINAL TRACT. S. Misra*, K.S. Murthy* and J.R. Grider*. Department of Physiology, Medical College of Virginia, Richmond, VA 23298

The effects of neuropeptide Y and related peptides were studied in isolated muscle cells from rabbit stomach. NPY, NPY(13-36), PYY (peptide YY) and PP (pancreatic polypeptide) caused concentration dependent contraction. Contraction was accompanied by increase in inositol trisphosphate (InsP₃) and cytosolic calcium, [Ca²⁺]_i. Contraction was abolished following depletion of intracellular Ca²⁺ stores with thapsigargin but was not affected by Ca²⁺ channel blockers or removal of extracellular Ca²⁺. All four peptides inhibited both basal and forskolin-stimulated cAMP levels. The substituted analog, [Leu³¹, Pro³⁴]NPY, which did not elicit contraction or increase in InsP₃ and [Ca²⁺]_i, also inhibited basal and forskolin-stimulated cAMP. Selective receptor protection using PYY or NPY(13-36) as protective agent preserved the contractile response to NPY, PYY and NPY(13-36) but not PP. Protection with PP preserved the response to PP only. The evidence indicates that NPY and PYY interact with the same receptor coupled to InsP₃-dependent Ca²⁺ release and inhibition of cAMP. PP interacts with a different receptor coupled to the same signaling pathways. [Leu³¹, Pro³⁴]NPY interacts with only one receptor coupled to inhibition of cAMP.

ATTENUATION OF PRENATAL STRESS (PS)-INDUCED MODIFICATIONS OF ULTRASONIC VOCALIZATIONS (UV'S) WITH CONCURRENT IN-UTERO EXPOSURE TO TESTOSTERONE (T). E. Mitchell*, C. Hancock*, N. Turner*, B.

Holt*, N. Covino*, & C. Kinsley, Dept. of Psych., Univ. of Richmond, Va. 23173. Prenatal stress disrupts sexual differentiation by modifying prenatal T levels. In general, males are demasculinized and feminized. Recently, we have examined PS effects on UV's. These sounds are emitted by neonates and elicit maternal behavior. Alteration in the number or quality of UV's could change the mother's responsiveness. Sex differences exist in UV's, and we have demonstrated that PS affects UV's. Both implicate prenatal T in their effects. We examined whether supplemental T administered to stressed fetuses could reverse the PS-induced disruption of UV's. Timed-mated females were implanted with either a blank or T-filled Silastic capsule on day 13 or day 18 of pregnancy. Stress (thrice-daily exposure to heat and restraint) began 24 hours after implantation and continued until the birth of the pups. Twenty-four hours after birth, neonates were tested for UV production using a "bat detector." We observed that T treatment significantly counteracted or simulated the effects of PS, depending upon the length of T exposure. These data demonstrate the sensitivity of UV's to alterations of prenatal androgen levels. (Supported by University of Richmond Undergraduate Research Committee)

TOPICAL AMINOCAPROIC ACID FACILITATES RE-EPITHELIALIZATION OF PERSISTENT EPITHELIAL DEFECTS. Amy R. Moler-Booth, Mehrdad Mazaheri,* James Lang,* James Slusser,* John Dickerson,* Earl R. Crouch Jr.* and Patricia B. Williams, Dept. of Pharmacology and Ophthalmology, Eastern Virginia Medical Sch., Norfolk, VA 23501.

