

## Materials Science

## ANISOTROPIC THERMAL CONDUCTIVITY IN ORIENTED POLYMERS.

R. Edward Barker, Jr., Seth J. Wheeler, Jay R. Maddux, Dept. of Materials Sci. and Engr., Univ. of Va., Charlottesville, VA 22903-2442, and L.J. Adams, Williams International Co., Walled Lake, MI. Measurements have been made using the de Sénarmont method to determine the ratio of thermal conductivities  $K_{11}/K_{22}$  for a selection of polymers chosen to illustrate the effect of molecular orientation. The polymers discussed include polypropylene (PP) and poly(ethylene terephthalate) (P.E.T.), both as functions of elongation up to  $\Delta L/L_0=5$  for PP and to 1.1 for PET. Other polymers investigated included polyparaphenylene benzobisthiazole (PBZT) and polyparaphenylene terephthalamide (PPTA). Both are lyotropic liquid crystalline polymers which form fibrous solids with very high degrees of molecular orientation.  $K_{11}/K_{22}$  increases approximately as  $(\Delta L/L_0)^{1/2}$ , to 2.5 for PP at  $\Delta L/L_0=5$  and to 2.3 for PET at  $\Delta L/L_0=1.1$ . For PBZT and PPTA  $K_{11}/K_{22}$  values are about 5.1 and 8.3, respectively, at 30°C. The data will be discussed in terms of the effects of orientation on the elastic moduli.

*IN SITU* HOT-STAGE STUDIES OF INTERFACE DYNAMICS DURING GROWTH AND DISSOLUTION OF  $\theta$ -Al<sub>2</sub>Cu {111} PLATES IN AN AL-CU-MG-AG ALLOY

William E. Benson\* and J. M. Howe\*, Department of Materials Science and Engineering, University of Virginia 22903; A. Garg\*, NASA Lewis Research Center, Cleveland, OH 44135; Y. C. Chang\*, Aeronautical Research Laboratory, Chung-Shan Institute of Science and Technology, Taiwan, R.O.C. Complementary conventional and high-resolution in situ hot-stage TEM studies were performed to determine the atomic mechanisms and kinetics of growth of  $\theta$ -Al<sub>2</sub>Cu plates with a {111} habit plane in an Al-Cu-Mg-Ag alloy. These studies show that the  $\theta$  plates grow by a terrace-ledge-kink mechanism, where the smallest ledges and kinks are one-half of a unit-cell of the  $\theta$  phase. The morphology of the plate within the habit plane is obtained by varying the density of kinks along the plate edge, and the plates change from an oval morphology near the solvus temperature to a faceted morphology at a slightly lower temperature by rapid nucleation of kinks along the (110)  $\theta$  facet and adjustment of the spacings among existing kinks along the periphery. Kinetic analyses of ledge motion indicate that surface diffusion may dominate the growth kinetics of  $\theta$  plates which intersect the foil surface in thin foils, while the kinetics are reasonable for a bulk diffusion process in thicker foils or when plates are wholly contained within thin foils.

FEASIBILITY OF CATHODICALLY PROTECTING EPOXY-COATED REINFORCING STEEL. D. Stephen Bognaski and S. Ray Taylor, Dept. of Materials Science, Univ. of Va., Charlottesville, Va. 22903; Gerardo G. Clemena, Va. Transportation Res. Council. Recent studies have documented that corrosion is occurring in bridge decks which utilize epoxy-coated reinforcing bars. This is often attributed to chloride contamination from road salts or marine environments and can be both aesthetically and structurally problematic, since the reinforcement's corrosion products create internal stresses which can ultimately lead to cracking of the concrete. Work is in progress to assess cathodic protection (CP) as a means of suppressing corrosion, so to prevent further deterioration and extend the service life of decks at risk. The focus of this work is to examine the feasibility of applying CP to arrest the corrosion of epoxy-coated bars in concrete while measuring any adverse effect it may have on the steel/concrete bond strength. Experimentation has focused on test protocol and preliminary assessment of mechanical and electrochemical behavior. (Supported by the FHWA and Va. Trans. Res. Council)

ALUMINUM 3104 RIGID CONTAINER STAINING PROJECT : A CREVICE CORROSION STUDY. Brian J. Connolly, Glenn E. Stoner, John R. Scully, and R. Scott Lillard, Dept. of Materials Science and Engineering, University of Virginia, Charlottesville, VA, 22903. Annually, aluminum canstock producers lose @ two million Lbs. of their total production due to water staining. The goals of this project are as follows: 1) Development of an accelerated, quantitative staining test procedure that will replicate the industrial stain 2) Investigation of the crevice corrosion parameters (electrochemical, metallurgical, crevice solution chemistry) in order to model the mechanisms involved in the staining event. The staining event is predicated by a characteristic electrochemical wave measured at open circuit using an innovative double crevice assembly developed at the University of Virginia. Future work using this test procedure will determine the relationship between metallurgical composition and resistance to staining. Analysis and simulation of the crevice solution will help us to identify the main factor (pH, aluminum cation concentration, or salt anion concentration) contributing to the formation of the critical crevice solution which initiates the staining event. (Sponsored by: Reynolds Metals Company and The Virginia Center for Innovative Technology)

CHARACTERIZATION OF OHMIC CONTACT SOLDERS TO HIGH PERFORMANCE THERMOELECTRIC MATERIALS FOR COOLING APPLICATIONS. M. H. Ettenberg, W. A. Jesser, F.D. Rosi, Dept. of Materials Science and Engineering, University of Virginia, Charlottesville, Va. 22903. Modern refrigerants are being phased out due to their toxicity to the environment and many alternatives are being studied including thermoelectric materials. Even though thermoelectric materials are not as efficient as Freon-12, they have many advantages. Thermoelectric materials of the pseudo-ternary  $\text{Bi}_2\text{Te}_3\text{-Sb}_2\text{Te}_3\text{-Sb}_2\text{Se}_3$  have been found to be the best for room temperature refrigeration, but they do not provide as much cooling ( $\Delta T$ ) as their figure of merit would predict. The discrepancy between theoretical and measured  $\Delta T$  may be due to the solders that are presently used. To make these devices as efficient as possible solders that provide a small ohmic contact resistance need to be developed. A four probe contact resistance testing station was built. Using this station two methods of obtaining the data were developed, the extrapolation and the step technique. The step technique was found to be a more reliable and accurate method to measure the contact resistance. Using this technique several lead-free solders are being studied electrically. The solders are also being investigated metallographically with a Scanning Electron Microscope (SEM). (Supported by Naval Surface Warfare Center Carderock Division, Detachment Annapolis)

HYDROGEN EFFECTS IN METASTABLE  $\beta$ -TITANIUM ALLOYS. Michelle A. Gaudett & John R. Scully, Dept. of Materials Science and Engineering, Univ. of Va., Charlottesville, VA, 22903. The effects of electrochemically charged hydrogen on the room temperature mechanical properties of Beta-C titanium (Ti-3Al-8V-6Cr-4Mo-4Zr, wt%) will be studied in order to define the relationships between the fracture process zone hydrogen concentration, trapping, and hydrogen-metal interactions and the resulting mechanical properties. The effects of heat treatment and microstructure on the resistance to hydrogen embrittlement (HE) will be investigated using a procedure that decouples hydrogen effects from other aqueous embrittlement mechanisms. A finite element analysis will be applied to pre-notched tensile bars that have been charged to various hydrogen concentrations and tested in air, in order to quantify the degree of HE in terms of the reduction in the maximum longitudinal stress and the plastic strain at maximum load. In addition, fracture toughness experiments will be performed on hydrogen precharged material in air to determine the threshold stress intensity for crack growth. The microstructural feature(s) that control the fracture process will be determined by establishing correlations between hydrogen concentration and trapping, microstructure and the degree of embrittlement. The damage observed will be rationalized in terms of existing or new HE models. Comparisons will be made to other  $\beta$ -titanium alloys such as TIMETAL 21S and TIMETAL 15-3 to evaluate the effect of alloying additions on HE resistance. (Supported by the Office of Naval Research and the Virginia Center for Electrochemical Sciences and Engineering at the Univ. of Va.)

TRACE ELEMENT EFFECTS ON PRECIPITATION AND MECHANICAL PROPERTIES IN AN AL-CU-LI ALLOY. D.L. Gilmore and E.A. Starke, Jr., Materials Science Dept., Univ. of Va., Charlottesville, VA 22903. Trace element additions can accelerate age-hardening in aluminum alloys. By favoring one precipitate system over another, these additions can also effect the yield anisotropy of the material. Anisotropy may also be reduced by substitution of an alloying addition for a pre-aging stretch (T8 heat treatment). Conventional transmission electron microscopy, high-resolution electron microscopy, x-ray texture measurements, and tensile yield tests have been performed in order to discover more about the mechanisms by which indium and magnesium affect precipitation and how this subsequently affects yield anisotropy in aluminum sheet. Findings suggest that both  $\theta'$  and T1 precipitates are affected, but not equally. The benefits of indium may be superceded by those of magnesium (Supported by the Office of Naval Research and the National Science Foundation.)

WRITING ACROSS THE CURRICULUM IN THE PHYSICAL SCIENCES AND ENGINEERING. Robert W. Hendricks and Eric C. Pappas, Materials Science and Engineering Department, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061-0237. We describe the development and implementation of an integrated program for engineering communications in the Materials Science and Engineering (MSE) Department and its extension into a writing across the curriculum program being co-developed by faculty from six departments, two in the physical sciences and four in engineering, at Virginia Tech. The on-going MSE program integrates a significant writing and communications component into eight required courses distributed over three years, and reaches approximately 90 students each semester. It starts with the students' first materials course in the fall semester of their sophomore year and culminates in the Senior Design Project. Limited results, based on two semesters of testing, indicate significant student participation and generally favorable response, as well as excellent faculty response. The broader WAC program, recently approved by SCHEV under the Funds for Excellence program, has several specific program objectives including 1) improving student writing and communications skills in order to enhance their post-graduation marketability, and on-the-job satisfaction and productivity; 2) creating a permanent writing and communications organizational structure that will encourage superior writing and communications skills among science and engineering students; 3) creating an organizational structure that will help faculty integrate writing and communications skills into discipline-specific settings; and 4) serving as a model for other university departments wishing to integrate writing and communications into their curriculum. The paper will report on our experiences to date and describe our anticipated future developments.

INVESTIGATION OF THE MECHANICAL PROPERTIES OF THE MACRO-INTERFACE IN SELECTIVELY REINFORCED ALUMINUM CASTINGS. Michael J. O'Connor\*, Dept. of Materials Science, University of Virginia, Charlottesville, Va. 22903. The ring groove areas of cast Al-12Si pistons can be reinforced with SiC whiskers to provide local high temperature strength and wear resistance. Due to the difference in thermal expansion between the reinforced region and the unreinforced alloy, thermal residual stresses can form at the interface between them when the piston experiences a temperature change relative to some stress-free temperature. Thermal cycling will therefore produce cyclic residual stress at this interface, possibly causing fatigue. To determine if fatigue will occur, the strength of the macro-interface in two alloy-composite systems was measured before and after thermal cycling. It was found that accumulated alloy precipitates or other material at the macro-interface can influence its initial strength. No evidence of thermal fatigue with thermal cycling was found. However, it was determined that the aging behavior of the alloy plays a significant role in defining the strength of the macro-interface with thermal exposure. (Funding provided by General Motors Corporation)

SUSCEPTIBILITY OF STAINLESS STEEL AND NICKEL BASED ALLOYS TO MICROBIAALLY INFLUENCED CORROSION(MIC). I.A. Petersen, D.G. Enos & S.R. Taylor, Dept of Materials Science, Univ. of Va., Charlottesville, Va. 22903. Industries which use natural waters for cooling have identified MIC as a problem. Weldments found in cooling water systems have been reported to have pitting corrosion. The welding process causes changes in the metallurgy of the alloy which effects surface texture, surface oxidation, elemental segregation and the formation of precipitates and inclusions. These changes enhance bacterial attachment and therefore contribute to MIC. One species which has been reported to facilitate MIC are the sulfate reducing bacteria. Proposed theories as to the mechanism by which sulfate reducers influence corrosion are: cathodic depolarization, attack by sulfides and by the formation of corrosive phosphorous containing metabolites. Material selection is one way of addressing MIC found in cooling water systems. Materials which contain molybdenum(Mo) have been reported to be less susceptible to corrosion. In this study eight alloys, with varying concentrations of Mo, were welded and exposed to natural water for nine months. Electrochemical techniques were used to evaluate corrosion resistance and to monitor bacterial activity. Previous work shows decreasing corrosion resistance for the following alloys: unwelded alloy 625 > welded alloy 625 > 317L > 316L > 308 > 304 > A36. Based on data obtained from a previous study a 6% Mo alloy has been added to the current test matrix and edge preparation has been modified for alloy 625 clad.

FORCES ON PARTIAL DISLOCATION PAIRS IN EPITAXIAL LAYERS. Chimin H. Simpson and Dr. William A. Jesser, Dept. of Materials Science and Engineering, University of Virginia, Charlottesville, VA 22903 . In epitaxial layers, driving force for dislocation movement is due to misfit strain and varies with the substrate orientations. In this work, driving forces on twelve  $\langle 112 \rangle$  {1 1 1} partial dislocation pairs versus various substrate orientations are calculated by Peach-Koehler equation. The Peierls force and line tension are considered as retarding forces. When two partial dislocations move in the same direction, stacking fault energy will act as the retarding force for the leading partial dislocation, but as a pulling force for the trailing dislocation. If the excess force on the leading partial dislocation is much greater than that on the trailing dislocation, widely separated stacking faults will be observed in the epitaxial layers. Selecting the substrate orientations with the least stacking faults and threading dislocations is the objective of this work. Both extrinsic and intrinsic stacking faults are addressed in epitaxial layers under tensile and compressive stress biaxial stresses are also contemplated. Under this conduction, the optimum orientation would be around {012} orientation.

MODELLING CREVICE CORROSION. Kevin C. Stewart and Robert G. Kelly, Department of Materials Science and Engineering, University of Virginia, Charlottesville, Va 22903. The goal of this research is to gain a greater understanding of crevice corrosion by combining modelling and experimental determination of the crevice environment during corrosion. Mathematical modelling of the generation and mass transport of chemical species is aided by the use of object-oriented design (OOD). OOD naturally leads to code which is modular, and thus easy to modify, and abstracts model parameters away from programming details. This work expands on previous modelling efforts by the use of OOD and in its implementation of boundary conditions. Experimental measurements of the crevice environment will be made by freezing the crevice solution and analyzing samples of it by capillary electrophoresis (CE). CE is able to detect concentrations as low as 2 mM in sample volumes as small as 30 nl. The ultimate goal of this research is to create functional model of crevice corrosion to allow evaluation of different theories of crevicing, permit separation of effects, and serve as a vehicle for "what-if" computer experimentation.

MAPPING OF COATING DEFECTS USING LOCAL ELECTROCHEMICAL METHODS. Markus W. Wittmann, and S. Ray Taylor, Department of Materials Science and Engineering, University of Virginia, Charlottesville, VA. 22903. Coating failure is often a local event occurring at a physical or chemical heterogeneity. Failure may be a result of a bad coating, or it may result from coating application, curing techniques, the substrate, or its preparation. The ability to map local electrochemical variations would aid in determining the mechanism of coating failure, and its prevention. The objective of this study is to use local electrochemical impedance spectroscopy (LEIS) for the evaluation of local coating defects. Local impedance measurements are determined from a ratio of applied voltage and local current density determined from potential gradients at the surface. This technique was used to scan various coating defects. These include pores, thinned regions, underfilm deposits, and chemical heterogeneities.

## Medical Science

ANANDAMIDE STRUCTURE-ACTIVITY RELATIONSHIPS. L. Adams, R. Razdan and B. Martin. Department of Pharmacology and Toxicology, Medical College of Virginia, Richmond, USA and Organix, Inc., Woburn, MA. Recent evidence implicates anandamide as the endogenous ligand for the cannabinoid receptor. The purpose of this study was to determine the structural requirements for anandamide's interaction with the cannabinoid receptor in the presence of phenylmethylsulfonyl fluoride (PMSF), an enzyme inhibitor. The ability of anandamide and analogs to displace [ $^3$ H]-CP-55,940, a potent synthetic cannabinoid agonist, was determined by a filtration assay. A Scatchard analysis of [ $^3$ H]-CP-55,940 binding resulted in a  $K_d$  of  $590 \pm 90$  pM and a  $B_{max}$  of  $344 \pm 22$  pM. Displacement curves for anandamide in the presence of PMSF produced a  $K_i$  of  $67 \text{ nM} \pm 8 \text{ nM}$ ; without PMSF the  $K_i$  increased to  $5400 \pm 1600 \text{ nM}$ . The structure-activity relationship indicated the importance of the double bond structure, with saturation of all double bonds except at carbon 11 resulting in inactivation ( $K_i > 10,000 \text{ nM}$ ). Increasing the length of the N-substituent by one or two carbons decreased receptor binding affinity. Also, the hydroxyl group was an important part of the structure of anandamide. Substitution of the hydroxyl group with a fluorine atom increased affinity ( $K_i = 7.0 \pm 0.9 \text{ nM}$ ), but only in the presence of PMSF. Hydroxyl substitution with a benzenesulfanilamide group did not significantly alter affinity; yet, addition of a methoxy group to the same position decreased affinity ( $K_i = 1400 \pm 230 \text{ nM}$ ). Certain structural modifications allowed the analogs to retain affinity without the addition of PMSF, such as methylations at carbon adjacent to the N. These results reveal a structure-activity relationship of anandamide which is consistent with a drug-receptor interaction. (Supported by DA-07027, DA-03672 and DA-05488).