Following corneal abrasions, persistent epithelial defects (PED's) may develop due to failure of healing epithelium to adhere to the underlying stroma. Aminocaproic acid (ACA) inhibits activation of plasmin which metabolizes fibronectin, a glycoprotein that anchors ocular epithelium to the stroma. The goal of this study is to ascertain if ACA improves adherence of epithelium to the basement membrane complex. To induce PED's, filter paper disks saturated with 4 N NaOH were placed for 2 min on corneas of anesthetized rabbits. After 7 days, most corneas were denuded of epithelium and treatment was started with either 30% ACA or vehicle (4% carbopol). Rabbit eyes were treated topically every 8 hrs. for 5, 11, 16 or 19 days. A control group received no treatment. Fluorescein staining analysis indicated that after 19 days, only 20% of ACA treated corneas still had PED's compared with 80% of vehicle treated and 67% of untreated. Immunofluorescent staining of frozen sections qualitatively indicated that more adherent fibronectin was present. Electron and light microscopy showed more disrupted, thinner and nonadherent epithelium in control corneas compared to ACA treated. This preliminary study indicates that topical treatment with ACA promotes reepithelialization of PED's. Supported in part by the Lions Eye Bank and Research Center of Eastern Virginia.

AN ANALYSIS OF THE EFFECT OF JOINT CURVATURE AND TISSUE THICKNESS ON THE MECHANICAL BEHAVIOR OF ARTICULAR CARTILAGE. N. Mukherjee and J.S. Wayne*, Ph.D., Va. Commonwealth Univ., Richmond, Va 23298-0694. The highly hydrated, viscoelastic nature of articular cartilage (A.C.) enables it to aid in lubrication and load distribution in diarthrodial joints. The u-p finite element method models the A.C. as consisting of two phases - a solid phase of collagen fibrils and proteoglycan aggregates and a fluid phase of interstitial water. It uses solid displacement (u) and fluid pressure (p) as the nodal parameters. This study investigates the effect of joint curvature and tissue thickness on the mechanical response of A.C. to indentation loading where a permeable indenter of radius 1mm is suddenly pressed onto the cartilage surface (The A.C. is still attached to the subchondral bone.) with a pressure of 0.06 MPa and the ensuing creep is studied. Analysis was performed for different radii of curvature -- 5mm, 15mm and an infinite plane and various tissue thicknesses -- 0.8mm, 1.2mm, 1.5mm. We used a mesh consisting of 338 axially symmetric elements and 382 nodes. The analysis showed that the tissue deforms uniformly under the indenter. The curved surfaces deformed more axially, probably because of greater scope for radial deformation in curved surfaces. The fluid pressure gradients and hence fluid velocities under the indenter were higher in thicker tissues but the deformation per unit tissue thickness was less in thicker tissues. Further study is required to assess if these differences substantially affect the mechanical properties determined for the A.C.- such as aggregate modulus, poisson's ratio and permeability -- when creep data from an experiment is curve fit with the u-p model (modified to incorporate a non-linear curve fitting routine) using the curved or flat surface geometries.

CHEMOTHERAPEUTIC EFFICACY OF ANTI-CANCER DRUGS DEPENDENT ON THEIR IMMUNOMODULATORY PROPERTIES. Eileen Murray and Mitzi Nagarkatti*. Dept. Biology, Virginia Tech. Blacksburg, VA 24061. Treatment of LSA tumor-bearing mice with nitrosoureas such as BCNU, can lead to 90-100% cures. However, BCNU was not effective in LSA-bearing nude or irradiated mice. These data suggest that BCNU was able to induce cures through immunomodulatory properties. In the current study we investigated the tumoricidal and immunomodulatory properties of 5-Fluorouracil (5-FU) and compared them to the capacity of 5-FU to induce cures in tumor-bearing mice. Administration of 5, 10, 50, 100 or 200mg 5-FU/kg body weight failed to induce cures, despite mediating significant tumoricidal activity. Furthermore, 5-FU failed to mediate immunosuppression. Thus, the current studies suggest that 5-FU despite having tumoricidal activity comparable to that of BCNU fails to induce cures, possibly, because 5-FU has no significant immunomodulatory activity to deplete T suppressor cells, a process critical for the host's immunity to destroy tumor cells spared from the tumoricidal actions of anti-cancer drugs.