REGULATION OF SUPPRESSOR MACROPHAGE NITRIC OXIDE AND TUMOR NECROSIS FACTOR- $\alpha$  PRODUCTION: ROLE OF FIBROSARCOMA-DERIVED INHIBITORY MOLECULES. David G. Alleva and Klaus D. Elgert, Dept. Biol., Va Polytechnic Inst. & State Univ., Blacksburg, Va. 24061-0406. *In vitro*-activated macrophages ( $M\phi$ ) co-express cytotoxicity for tumor cells and suppression of lymphocyte proliferation. These  $M\phi$  functions are increased during tumor growth and are mediated by soluble suppressor molecules. Because  $M\phi$ -derived nitric oxide (NO) and tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ) mediate both cytotoxicity and suppression, we determined if tumor growth increases  $M\phi$ -mediated suppression of T cell proliferation by increasing  $M\phi$  NO and TNF- $\alpha$  synthesis. Activated tumor-bearing host (TBH)  $M\phi$  produced more NO and TNF- $\alpha$  than normal host (NH)  $M\phi$ . This tumor-induced increase in  $M\phi$  NO and TNF- $\alpha$  synthesis mediated suppression of alloantigen-driven T-cell proliferation because treatment with N $^G$ monomethyl-L-arginine or anti-TNF- $\alpha$  antibody blocked TBH  $M\phi$ -mediated suppression. TNF- $\alpha$  did not directly suppress T cells, but it induced  $M\phi$  NO synthesis which down-regulated proliferation. When nontumor-infiltrating peritoneal  $M\phi$  were cultured with tumor cell supernatants,  $M\phi$  synthesis of NO and TNF- $\alpha$  was strongly down-regulated. The tumor-derived molecules responsible for this inhibition were interleukin-10, transforming growth factor- $\beta$ , and prostaglandin  $E_2$  because the fibrosarcoma cells produced significant levels of these molecules, recombinant forms of these molecules suppressed NO and TNF- $\alpha$  synthesis, and antibody-mediated absorption of these cytokines from tumor cell supernatants restored NO and TNF- $\alpha$  synthesis. Collectively, these results suggest that tumor growth favors  $M\phi$  suppressor activity mediated by cytotoxic molecules by increasing  $M\phi$  synthesis NO and TNF- $\alpha$  in tumor distal locations and down-regulating their local synthesis.

MODULATION OF VOLTAGE-SENSITIVE  $\text{Ca}^{++}$  CHANNELS IN MORPHINE-TOLERANT MICE. Marissa A. Bernstein, Charity E. Thomas, & Sandra P. Welch. Dept. of Pharmacology & Toxicology, Med. Col. of Va., Richmond, Va. 23298. Chronic morphine treatment has been shown to increase both  $\text{Ca}^{++}$  content as well as  $\text{K}^{+}$ -stimulated  $\text{Ca}^{++}$  uptake in synaptosomes, suggesting a possible increase in the number of voltage-sensitive  $\text{Ca}^{++}$  channels concurrent with the development of tolerance. However, studies to date have produced conflicting results. In this study, regulation of "L-type"  $\text{Ca}^{++}$  channels by chronic morphine exposure in mouse brain and spinal cord was determined by binding of [ $^3\text{H}$ ]nitrendipine. Mice were treated for 5-7 days with subcutaneously implanted placebo or morphine pellets. Tolerance was determined by testing for antinociception using the tailflip procedure following an 8 mg/kg sc dose of morphine. P2 pellets were resuspended in 50 mM Tris buffer (pH 7.4) to a final protein concentration of 0.8-1.2 mg/ml for brain, 1.2-2.4 mg/ml for cord. Tissue was frozen and stored at  $-70^{\circ}\text{C}$  until day of assay. Thawed tissue was incubated with labelled drug, using nifedipine to determine nonspecific binding, for 90 minutes at room temperature in the dark, with a total volume of 2 ml per tube. In untreated whole brain,  $K_D = 62.8$  pM and  $B_{\text{max}} = 172.3$  fmol  $\text{mg}^{-1}$  protein. In the untreated spinal cord,  $K_D = 145.8$  pM and  $B_{\text{max}} = 49.5$  fmol  $\text{mg}^{-1}$  protein. Nitrendipine was competitively displaced with high affinity by BAYK 8644. The results showed no significant difference in binding between fresh and frozen tissue, nor among naive, placebo-treated, and morphine-tolerant mice for either brain or spinal cord. The involvement of "N-type"  $\text{Ca}^{++}$  channels is currently being investigated by binding of [ $^{125}\text{I}$ ]- $\omega$ -conotoxin MVIIA in mouse brain and spinal cord. (Supported by NIDA grants DA06031 and DA07027.)

THE EFFECTS OF PRENATAL STRESS ON FREE CALCIUM CONTENT IN THE SERA OF RATS. B. C. Billack, K. Devine\*, & C. H. Kinsley. Department of Psychology, University of Richmond, VA 23173. Recent studies have shown that exposure to various stressors results in elevated levels of free calcium (FC) in the sera of rats. These data suggest that activation of stress-related systems may have an impact on this realm of regulatory function, insofar as adult exposure to stress is concerned. What of stress exposure on developing systems? In the present study, the effect of prenatal stress (exposure to heat, light, and restraint three times daily on days 14-21 of pregnancy) on FC levels in sera of juvenile rat offspring was examined. Pregnant females were stressed as above; controls were left undisturbed. At birth, litters were culled to 10 pups. At 45 days of age trunk serum samples were collected from both stressed and control offspring. A calcium ion selective electrode was used to determine FC concentration. A sex difference in FC was observed, with males having higher FC levels than females. Preliminary data demonstrated no effect of prenatal stress on FC levels. (Supported by University of Richmond research funds.)

USE OF IMAGE ANALYSIS AND VIDEO MICROSCOPY TO DETERMINE THE EVOLUTION OF INTRALUMINAL DISTRIBUTIONS OF HEMOGLOBIN CONCENTRATION AND OXYGEN SATURATION IN ARTERIOLES OF THE HAMSTER RETRACTOR MUSCLE. Daniel W. David & Roland N. Pittman, Dept. of Physiol., Va. Commonwealth Univ., Richmond, Va. 23298-0551. The observed diffusion of oxygen from arterioles is an order of magnitude higher than expected (Popel et al., AJP 256:H921, 1989). The calculation of oxygen diffusion requires estimates of oxygen saturation ( $\text{SO}_2$ ) and hemoglobin concentration ( $[\text{Hb}]$ ) in the blood flowing through the arterioles. The values previously used for  $\text{SO}_2$  and  $[\text{Hb}]$  were obtained from center-line measurements, and based on the assumption that the luminal distributions of  $\text{SO}_2$  and  $[\text{Hb}]$  were uniform. However, Ellsworth and Pittman observed that the profiles were indeed not uniform (Ellsworth et al., AJP 251:H869, 1986), and we are exploring the possibility that the non-uniform nature of the distributions is a major contributor to the order of magnitude discrepancy. In an effort to reduce the discrepancy between the experimental observations and the theoretical model, Parthasarathi obtained full diametric light intensity measurements using image analysis of video-taped arterioles to improve the estimates of  $\text{SO}_2$  and  $[\text{Hb}]$  (Parthasarathi, VCU/MCV M.S. Thesis, 1993). However, a low signal-to-noise ratio and geometric distortions in the recorded image made the analysis difficult. The current work describes modifications made to the video microscopy setup and analytical methods that will lead to more reliable determinations of  $\text{SO}_2$  and  $[\text{Hb}]$  distributions. (Supported by NIH Grant HL18292)

IMMUNOSUPPRESSION IN B6C3F1 MICE BY DERMAL EXPOSURE TO BENZO(a)PYRENE. C. L. Deal III, L. F. Butterworth\*, D.J. Mason\*, and K.L. White Jr., Dept of Pharm. and Tox., Med. Col. of Va/VCU, Richmond, VA. 23298 The immunosuppressive effects of benzo(a)pyrene, [B(a)P], the prototypical polycyclic aromatic hydrocarbon, have been shown by many investigators. However, much of this work has utilized subcutaneous injection as the route of administration. Consistent with human environmental exposure, we examined the effects of B(a)P on the humoral immune response via the dermal route of administration. The objective of these studies was to determine if dermal exposure to B(a)P was capable of suppressing the IgM and IgG antibody responses to the T-dependent antigen, sheep erythrocytes (sRBC). The lower backs of female B6C3F1 mice were shaved and exposed for 14 consecutive days to B(a)P at doses of 5, 20, and 40 mg/kg or vehicle (4:1; acetone:olive oil). Using an Enzyme Linked Immunosorbent Assay (ELISA), a statistically significant, dose-dependent suppression was observed in serum antibody levels (titers). The serum IgM antibody titers evaluated 4 days after the primary injection of sRBC (day 15 of the study), of animals treated with 5, 20 and 40 mg/kg were 63, 40 and 31 percent of control, respectively. IgG titers, evaluated 5 days after secondary injection of sRBC (day 30 of the study), were 55, 33 and 29 percent of control, respectively. In most of the previous *in vivo* studies of humoral immunity, primary splenocytes were used for enumeration of antibody forming cells in the plaque assay necessitating separate groups of animals to evaluate the IgM and IgG response at each time point studied. In our studies, we were able to evaluate serum titers of both IgM and IgG antibodies at multiple time points in the same animals. The ELISA methodology allows cost and time-effective determination of humoral response changes in IgM as well as in IgG. Additionally by evaluating the ELISA response to a different T-dependent antigen, the recovery from immunotoxic compounds can be carried out in the same group of animals. Supported by NIEHS contract ES 05288.

MORPHOMETRIC POST-NATAL DEVELOPMENT OF THE MOUSE EPIDIDYMISS. Peter A. Good and Roman J. Miller, Eastern Mennonite College, Harrisonburg, Va. 22801. To determine significant epididymal developmental patterns, the maturation of the caput/corpus epididymis was examined in mice killed at postnatal days (d) of 20, 30, 40, 50, 60, 90, and 120, using light microscopy, DNA and RNA assays, and sperm counts from homogenized epididymides. Tubule diameter (TD), tubule wall width (TW), and epididymal wet weight (WW) increased most between d20 and d40 (TD: 62%; TW: 50%; WW: 350%). During the same time period, the RNA/DNA ratio increased 28%, after which it decreased sharply by 40% between d40 and d60. Both tubular wall (TW) and extra tubular tissue (ET) grew faster between d20 and d30 (TW: 590 µg/d; ET: 400 µg/d) than between d90 and d120 (TW: 143 µg/d; ET: 53 µg/d). Total lumen volume increased 275 µl/d between d20 and d60 after which lumen volume reached a plateau. Epididymal sperm were first seen histologically at d40. While homogenized sperm counts peaked at d90, histological sperm concentration reached a maximal level at d60 (5.1 mg/organ), which was not statistically different from d90. DNA content correspondingly increased 75% between d50 and d60. Thus sexual maturity in mice, as indicated by maximal sperm levels in the epididymis, occurred between d60 and d90. Both histological analysis and homogenized sperm counts showed that sperm production declined significantly from peak levels by d120.

#### MORPHOMETRIC CHARACTERISTICS OF THE MOUSE TESTIS DURING POSTNATAL DEVELOPMENT PERIODS. Mark R. Grimaldi and Roman J. Miller. Eastern Mennonite Col.,

Harrisonburg, Va. 22801. The postnatal histology of the Swiss-Webster mouse testis was studied to determine significant developmental events. Using light microscopy, morphometric analysis was done at day (d) 20, 30, 40, 50, 60, 90, and 120. The parameters of study included seminiferous tubule diameter (TD), tubule wall thickness (TT), and volume percent of tubule wall (TW), total lumen (TL), empty lumen (EL), lumen sperm (LS), and extra-tubular tissue (ET). TW increased from 13% on d20 to 68% on d120. TL peaked at 26% on d50 and decreased to 24% by d120. EL increased steadily from 2% on d20 to 16% on d120. LS was first apparent on d30, peaked at 12% on d50, and decreased to 7% by day 120. ET peaked at d60 and then decreased slightly by d120. TD increased from 112µm on d20 to 185µm on d50 and then remained relatively constant. TT increased from 42µm on d20 to 69µm on d60 and then dropped to 63µm by d120. Based on the amount of growth and the appearance of sperm, the testis becomes functional at approximately d30.

ROLE OF CYTOTOXIC T CELLS IN THE INDUCTION OF VASCULAR LEAK SYNDROME (VLS) DURING CANCER IMMUNOTHERAPY. Denise M. Hammond and Prakash S. Nagarkatti, Dept. of Biology Virginia Polytechnic Inst. and State Univ., Blacksburg, Virginia 24061. Immunotherapy of cancer with IL-2 or a combination of LAK (Lymphokine Activated Killer) cells and IL-2 has met with varying degrees of success. One of the major problems associated with such an approach is severe toxicity clinically characterized by development of vascular leak syndrome (VLS). The mechanism of increased vascular permeability causing VLS not clearly understood. In the current study we investigated the role of cytotoxic T lymphocytes (CTL) in the induction of VLS. The CTL clone, PE-9 used in this study was CD8<sup>+</sup>  $\alpha$ TCR<sup>+</sup> and was specific to a tumor designated LSA. When rIL-2 (~130,000 U/mouse) was injected twice daily for 5 days into normal C57BL/6 mice, they exhibited significant VLS as evidenced by extravasation of <sup>125</sup>I-BSA in the lungs, liver, and spleen. IL-2 failed to induce VLS in irradiated C57BL/6 mice thereby suggesting that the VLS was triggered by a radiosensitive cell. Interestingly, administration of CTL clone and IL-2, but not the CTL clone or IL-2 alone into irradiated mice triggered VLS. Our data therefore suggests that CTL when activated *in vivo* can induce VLS *in vivo*. The CTL clone, upon culture with IL-2 could also mediate lysis of endothelial cells *in vitro*. Such lysis was TCR-independent and MHC-unrestricted. Together, our data demonstrated that CTL when activated with high concentrations of IL-2 may exhibit MHC-unrestricted killing and this may lead to killing of endothelial cells via certain adhesion molecules, such as, CD44 and gp90<sup>MEL-14</sup> and such a mechanism may in turn lead to induction of VLS *in vivo*.

THE TRANSFORMATION AND MAINTENANCE OF T CELL LYMPHOMAS AS A RESULT OF IL-2 AUTOCRINE STIMULATION. Mona Hassaneh and Miltzi Nagarkatti. Dept. of Biology, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. The development of neoplasia requires the simultaneous presence of a number of molecular perturbations. Autocrine growth factor constitutive production is one such perturbation. In recent work we investigated the spontaneous transformation of a couple of T cell clones during routine cell culture. We demonstrated that the transformed clones were exclusively dependent on IL-2 autocrine stimulation in their *in vitro* as well as *in vivo* growth. This was evidenced by the fact that such T cells constitutively expressed IL-2 gene and the cells were inhibited from growing in the presence of mAbs against IL-2, IL-2R and IL-2 antisense oligonucleotides. During that work several T-cell lymphomas that spontaneously originate *in vivo* such as LSA and EL-4 were also tested. Interestingly, LSA cell line was inhibited from *in vitro* proliferation in the presence of mAb directed against IL-2 and IL-2R. Also, treating this lymphoma cell line with cyclosporin A inhibited their *in vitro* growth in a dose dependent manner. These data show that the *in vitro* growth of these tumors is maintained through the continuous production and responsiveness to IL-2. Furthermore, LSA demonstrated the constitutive expression of mRNA for IL-2 and IL-2R  $\beta$ -chain (p75). Together our Studies suggest that T cell lymphomas that originate spontaneously *in vivo* can be dependent on IL-2 as an autocrine growth factor and that such T cell lymphomas can be treated using IL-2 antagonists.

#### THE ROLE OF PRENATAL STRESS ON THE ANTERIOR COMMISSURE OF MALES.

1)Hendree Jones, 1) \*Lori Keyser, 1) \*Claudia Gonzalez, 1) \*Mike Ruscio, 1) Ricky Rowe, 2) Kelly G. Lambert & 1) Craig H. Kinsley, 1) Dept. of Psych., Univ., of Richmond, Richmond, Va. 23173. 2) Dept., of Psych., Randolph-Macon Coll., Ashland, Va. 23005. The effects of prenatal stress (light/restraint) on the development of the anterior commissure (AC) were investigated. The AC is known to be a sexually dimorphic structure of the brain not directly involved in reproductive behavior, but unlike hypothalamic structures and nuclei, little is known about its development. The present work examines the factors, sex and stress, known to influence other brain areas. Pregnant rats were assigned to prenatal treatment and control groups. The treatment group was stressed thrice daily for thirty minutes using light/restraint during the third trimester (day 14-21). Control dams remained undisturbed. Male and female offspring were killed between days 90-100 of life. The brain was coronally sectioned and stained with thionin. The AC of each animal was measured for area (mm<sup>2</sup>) and volume (mm<sup>3</sup>). Results indicated control females had a greater AC area and volume relative to control males. Prenatally stressed males had a significantly greater area and volume of AC relative to control males. The neuroanatomical differences support the hypothesis that factors operating in the prenatal environment affect sexually dimorphic structures in the brain not directly involved in reproduction.

THE EFFECTS OF ANGIOTENSIN II AND FIBROBLAST GROWTH FACTOR- $\beta$  ON DEVELOPMENT OF PERIPHERAL COLLATERAL ARTERIES. Treacy D. Jones, Lara E. Storms, and Patricia B. Williams, Dept. of Pharmacology, Eastern Virginia Medical School, Norfolk, VA 23501.

Collateral arterial growth results from hypertrophy or hyperplasia of existing vessels as a means of restoring peripheral blood flow to chronically ischemic tissues. Basic fibroblast growth factor- $\beta$  (bFGF), angiotensin II (All), and captopril have been shown to affect vascularization in tissues deprived of normal blood flow. To induce collateral development, left femoral arteries in Wistar rats were ligated. bFGF (24 ng/d), All (288 mg/Kg/d), or captopril (6.5 mg/K/d) was administered by osmotic pump for 4 wk. Collateral arteries were visualized by Microfil perfusion, photographed, and measured by digital planimetry. bFGF and All had an angiogenic effect in both limbs. However, the effects of bFGF were more prominent in the ischemic limb compared to the normal limb. Captopril had minimal effect upon vessel growth and development. In conclusion, this model appears to be appropriate for the study of peripheral collateralization. (Supported in part by the American Heart Association/Virginia Affiliate).