DISTRIBUTION AND PROPERTIES OF MULTISENSORY NEURONS IN RAT CEREBRAL CORTEX. R. Ramachandran^{1*}, M.T. Wallace^{2*}, and B.E. Stein^{2*}. Departments of Biomedical Engineering¹ and Physiology². Medical College of Virginia, Virginia Commonwealth University, Richmond, VA, 23298

A grid of microelectrode penetrations (n=81) was made across occipital, temporal, and parietal cortices in 26 rats. A total of 843 neurons was recorded, and although the conventional functional division of these cortical areas into visual, auditory and somatosensory domains was apparent, multisensory neurons (n=93) were encountered within each of them. The incidence of multisensory neurons was higher near the borders between 'unimodal' regions, with the multisensory convergence patterns matching the modalities represented in the adjoining areas. Regardless of a neuron's modality convergence pattern or its location, it exhibited the capacity to integrate information from the different sensory modalities. Thus, stimuli that originated from similar points in sensory space resulted in response enhancements, whereas spatially disparate stimuli either failed to produce an interaction or resulted in response depression. These multisensory interactions were multiplicative and could take place within a wide (up to 400 msec) temporal window. These spatial, temporal, and multiplicative principles governing multisensory interactions appear to be similar to those governing multisensory interactions in other species and other structures. Thus, it appears that many of the principles of multisensory integration supersede structure and species. Supported by NIH grant NS 22543.

IMMUNOTOXICITY OF TCDD. Mark Rhile and Prakash Nagarkatti, Dept. of Biol., Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061.

2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) is an environmental contaminant which has been previously shown to have strong immunomodulatory properties. While the immunotoxicity of TCDD has been widely studied, the mechanism of toxicity remains unclear. In the current study, we therefore addressed the mechanism of immunotoxicity mediated by TCDD. Adult C57BL/6 mice were administered 0, 0.1, 1.0, or 5.0 $\mu\text{g}/\text{kg}$ body weight of TCDD for 11 days and thymocytes were stained to examine T cell subpopulations. We observed no change in the percentages of CD4+, CD8+, CD4+CD8+, or CD4-CD8- T cell subpopulations. However, there was a dose-dependent decrease in total cellularity in TCDD-treated thymocytes. Also, when mice were injected with 0, 0.01, 0.1, or 1.0 $\mu\text{g}/\text{kg}$ body weight for 7 days or given an acute dose of 0, 5, 10 or 50 $\mu\text{g}/\text{kg}$ TCDD, and their T cells were analyzed for DNA synthesis following activation through the TCR, we did not observe any decrease in T cell activation in TCDD treated mice. To address whether TCDD would act on activated but not naive T cells, lymph nodes from mice treated with 0, 0.1, 1.0, or 5.0 $\mu\text{g}/\text{kg}$ TCDD for 11 days and immunized with conalbumin were stimulated with T and B cell mitogens *in vitro*. Such cells showed no decrease in response to mitogen stimulation. However, the same lymph node cells exhibited a significant decrease in response to secondary stimulation with conalbumin *in vitro*. These data suggest that TCDD may affect cells that are differentiating and dividing but not naive cells.

A QUANTITATIVE HISTOLOGICAL ASSESSMENT OF MALE REPRODUCTIVE DEVELOPMENT IN SWISS-WEBSTER MICE. John Rittenhouse, Mark Grimaldi, Peter Good and Roman Miller, Dept. of Biology, Eastern Mennonite College, Harrisonburg, VA 22801.

Testes and caput/corpus epididymides were harvested from Swiss-Webster mice aged 20, 30, 40, 50, 60, 90, and 120 days postnatally. Tissues were fixed in Bouin's solution, embedded in paraffin, and sectioned at 8 μm . In the seminiferous tubules, luminal spermatozoa, first evident at day 30, peaked at day 50 and decreased steadily through day 120. Over the course of the experiment, total lumen percentage increased by 225% and tubule wall percentage decreased by 85%. The extra tubular tissue increased 168% from days 20 to 60 but decreased by day 120 to 99% of its percent composition at day 20. Also, a steady increase in tubule diameter paralleled an increase in tubule wall thickness over days 20 to 120. In the epididymis, tubule diameter increased 62% and tubule wall width increased 50% from days 20 to 40. Epididymal sperm, first evident at day 40, reached a maximal level at day 60 and decreased to 70% of the maximum by day 120. The percent composition of tubular wall tissue declined from 73% at day 20 to 60% at day 40, where it stabilized. Lumen percent composition peaked at 34% on day 60 while the extra tubular tissue percent composition remained relatively constant at 25% throughout development. Based on histological data, the onset of puberty occurs about day 30 with early maturation by day 50 or 60.

EXPOSURE TO STRESS IN UTERO ALTERS ULTRASONIC VOCALIZATIONS IN NEONATAL RATS. R. Rowe, H. Jones, E. Mitchell, & C.H. Kinsley, Dept. of Psych., Univ. of Richmond, Richmond, Va. 23173. Prenatal stress (PS) is a very potent disruptor of sexual differentiation. Effects ranging from alterations of sexual behavior to modifications in immune function have been reported. The causes of such a myriad of effects have been linked--convincingly--to perturbations in prenatal hormone profiles. Little work, however, has examined postnatal maternal interactions and their potential for shaping these many effects. In particular, the ultrasonic vocalizations (UVs) made by the pups alert the dam to the pups' condition. If such UV signals are qualitatively or quantitatively altered, maternal care may be modified--thereby resulting in decreased maternal attention and ultimately, severe alterations of adult behaviors in the pups. To address these questions, we timed-mated adult female rats and, on gestation days 14-21, exposed them to thrice-daily 30-min sessions of heat, light, and restraint stress. On the first day of life, pups were removed from their mother and tested for the number of UVs over a 5-min period. Control males (n=21) made significantly more UVs than did PS males (n=28), but control females (n=20) produced significantly fewer UVs than PS females (n=45). More interestingly, the number of UVs produced by PS males did not differ significantly from the number made by female controls, suggesting that prenatal stress has a demasculinizing effect on the behavior of males whereas the number of UVs in PS females also did not differ significantly from those produced by control males, suggesting that prenatal stress has a virilizing effect on the behavior of females.

SURFACE-INDUCED DISSOCIATION (SID) SPECTRA OF KETONES

Árpád Somogyi, Thomas E. Kane, Vicki H. Wysocki, Dept. of Chemistry, Virginia Commonwealth University, Richmond, VA 23284. Collisions of selected polyatomic ions with self-assembled monolayer films has been shown to induce fragmentation of the ion (SID) and to produce ion-surface reaction products.¹ In this work, ion-surface collision spectra of simple ketones, RCOR' (R and R'=CH₃ and/or CD₃, C₆H₅), are reported.

The addition of H and CH₃ (D and CD₃ addition with a perdeutero-eicosanethiolate monolayer) to the molecular ions has been observed with an octadecanethiolate surface. The H-addition observed with the deutero and a 2-(perfluorooctyl)-ethanethiolate surface shows the presence of trace physisorbed contaminations (presumably hydrocarbons from the pump oil) on the surfaces. Extensive fragmentation of the acetone molecular ion even at low collision energies (7-10 eV) supports the formation of a percentage of ions in their electronically excited state.²

¹(a) M. Morris, D.E. Riederer, Jr., B.E. Winger, T. Ast, R.G. Cooks, C.E.D. Chidsey, *Int. J. Mass Spectrom. Ion Processes*, **1992**, 122, 81. (b) Á. Somogyi, T.E. Kane, J.-M. Ding, V.H. Wysocki, *J. Am. Chem. Soc.*, in press. ²A.K. Shukla, K. Qian, S. Anderson, J.H. Futrell *J. Am. Soc. Mass Spectrom.* **1989**, 1, 6.