CARDIOVASCULAR EFFECTS OF ANANDAMIDE IN ANESTHETIZED RATS. Kristy D. Lake, Karoly Varga\* and George Kunos\*. Dept. of Pharmacology & Toxicology, Virginia Commonwealth Univ., Richmond, VA 23298. Previous research has shown that cannabinoids can affect blood pressure (BP) and heart rate (HR) in experimental animals and in humans. We examined whether the recently discovered endogenous cannabinoid ligand, anandamide (AN), also has cardiovascular effects. In urethane-anesthetized rats AN, 0.2-20 mg/kg iv., caused complex, dose-dependent and highly reproducible changes in BP and HR. The response to AN consisted of 3 phases: (1) initial acute bradycardia associated with apnea and hypotension, followed by a (2) brief pressor component and (3) a delayed hypotension lasting 5-10 min. The initial bradycardia and hypotension could be prevented by methylatropine, 2 mg/kg iv., or bilateral vagotomy. The  $\alpha$ -adrenergic antagonist, phentolamine, reduced BP but did not affect the pressor component of the response to AN. The more prolonged hypotensive phase was inhibited by indomethacin. During this third phase, the pressor response to phenylephrine was markedly attenuated. We conclude that AN potently affects the cardiovascular system: the initial bradycardic phase is probably due to central vagal activation. The secondary pressor component is not sympathetically mediated, while the more prolonged hypotensive phase may be related to reduced sympathetic vasoconstriction associated with decreased sensitivity of vascular  $\alpha$ -receptors. The ability of indomethacin to block the hypotensive phase implicates the arachidonic acid pathway in this action of AN. Further characterization of the mechanism of action of AN is underway.

TUMOR GROWTH INCREASES T-CELL AND MACROPHAGE SENSITIVITY TO TRANSFORMING GROWTH FACTOR-BETA. Christopher A. Learn, Thomas M. Walker, and Klaus D. Elgert, Dept. of Biol., Va. Polytechnic Inst. & State Univ., Blacksburg, Va 24061-0406. Transforming growth factor-beta (TGF- $\beta$ ) is a downregulatory cytokine that restricts immune cell proliferation during immunogenic challenge. We and others show that several tumor types synthesize TGF- $\beta$ , and that tumor-derived TGF- $\beta$  may contribute to decreased immune responsiveness in tumor-bearing hosts (TBH). The objective of our investigation was to determine if tumor growth increases the sensitivity of two important immune cell populations (T cells and macrophages [M $\phi$ ]) to TGF- $\beta$ . T-cell sensitivity was assessed by comparing normal host (NH) and TBH T-cell proliferation in the absence or presence of TGF- $\beta$ . M $\phi$  sensitivity was assessed by comparing NH and TBH M $\phi$  GM-CSF synthesis in the absence or presence of TGF- $\beta$ . TBH T-cell proliferation in response to several activation signals was suppressed by TGF- $\beta$ . TBH M $\phi$  synthesis of granulocyte-macrophage colony-stimulating factor (GM-CSF) was significantly suppressed by TGF- $\beta$ . Collectively, the current data suggest that tumor-derived TGF- $\beta$  contributes to the rapid degeneration and suppression of immune cell reactivity during tumor growth. Future studies will determine if tumor growth increases immune cell synthesis of TGF- $\beta$ .

ANGLE INDEPENDENT DOPPLER COLOR IMAGING TECHNIQUE. Danhui Liu, Cai-Ting Fu\*, & Ding-Yu Fei\*, Dept. of Biomed. Eng., Va. Commonwealth Univ., Richmond, Va. 23298. Doppler Color imaging is now widely used in ultrasound techniques as a mean of diagnosis and monitoring in surgery, mainly involved in the cardiovascular system. However, the image obtained from a commercially available color Doppler flow imaging system has been proved to be angle dependent, i.e., the velocity shown on the machine is not the true velocity but a component of true velocity on the direction of the ultrasound beam. These unfaithful images would give some misleading information. Recently, a computer system has been set up to obtain angle independent Doppler color images by image processing method. The basic principle of the processing is to obtain the angle independent velocity amplitudes and angles in a flow field from three images acquired with three different beam steering directions. The images are taken by an Acuson 128 ultrasound imaging system using linear array transducer. Data processing is performed by a computer and the results can be presented in different formats. Experiments have been conducted both in steady flow and pulsatile flow models and in large vessels of the vascular system. The reconstructed color flow maps, not affected by the Doppler angle, show the real flow patterns and velocity distribution in vitro and in vivo. This may provide more accurate and intuitive information for the local physiological and pathological events. Significance of this technique may be expected in hemodynamics and diagnosis of vascular abnormalities.

THE EFFECT OF JOINT CURVATURE ON THE MECHANICAL PROPERTIES OF ARTICULAR CARTILAGE. N. Mukherjee and J.S. Wayne\*, Ph.D., Va. Commonwealth Univ., Richmond, Va 23298-0694. The hydrated and 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 modelled 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 used solid displacement (u) and fluid pressure (p) as the nodal parameters. This study investigated the effect of joint curvature on the mechanical properties of A.C. as obtained from its response to indentation loading. A permeable indenter of radius 0.75 mm was suddenly pressed onto the cartilage surface of rabbit medial and lateral femoral condyles (The A.C. was still attached to the subchondral bone.) with a load of 10 grams and the ensuing creep was studied. To model the indentation geometry, a mesh consisting of 338 axially symmetric elements and 382 nodes was used. The mechanical properties determined for the A.C. were aggregate modulus, Poisson's ratio and permeability. Creep data from experiments were curve fit with the u-p model (modified to incorporate a non-linear curve fitting routine) using curved or flat surface geometries for six sets of creep data. The results show that different values of all three properties were obtained in all cases when the curvature of the joint was accounted for. Only the Poisson's ratio was significantly overestimated ( $p < 0.05$ ) by the assumption of a flat surface when interspecimen variability was taken into account.

APPLICATION OF 5-BROMOMETHYL FLUORESCHEIN (5-BMF) FOR DERIVATIZATION OF CARBOXYLIC ACIDS SUITABLE FOR LASER-INDUCED FLUORESCENCE DETECTION Partha.S. Mukherjee & H.Thomas Karnes, Dep.t of Pharmacy & Pharmaceutics, Virginia Commonwealth University, Richmond, VA 23298-0533. The goal of this work is to produce optimally excited fluorescent derivatives of carboxyl containing analytes for argon ion laser excitation using 5-BMF as the reagent. The model analytes chosen were (a) benzoic acid, (b) prostaglandin  $E_2$  (PGE<sub>2</sub>) and (c) palmitic acid. The reagent failed to conjugate benzoic acid but was found to be a potential candidate for PGE<sub>2</sub>. 5-BMF was refluxed with palmitic acid at 70°C for 35 min. in the presence of K<sub>2</sub>CO<sub>3</sub> and 18-crown-6 as the catalyst. Under the HPLC conditions employed, two peaks eluted at 16.7 and 23.7 min and were due to apparent conjugates of palmitic acid as confirmed by carrying out elimination reactions. The peaks retained 87% and 23% of the original fluorescence upon derivatization. The yield of the conjugate eluting at 16.7 min was maximized by sequential optimization of several reaction variables. The excitation and emission maximum of the conjugate were 501 and 523 nm respectively and showed potential for quantitation using the intense 488.0 nm argon ion emission line. A limit of detection of 1.04 pmole on-column was established using conventional fluorescence for the conjugated palmitic acid. Work is on-going to evaluate the detectability of the conjugate using laser-induced fluorescence.

DRUG MEDIATED IMMUNOMODULATION IS NECESSARY IN THE CURE OF CANCER. Eileen Murray and Mitzi Nagarkatti, Biol. Dept. VPI & SU, Blacksburg, VA 24060. Previously we showed a correlation between the immunosuppressive properties and the ability of nitrosoureas to cure C57BL/6 mice bearing a syngeneic LSA tumor (TBM). We tested our hypothesis with two classes of anti-cancer drugs, 5-fluorouracil (5-FU) and cyclophosphamide (CY). First, we checked the efficacy of these drugs in TBM and found that neither proved effective in our tumor model. Next, we evaluated the *in vitro* and *in vivo* tumoricidal activity. CY lacked *in vitro* tumor toxicity, but both drugs demonstrated a dose dependent tumor toxicity *in vivo*. Thus, indicating that the LSA lymphoma is not CY nor 5-FU resistant. Finally, we administered various doses of these drugs to normal C57BL/6 mice and examined the T and B-cell response to mitogens. CY proved to be highly immunosuppressive while 5-FU was not. Thus, 5-FU fits our hypothesis that anti-cancer agents which cure TBM should be immunomodulatory. However, CY did suppress T and B-cell activation but failed to cure TBM. These data suggested that amongst the immunomodulatory drugs, some drugs may be more efficacious than others depending on their ability to selectively delete T-suppressor cells and enhance T-helper and T-cytotoxic cell activity which is necessary to eliminate the tumor cells spared from the toxic action of the drug.

EFFECT OF APROBARBITAL ON PHENOBARBITAL N-GLYCOSYLATION IN MOUSE LIVER MICROSOMES. Vrinda R. Nayak, William H. Soine, and Diana Thomas, Dept. of Medicinal Chemistry, MCV/VCU, Richmond, VA. 23298. N-Glucosylation occurs as a metabolic pathway for phenobarbital in mice. When phenobarbital is incubated with mouse liver microsomal homogenate, phenobarbital N-glucoside is formed and can be quantitated. In the standard assay for the formation of phenobarbital N-glucosides, the incorporation of other barbiturates, such as amobarbital, secobarbital, aprobarbital, hexobarbital, pentobarbital, mephobarbital, butobarbital, butalbital and barbital decreases the formation of phenobarbital N-glucoside. The extent to which these drugs inhibit phenobarbital N-glucosylation was found to depend on the lipophilicity of the barbiturate; the more lipophilic barbiturate causing greater inhibition. To determine if inhibition was associated with concomitant N-glucosylation of aprobarbital present in the assay, aprobarbital N-glucoside was synthesized and characterized. An *in vitro* assay was developed for the detection and quantitation of aprobarbital N-glucosides, using mouse liver microsomal homogenate. Aprobarbital N-glucosides were formed at a rate comparable to that of phenobarbital N-glucoside formation. Product enantioselectivity was observed with the later eluting diastereomer predominating. (Support : Public Health Service grant, GM 34507).

N-GLUCURONIDATION AS A POSSIBLE METABOLIC PATHWAY FOR AMOBARBITAL IN HUMANS. Vrinda R. Nayak and William H. Soine, Dept. of Medicinal Chemistry, MCV/VCU, Richmond, VA. 23298. N-Glucosylation is a quantitatively significant route for the metabolism of amobarbital in humans and compounds that are substrates for N-glucosylation are usually substrates for N-glucuronidation. It is proposed that amobarbital also undergoes N-glucuronidation in humans. A study is in progress to determine if amobarbital N-glucuronide is excreted after an oral dose of amobarbital. Amobarbital N-glucoside and amobarbital N-glucuronide were synthesized and characterized. A reverse phase HPLC system was developed for the detection of the N-glucuronide metabolites. Using post column ionization, the column effluent could be monitored at a wavelength of 240, thereby enhancing the detection of the metabolites. Amobarbital sodium (100 mg), was administered orally to healthy male subjects and the total urine was collected for a period of 60 hours after dosing. The urine samples were directly analyzed for the presence of metabolites by HPLC. In the subject studied to date, only the previously identified S-diastereomer of amobarbital N-glucoside was detected. There was no evidence for the formation of amobarbital N-glucuronide. This indicates that N-glucuronidation may not be a quantitatively significant pathway for the metabolism of amobarbital in humans. (Support: Public Health Service grant GM 34507).

DECREASED EXPRESSION OF THE ONCOGENE, C-MYC, INDUCED BY VM-26 IN MCF-7 BREAST TUMOR CELLS: IS THE DECLINE IN C-MYC MESSAGE RESPONSIBLE FOR GROWTH INHIBITION?

Michael S. Orr and David A. Gewirtz\*, Dept. Pharmacology, Medecol College of VA, Richmond, VA. 23298. Various topoisomerase II, inhibitors including m-AMSA and VM-26, produce concentration dependent reductions in expression of *c-myc* (a growth regulatory gene) which parallels growth inhibition in MCF-7 breast tumor cells (Gewirtz et al. Cancer Research 53, 3547, 1993; Bunch et al Biochemical Pharmacology 47, 317, 1994); in contrast, the microtubule inhibitor, vincristine, does not produce a decline in *c-myc* expression. Although cycloheximide (70µM) increases *c-myc* steady state mRNA levels, the protein synthesis inhibitor fails to block the VM-26 induced reduction in *c-myc* expression. This suggests that de-novo protein synthesis is not involved in the influence of VM-26 on *c-myc* expression. Studies assessing the decline in *c-myc* expression in the presence of actinomycin D demonstrates that VM-26 does not alter the stability of the *c-myc* transcript. Preliminary nuclear run off analyses suggest that VM-26 alters the rate of *c-myc* transcription. In MCF-7 cells exposed to VM-26 for three hours followed by a chase with media for up to 72 hours, we observe: a) an initial, early transient decline in *c-myc* gene expression (30% of control levels) followed by b) a return to greater than 60% of control expression within six hours and c) a subsequent decline of *c-myc* gene expression to 40% of control expression at 48 and 72 hours. It is proposed that growth arrest in response to DNA damage produced by topoisomerase II inhibitors is a result of alterations in the activity of regulatory factors which modulate *c-myc* expression in this breast tumor cell line.

CHARACTERIZATION OF PHENOBARBITAL-N-GLUCURONIDE DIASTEREOMERS IN HUMAN URINE.

Sheela G. Paibir\* and William H. Soine, Dept. Medicinal Chemistry, MCV/VCU, Richmond, VA-23298. In humans, phenobarbital is metabolized by conjugation with glucose to form predominantly (S)-phenobarbital-N-glucoside. Drugs known to form glucosides generally form the glucuronides and therefore it is proposed that phenobarbital-N-glucuronide (PbGA) may be a urinary metabolite in humans. (S)-PbGA and (R)-PbGA and their derivative, (S)- and (R)-phenobarbital methylglucuronide (PbMGA), respectively, were synthesized and chemically characterized. Phenobarbital (100mg) was given orally to a healthy male and urine was collected for 40 hours following administration of the drug. The urine was concentrated, partially purified by liquid-liquid extraction followed by semi-preparative reversed-phase HPLC. HPLC-UV analysis of the purified urine showed two compounds with similar retention time as that of the standard (S)- and (R)-PbGA. The UV scans (with and without post-column ionization) of each of these two compounds was identical to that of the standard PbGA under the same conditions. On derivatization, the products from biological origin had similar retention times and UV characteristics (with and without post-column ionization) as that of the standard (S)- and (R)-PbMGA. This evidence indicates that (S)- and (R)-PbGA are metabolites of phenobarbital in humans. These metabolites together account for approximately 7% of the oral dose. (Supported by NIH Grant GM 34507).

CD44-HYALURONIC ACID INTERACTIONS IN LYMPHOCYTE CELL ACTIVATION.

Asimah Rafi\*, and P. Nagarkatti, Department of Biology, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. Adhesion molecules play an important role in cell-cell and cell-extracellular matrix interactions. Such interactions are crucial to all developmental processes. Recently, adhesion receptors and interaction of lymphocytes with extracellular matrix (ECM) has been shown to play a central role in regulating the migration, differentiation and functions of the cells of the immune system. Our lab has demonstrated that activated cytotoxic T lymphocytes (CTL) can mediate efficient lysis of target cells when activated through adhesion molecule, CD44. CD44 is expressed on a wide variety of cell types, including T cells, thymocytes, B cells, and granulocytes and has been shown to bind to ECM components such as hyaluronate. In this study we looked at the role of hyaluronate in the activation of lymphocytes. Spleen cells incubated with anti-CD44 monoclonal antibodies (mAbs) or hyaluronate proliferated strongly *in vitro*. Interestingly, purified B lymphocytes but not T cells responded by proliferation. The T cells failed to respond to hyaluronate even in the presence of accessory cells. Bone marrow cells were also found to express CD44 and demonstrated a proliferative response to stimulation with hyaluronate. Together our data suggested that hyaluronate plays an important role in the differentiation of lymphocytes and their functions *in vivo*.

THE EFFECTS OF PRENATAL STRESS ON THE SIZE OF THE CORPUS CALLOSUM. R. Rowe, B. Donnelly\*, K. Golden\*, H. Jones, B. Bailey\*, C. Kinsley, Dept. of Psych., Univ. of Richmond, Richmond, Va. 23173. The effects of prenatal stress on the size of the corpus callosum in rats was investigated using a prenatal heat, light, and restraint stress paradigm that influences the fetal hormonal milieu. Females were stressed three times daily from day 13 of pregnancy through parturition. Control females were left unstressed through parturition. At approximately 215 days of age, males and females from the two groups were sacrificed. Area (squared mm) of the corpus callosum was determined from sagittal sections of each brain. A main effect existed for sex,  $F(1,25)=15.187$ ,  $p=.001$ , with males having a larger corpus callosum than females. The predicted sex by stress interaction was not apparent, although the means were in the hypothesized directions. The results support previous findings that the corpus callosum is sexually dimorphic. The results also suggest that prenatal stress may not have as great an effect on the development of the corpus callosum as it does on other structures in the brain. Measurements of perimeter and length are currently being investigated.

SURFACE LAYERS AS A POTENTIAL MECHANISM FOR GENETIC EXCHANGE IN STREPTOCOCCI. Andrea C. Scharfe and Lynn O. Lewis, Dept. of Biological Sciences, Mary Washington Col., Fredericksburg, VA 22401-5358. Antibiotic resistance in streptococci has been documented worldwide, however the mechanism leading to the spread of antibiotic resistance is not known. Gram negative bacteria often conjugate to transfer antibiotic resistance plasmids, but conjugation in streptococci has not been demonstrated. One hypothesis for mating in Gram positive organisms involves the presence of a protein layer on the outside of the cell, known as an S-layer. The literature does not show streptococci to have S-layers, however these organisms may not have been examined. Therefore, two strains of Streptococcus pneumoniae, one which is penicillin resistant and one which is not, are being examined for the presence of S-layers. Preliminary data indicate that protein can be extracted from the surface of the nonresistant S. pneumoniae. Therefore, further studies will be done to determine whether these proteins are S-layers and whether they may participate in mating between streptococci.