A GOLLIMBP GENE PROMOTER: EVIDENCE OF NUCLEAR PROTEIN BINDING.

Weikle, AA and Newman, SL* Medical College of Virginia, VCU, Richmond, Virginia 23298. The myelin basic protein (MBP) gene is now known to be encompassed by a much larger gene that encodes a number of MBP and MBP-related peptides. This Gene of the OLigodendrocyte Lineage (GOLLImbp gene) uses at least three transcription start sites for production of multiple mRNAs. We previously demonstrated by SouthWestern blot analysis that the gene region upstream of the second start site (exon 0) binds proteins with the apparent molecular weights of 40 and 56 kDa. This protein binding profile differs from that seen for the classical MBP promoter. In this report, we present gel mobility shift analyses of fragments of the putative promoter region for the transcripts initiating with exon 0. The region of the gene from -742 to -551 strongly bound nuclear proteins prepared from the brains of 18 day old mice. The same gene region that presented shifts using the 18 day old mouse brain nuclear proteins also strongly bound nuclear proteins prepared from the brains of 3, 10, and 30 day old mice. The band shift patterns for each of these stages in development were different, suggesting this region is under developmental control. We conclude that the region of the GOLLImbp gene upstream of exon 0 has protein-binding activity that may modulate transcription of mRNAs initiating at this site. (Supported by the Thomas F. Jeffress and Kate Miller Jeffress Memorial Trust grant J-193).

EFFECT OF INTRATHECAL MORPHINE ON BLOOD-GLUCOSE LEVELS IN LOW LEAD-TREATED MICE. Catherine W. White, L. Dale Dunlow, and William L. Dewey, Dept. of Pharmacology and Toxicology, Med. Col. of Va./Va. Commonwealth Univ., Richmond, VA 23298.

Low levels of i.p. lead acetate produce a change in blood-glucose levels in mice when administered in combination with i.t. morphine (10 µg/mice) as compared to saline controls. Experiments were performed on lead and morphine separately to find doses which had no effect by themselves. Lead acetate (5 µmoles/25g) was administered two days before morphine and blood-glucose levels were determined just preceding morphine administration and 60 min following morphine administration. Morphine (10 µg/mouse) produced a rise in blood-glucose levels, whereas at high doses of morphine, 40 µg/mouse, blood-glucose levels fall about 75%. Using low doses of both i.t. morphine and i.p. lead acetate the i.p. lead/i.t. morphine mice have a change in blood glucose that is significantly lower than i.p. lead/i.t. saline-treated mice. (Supported by USPHS Grant DA-01647)

Microbiology and Molecular Biology

STRUCTURAL AND MOLECULAR ANALYSIS OF AKINETE FORMATION IN THE CYANOBACTERIUM *Anabaena azollae* var. mexicana. Robert W. Fisher and Robert J. Blem. Department of Biology, Virginia Commonwealth University, Richmond, VA 23284. Cyanobacteria are important organisms for the study of prokaryotic cell development. They are one of the few organisms that can fix atmospheric nitrogen. The cyanobacterial strain *Anabaena* exists in one of three cell phases: the vegetative or reproductive phase, the heterocyst or nitrogen fixing phase, and the akinete or temporary shut down phase. Both the heterocyst and the akinete develop from vegetative cells. The vegetative cell undergoes drastic morphological and genetic changes to become a heterocyst. For example, the vegetative cell excises 55 kb and 11 kb DNA sequences to produce heterocyst DNA. Vegetative cells are expected to undergo similar morphological and genetic changes to produce akinetes. The species *Anabaena azollae* var. mexicana was utilized to compare the morphological and genetic properties of vegetative cells and akinetes. Morphological and physiological studies monitored chlorophyll concentration, septation rate, and cell size. In addition, genetic studies have been initiated. DNA was extracted from vegetative cells using the Marmur isolation technique. Gel separation was achieved using a mini-gel set and 0.8% EEO agarose. DNA was restricted with Hind III, EcoRV, and Sau3A, with best results using Sau3A. Our intention is to probe both vegetative DNA and akinete DNA cut with Sau3A using a probe (STRR I) matching a highly repeated tandem sequence in *Anabaena* sp. The probe will be labelled with biotinylated adenine. Southern Blot analysis of the labelled, restricted DNA should reveal any genetic rearrangements occurring during akinete differentiation.