QUANTIFICATION OF ORGANIZATION OF VENTRICULAR FIBRILLATION. Samir Shah, Peng-Wie Hsia\*, Ralph Damiano Jr.\*, Dept. of Biomed. Eng. and Surgery, Medical College of Virginia, Richmond VA 23298. Ventricular Fibrillation (VF) is characterized by irregular and random patterns of epicardial electrical activation and contraction of the myocardial muscles. VF is terminated by delivering a DC shock to the heart (defibrillation). The outcome of a defibrillation attempt, however, remains largely probabilistic. Clinically, shocks of energy levels 2 to 3 times the calculated minimum are routinely used to compensate this uncertainty. However, the high energy shock may damage the heart. Hence, lowering the defibrillation shock energy level has been a long-standing goal. Previous studies suggested that there exist "windows" during VF when the fibrillatory process is more vulnerable to defibrillation. This could explain the probabilistic nature of defibrillation. In this paper we further hypothesize that the underlying level of organization of epicardial activation during VF may affect the defibrillation success and help identify a vulnerable window to defibrillation. In a canine defibrillation study, unipolar electrograms were recorded from 112 closely spaced sites on the epicardial surface. Using vector-loop methods, the direction of epicardial activation was determined at 90 individual sites for 5 successive beats during VF. A multiple linear regression model was used to predict the direction of epicardial activation at a site from those at adjacent sites during the same beat and at corresponding sites during the previous beat. The normalized coefficient of correlation between the predicted and observed values of epicardial activation direction was used to quantify the level of organization. The effect of this quantified level immediately prior to a defibrillation trial on the outcome of the trial was studied.

CLONING AND CHARACTERIZATION OF A MAIZE  $\beta$ -GLUCOSIDASE ALLELE.

Mohammad Shahid and Asim Esen, Dept. of Biol., VA Polytechnic Inst. & State Univ., Blacksburg, VA 24061. Maize  $\beta$ -glucosidase is the most polymorphic enzyme with 31 allozymes. These allozymes detected by conventional electrophoretic methods, represent only 25% of the total variation at amino acid level. Thus >100 mutants at the protein and several hundred at the nucleotide level are expected. It is not known whether these mutations are scattered throughout coding sequence or clustered at particular regions (hot spots). We made oligonucleotide primers based on N-terminal sequence of the maize enzyme and conserved regions of  $\beta$ -glucosidase from other organisms to amplify and clone the 5' region of the Glu1 locus from maize cDNA. The clone was sequenced and confirmed to be  $\beta$ -glucosidase. Then the clone was used to isolate a near full-length  $\beta$ -glucosidase cDNA from the cDNA library of maize inbred K55. After isolation, the  $\beta$ -glucosidase cDNA was sequenced and found to be 1931 bp long. The cDNA is coded for a 566 amino acids long protein and 512 amino acid long mature protein. When the sequence was compared with the sequence of another maize  $\beta$ -glucosidase cDNA (zm-p6.1), 15 nucleotide differences was observed within open reading frame. Three of these nucleotide substitutions resulted in amino acids substitutions. We also have shown that the genomic DNA encoding maize  $\beta$ -glucosidase lacked intervening sequences (intron).

EVALUATION OF ACUTE AND CHRONIC ANABOLIC STEROID TREATMENT ON THE SEROTONIN TRANSPORT SYSTEM. Suzanne R. Thornton and David R. Compton, Dept. of Pharm. Tox., Med. Col. of Va., Richmond, Va. 23298.

Over the last 10 years, there has been a dramatic increase in the abuse of synthetic androgenic/ anabolic steroids which prompted the passage of the Anabolic Steroids Control Act of 1990. Dosages of 10 to 100 times therapeutic levels have been reported. Symptoms such as depression, aggression, psychosis and mania have also been reported anecdotally. Depression can be treated with antidepressive drugs such as fluoxetine which prevent uptake of serotonin from the synaptic cleft. The depression reported during steroid abuse and after discontinuation has been treated with fluoxetine (Malone and Dimeff, 1992). The present study was conducted to determine the effects of acute and chronic steroids on the serotonin transport system. The study was conducted using male ICR mice (weighing 25-30 g) injected I.P. with either sesame oil (vehicle) or sesame oil with 5% benzyl alcohol or 500 mg/kg of nandrolone deconate, nandrolone propionate, testosterone deconate and testosterone propionate. The acute steroid treatment groups were sacrificed one hour after injection while the chronic steroid treatment groups were treated for four weeks and sacrificed one hour after their final injection. Animals were decapitated and homogenates of cortical tissues prepared for binding using [ $^3$ H]-paroxetine. There was no statistically significant effect on the  $K_d$  or  $B_{max}$  of the serotonin transport system for any of the steroid treatments. The anecdotally reported depression following chronic anabolic steroid abuse seems to be similar to other clinical depression which responds to fluoxetine. These data suggest that anabolic steroids do not have either direct or indirect effects on the serotonin transporter, as might have been suggested by the results of fluoxetine treatment of humans suffering "withdrawal" from anabolic steroid abuse. The depression, if produced, may still be due to other alterations of the serotonin neurotransmission system, such as synthesis, release or postsynaptic receptors.

THE EFFECTS OF PRENATAL STRESS ON THE QUANTITY OF ULTRASONIC VOCALIZATIONS PRODUCED BY MALE AND FEMALE RATS DURING SEXUAL ENCOUNTERS. N.C. Turner, J.A. Eskandarian, C.H. Kinsley, Dept. of Psych., Univ. of Richmond, Richmond, Va. 23173.

Ultrasonic vocalizations (UVs) are an important means of communication among rodent species, especially during sexual activity. Many studies indicate that prenatally stressed (PNS) animals show deficits in sexual behavior. The purpose of the present study was to examine the effects that PNS has on UV production. The stress procedure, which began on day 15 of gestation and continued through day 22, consisted of exposing the female to a regimen of heat and restraint for 30 minutes 3 times a day. The offspring were then tested when they reached adulthood (~110 days). We observed the frequency of occurrence of UVs produced by control and PNS, male and female rats during exposure to an anesthetized sexually receptive opposite-sex stimulus animal. We found that the control females produced significantly more UVs than the control males. The control females also produced a significantly greater amount of UVs than the PNS females. The amount, however, of UVs emitted by the control males and PNS males was not significantly different. Likewise, the PNS males and the PNS females showed no significant difference in UV production. Analysis indicates that when a female is PNS, her quantity of UVs decreases to a number which resembles that of the control male. Therefore, it can be inferred that the PNS female has become masculinized, and/or defeminized.

FIBROSARCOMA-INDUCED ALTERATIONS IN HELPER T-CELL ACTIVATION INVOLVE DECREASE RESPONSIVENESS TO CO-STIMULATORY CYTOKINES AND INCREASED SENSITIVITY TO SUPPRESSOR CYTOKINES. Thomas M. Walker and Klaus D. Elgert, Dept. of Biol., Va. Polytechnic Inst. & State Univ., Blacksburg, Va 24061-0406. Tumor growth induces several functional changes among immune cell populations. CD4<sup>+</sup> helper T cells represent a significant effector component of the immune system, and their activities are dictated by their responsiveness to cytokines. The current investigation evaluated tumor-induced alterations in helper T cell responsiveness to several cytokines involved in T-cell activation and downregulation. We also evaluated tumor-induced changes in helper T cell responses to the anti-cancer drug taxol. T-cell responsiveness to specific signals was assessed by measuring T-cell proliferation. Specific cytokines associated with T-cell activation such as interleukin-2 (IL-2) and interferon-gamma (IFN- $\gamma$ ) could partly restore tumor-bearing host (TBH) T-cell proliferation to levels comparable to normal host (NH) T cells, but this effect was blocked by the suppressor cytokines interleukin-10 (IL-10) and transforming growth factor-beta, (TGF- $\beta_1$ ). TBH helper T cells were unresponsive to the co-stimulatory cytokines interleukin-1 (IL-1) and interleukin-6 (IL-6) and produced lower concentrations of upregulatory cytokines during activation. TBH helper T cell showed a higher sensitivity than NH helper T cells to IL-10 and TGF- $\beta_1$ . We have previously shown that these two suppressor molecules are produced by suppressor immune cells and cancer cells. TBH helper T cells also demonstrated a higher sensitivity to the anti-mitotic compound taxol. TBH T-cell sensitivity to taxol was significantly increased by TGF- $\beta_1$ . These data collectively suggest that tumor growth changes helper T cell responsiveness to specific regulatory signals associated with T cell activation and downregulation. Furthermore, our data suggest a novel mechanism of T-cell suppression by taxol during tumor growth and may partly explain the limited success of taxol as an effective immunotherapy for cancer patients.