HOMOLOGOUS SEQUENCE IN TWO MAIZE UBIQUITIN PROMOTERS. Jessica M. Jones and Alan H. Christensen. Department of Biology, George Mason University, Fairfax, VA 22030. The remaining sequence of the *Zea mays* (maize) ubiquitin 2 (Ubi2) gene was determined by the dideoxy chain termination method. The promoter, first exon, and 5' region of the intron were linked to previously published sequence composed of the rest of the first intron, protein coding region and the 3' untranslated regions of Ubi2. Thus, 5471 bp of sequence containing the Ubi2 transcription unit and regulatory regions have been determined. Both the Ubi1 and Ubi2 genes are expressed constitutively, and these two promoters are co-regulated in response to heat shock. By implication they may be acted upon by the same transcription factors interacting with identical or nearly identical sequences in the promoters. Comparison of the Ubi1 and Ubi2 promoter sequences shows homology in several regions occurring primarily between -350 and the transcription start sites. These include 1) a 26 bp element (AGTCTAACGGACACCAACC ACAACCA) that occurs at -297 in the Ubi1 promoter and -336 from the putative Ubi2 transcription start site, 2) a CGGCACGGCA motif that is repeated with slight variations three times in the Ubi1 promoter and twice in the Ubi2 promoter, and 3) the canonical "TATA" box (TAAATA) at -28. Thus, the identification of common sequence modules that may act as protein binding sites in the upstream promoter regions of maize Ubi1 and Ubi2 lends further support to this regulatory scheme.

DETECTION OF *VIBRIO CHOLERAE* IN WATER BY THE POLYMERASE CHAIN REACTION. Catherine E. Monahan and Ivor T. Knight, Dept. of Biology, James Madison Univ., Harrisonburg, VA 22807. The waterborne enteric pathogen, *Vibrio cholerae*, responds to nutrient limited environments by entering into a state of dormancy known as viable but nonculturable. In order to circumvent the detection problems posed by the culturing methods, the polymerase chain reaction (PCR), was investigated as a more direct tool for the detection of *V. cholerae* in the viable but nonculturable state. A 237 base pair sequence located within the B gene of the *ctxAB* operon was used as the PCR amplification target. Chromosomal target DNA, used as template for the PCR, was obtained from *V. cholerae* spiked water samples by concentrating and then lysing the cells. Two cell collection methods (centrifugation and filtration) and three cell lysis techniques (chemical lysis, boiling lysis, and freeze/thaw lysis) were compared and the most efficient cell concentration-cell lysis protocol was determined. The amount of DNA recovered was measured by fluorometric assay using bisbenzamide. Centrifugation, at 14,000 rpm for 5 min, followed by a rapid boiling lysis technique, was found to be the most efficient cell concentration/cell lysis protocol for obtaining template for the PCR (DNA yield of 26.3 ± 2.12 ng/ 10^6 cells). Artificial seawater microcosms were inoculated with *V. cholerae*, placed at 4°C, and monitored by plate count and PCR as the cells proceeded from a culturable state to a nonculturable state. The *V. cholerae* cells were detectable by the PCR for all time points that the cells were culturable and for four days after culturable counts were below detection limits (<2 cells/mL). Thus, it was concluded that a simple, rapid PCR method for detection of *V. cholerae* in estuarine water is useful for detection of both culturable and nonculturable cells.

STORAGE AND MOBILIZATION OF TREHALOSE IN *SUILLUS VARIEGATUS*. JUDY H. NIEHAUS, Dept. of Biology, Radford Univ., Radford, VA 24142 and Kenneth Söderhäll*, Institute of Physiological Botany, Univ. of Uppsala, Uppsala, Sweden. *Suillus variegatus*, a basidiomycete mycorrhizal on *Pinus sylvestris*, obtains glucose from the tree and stores much of this carbon as the typically fungal carbohydrate trehalose (α -D-glucopyranosyl α -D-glucopyranoside). We studied the mechanism by which glucose is sequestered as trehalose, and trehalose is later mobilized as glucose. When cultured at 20° C for three weeks on Norkans medium with glucose as the sole carbon source, *S. variegatus* produced the enzyme trehalase, which catalyzes the hydrolytic cleavage of the disaccharide trehalose to glucose. Trehalase was partially purified from cell-free culture filtrates by ammonium sulfate precipitation, Sephadex G-25 column chromatography, and DEAE Sephacel column chromatography. Trehalase had a pH optimum of 4.5, and the K_M for trehalose was 0.18 mM in citrate buffer and 0.17 mM in acetate buffer. Trehalose may be biosynthesized from glucose via synthesis of trehalose phosphate from glucose-6-phosphate and uridine diphosphate glucose, because the enzyme catalyzing this reaction, trehalose phosphate synthase, was found to be present in *S. variegatus*. An assay for trehalose phosphate synthase was developed. (Supported in part by a grant from the Swedish Research Council)

PRODUCTION OF HYDROGEN PEROXIDE BY PATHOGENIC AND NON-PATHOGENIC AVIAN MYCOPLASMA SPECIES. Lindsey C. Weller, Andrea K. Gallimore, and Lynn O. Lewis, Dept. of Biological Sciences, Mary Washington Col., Fredericksburg, VA 22401-5358.

Both pathogenic and non-pathogenic strains of mycoplasmas have been isolated from avian species. Four species of mycoplasmas are known pathogens: Mycoplasma gallisepticum (MG), M. synoviae (MS), M. meleagridis (MM), and M. iowae (MI). Pathogenicity may be due to a variety of mechanisms, including attachment to target cells and the production of peroxides. This study focused on the production of hydrogen peroxide by M. gallinaceum (D), MS, MI, and three strains of MG with varying levels of pathogenicity: S-6, F-10, and A5969. Hemolysin production was detected by lysis of guinea pig erythrocytes. Benzidine, catalase, and 3-amino-1,2,4-triazole were used to determine if the hemolysin was hydrogen peroxide. Strains D, S-6, and A5969 produced a hemolysin, while strains MS, F-10, and MI did not. Preliminary data indicates that this hemolysin is hydrogen peroxide.

DNA BINDING OF PUTATIVE TRANSCRIPTION FACTORS DERIVED FROM ETIOLATED MAIZE SEEDLINGS. Joan M. Zimmermann and Alan H. Christensen, Department of Biology, George Mason University, Fairfax, VA 22030. Deletion analysis of the maize Ubiquitin 1 (Ubi1) gene promoter region revealed sequences that, when linked to a reporter gene, demonstrate transcriptional regulatory ability. Crude nuclear extracts of homogenized etiolated maize seedlings are postulated to contain transcriptional regulatory proteins that interact with DNA promoter sequences and RNA polymerase II. Regions of truncated promoter (-162 to -74 and -74 to +25) have been ligated into plasmids and maintained in *E. coli*. Plasmid DNA is extracted and purified from bacteria via standard methods; subsequent digestion with selected restriction endonucleases yields the desired Ubi1 promoter sequences. These sequences are radiolabelled, incubated with proteins contained in crude nuclear extracts and then run on a polyacrylamide gel. Sequences of DNA that are specifically bound to proteins migrate at a slower rate than free DNA and thus exhibit altered mobility when the gel is exposed to an autoradiogram. Presence of such altered DNA mobility is construed as preliminary evidence that the DNA contains a protein binding site that is functional in transcription of DNA to RNA.