MORPHOMETRIC POST NATAL DEVELOPMENT OF THE MOUSE SEMINAL VESICLE. Matthew B. Zook and Roman J. Miller. Eastern Mennonite Col., Harrisonburg, Va. 22801. The histology of the mouse seminal vesicle was studied to determine significant developmental events. Using light microscopy, morphometric analysis was done at day (d) 20, 30, 40, 50, 60, 90, and 120 postnatal. Parameter changes (rate units =  $\pm \mu\text{g}$  or  $\mu\text{l}/\text{organ}/\text{day}$ ) were determined for stromal (ST), glandular (GT), and total lumen (TL) area comprised of empty area and secretions. All three areas significantly increased from d 20 to d 40 (ST = +330; GT = +700; TL = +1,180). From d 50 to d 90 ST decreased in value (-125) while GT showed a decreased rate of growth (+286). TL remained relatively constant during this time, but increased after d 90 (+630). TL increase was due primarily to secretion material, which increased at an approximate rate of +850 during the d 20 to d 40 and d 90 to d 120 periods. No change was found in the epithelial cell length, width, or nucleus/cytosol ratio over the time period. Growth occurred rapidly from d 20 to d 40 in all tissues. GT and TL growth rate decreased from d 40 to d 90 while ST area decreased over this period. TL increased more rapidly after d 90. Based on these biological indicators, seminal vesicle functionality is reached by d 40 and organ maturation between d 90 and d 120.

## Microbiology and Molecular Biology (*No Abstracts Submitted*)

## Natural History and Biodiversity

USE OF PONDS TO PROTECT NATIVE FRESHWATER MUSSELS. Jonathan W. Burress and Dick Neves, Dept. of Fisheries and Wildlife, Virginia Tech, Blacksburg, Va. 24061-0321. The survival of 12 species of freshwater mussels was monitored in ponds at 3 study sites in Critz, Blacksburg, and Marion, Virginia. Mussels were held within 1m x 1m x 0.5m plastic screen cages fastened to PVC float collars. Holding methods consist of placing mussels unrestricted on cage bottoms and within 100mm mesh plastic sleeves hung horizontally from the cage tops. Survival in the farm pond at Critz was 74% overall, with significant differences in survival after 1 year of captivity. *Elliptio* spp. exhibited high survival (x=94%), whereas survival of *Pleurobema cordatum* and *Lampsilis ovata* was lower (74% and 36%, respectively). Survival of mussels in the pond at Blacksburg was higher (>93%) after 5 months, whereas survival at Marion was high (x=85%) in sleeves but low in mussels placed on the cage bottom.

EVALUATING EFFECTS OF PRESCRIBED BURNING ON AN ENDANGERED PLANT: PETERS MOUNTAIN MALLOW. Caren A. Caljouw, Dept. Conservation and Recreation, Div. Natural Heritage, 1500 E. Main St., Suite 312, Richmond, Va. 23219, M.V. Lipscomb, Dept. Biology, Va. Polytechnic Inst. & State Univ., Blacksburg, Va. 24061, S.A. Adams, D.S. Lancaster Community Col., Clifton Forge, Va. 24422, & M.S. Hobbs, Va. Field Office, The Nature Conservancy, Charlottesville, Va 22903. In 1991, just three individuals of the federally endangered plant, Peters Mountain mallow (Iliamna corei) remained in the wild. In 1992 and 1993, prescribed fire was used in an attempt to stimulate seedling recruitment in the population. Eleven plants appeared in a burn plot in 1992, of which three survived to 1993. A burn in 1993 yielded an astounding 495 seedlings. Such results portray Peters Mountain mallow as a fire dependent species, and emphasize the importance of prescribed fire as an ecological management and endangered species recovery tool. Population monitoring is ongoing and additional burns are planned. In an effort to understand the factors that may have contributed to the decline of Peters Mountain mallow and the role that fire has played in maintaining this endangered species, disturbance history studies were initiated in 1992. Preliminary investigations reveal that the mean fire return interval for this site was 6.1 years.

THE SUCKING LICE (INSECTA: ANOPLURA) OF VIRGINIA SCIURIDS. Ralph P. Eckerlin and Harry F. Painter, Natural Sciences Div., Northern VA Cmnty. Col., Annandale, VA 22003. All seven species of the mammalian family Sciuridae were examined for lice. Woodchucks (n=15), red squirrels (n=7), northern flying squirrels (n=2), and southern flying squirrels (n=6), were without lice. One chipmunk of 26 examined was infested with Hoplopleura erratica, a new state record. Fox squirrels (n=9) had Hoplopleura sciuricola, Neohaematopinus sciuri, Neohaematopinus sciurinus, and Enderleinellus longiceps. Only N. sciurinus is new to the Virginia fauna. Gray squirrels (n=128) were hosts to N. sciuri (22% prevalence) and H. sciuricola (6% prevalence). The prevalence and intensity of louse infestations from these road kill gray squirrels from northern VA were much lower than those of another study using shot or trapped gray squirrels from southwest VA.

AN EXEMPLARY FIRE-MAINTAINED ECOSYSTEM IN THE VIRGINIA PIEDMONT. 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. Fort Pickett is a 45,000-acre U.S. Army installation occupying parts of Nottoway, Brunswick, and Dinwiddie Counties in the southern Virginia piedmont. Within the base, a 10,000-acre controlled access area, which contains firing ranges and target sites for artillery and small arms training, has been subjected to very frequent wildfires and some prescribed burns during the past fifty years. In the course of a base-wide inventory for rare species and significant communities, Division of Natural Heritage biologists discovered that the regularly burned landscape supports extensive pine and hardwood savannas, open seepage wetlands, and occurrences of several rare species. These included the largest known population of the federally endangered shrub Michaux's Sumac (Rhus michauxii) and viable populations of Bachman's Sparrow (Aimophila aestivalis), a candidate for federal listing. Fire-maintained woodlands and savannas were present historically in southeastern Virginia, but have almost entirely disappeared because of fire suppression and other recent disturbances. As a result of the Fort Pickett inventory, management and research are now underway to ensure the long-term conservation of these rare community types and species in the Commonwealth.

POSSIBLE DIVERSITY IMPLICATIONS: 1992-3 TURKEY RUN PARK HERPETOLOGICAL SURVEY Dean A. Lindholm, 14226 Glenkirk Rd., Nokesville, VA 22123 (under contract to National Park Service). A one year, approx. 175 hr. survey by 4 people discovered 4 salamander, 2 toad, 6 frog, 1 turtle, 2 lizard, and 6 snake species within the wooded, 300 acre Turkey Run park. These specimens represent only what was found during this inventory; they should not be taken as a complete list of park herpetofauna. Varying population evidence is discussed. Examination as well as photographic evidence of these specimens illustrate that they are all common Piedmont sp., and make up only part of potential populations. Yet this park is surrounded by the Potomac river and Washington D.C. suburbs. Does this study have diversity implications? This question is addressed, and related to recent declines in herpetofauna.

DISTRIBUTION AND ECOLOGY OF STREAM-DWELLING CRAYFISHES IN THE CLINCH RIVER DRAINAGE, VA. Patrick S. Lookabaugh\*, Paul L. Angermeier\*, and Richard J. Neves, Dept. of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061-0321. Species composition and distribution of stream-dwelling crayfishes were determined at 34 sites throughout the Clinch River drainage of Virginia. Six species were collected: *Cambarus (Cambarus) angularis*, *C. (C.) bartonii*, *C. (Hiatacambarus) longirostris*, *C. (Puncticambarus) buntingi*, *Orconectes (Procericambarus) forceps*, and *O. (P.) spinosus*. *Cambarus (C.) angularis*, *C. (H.) longirostris*, and *O. (P.) spinosus* were distributed widely in the drainage, whereas other species, especially *O. (P.) forceps*, were localized. *Cambarus (P.) buntingi*, which occurred in the Guest River drainage, was recorded for the first time in Virginia. A "saddled" form of *C. (H.) longirostris* was collected in the upper reaches of Copper Creek. Preliminary analyses suggest higher relative abundances of orconectids in degraded areas.

ALLOZYMIC VARIATION IN MAINLAND AND INSULAR POPULATIONS OF *ORYZOMYS PALUSTRIS* AND *PEROMYSCUS LEUCOPUS*. Janet L. Loxterman<sup>1</sup>, Nancy D. Moncrief<sup>2</sup>, Raymond D. Dueser<sup>3</sup>, & John F. Pagels<sup>1</sup>. <sup>1</sup>Dept. Biology, Virginia Commonwealth Univ., Richmond, VA 23220, <sup>2</sup>Virginia Mus. Nat. Hist., Martinsville, VA 24112, and <sup>3</sup>Dept. Fish. & Wildl., Utah State Univ., Logan, UT 84322. We examined allozymic variation in mainland and insular populations of the marsh rice rat (*Oryzomys palustris*) and the white-footed mouse (*Peromyscus leucopus*). The sampling localities include four sites on the Eastern Shore of Virginia and five sites on adjacent barrier islands. A total of 118 rice rats from nine sites and 96 white-footed mice from seven sites were assayed among 32 presumptive gene loci. To date, rice rats are variable at 5 of 32 loci: PGM3, 6PGD, NP, G3PD, and ADA. White-footed mice are variable at 7 of 32 loci: G6PD, PEPA, IDH2, MPI, NP, PGM1, and ADA. Preliminary results indicate that *O. palustris* exhibits less genetic differentiation among populations than does *P. leucopus*. These differences in levels of intraspecific variability may be related to colonization ability. We hypothesize that rice rats are relatively good dispersers among islands and adjacent mainland sites, whereas white-footed mice are relatively poor dispersers across water barriers.

BIOLOGICAL CONTROL OF PURPLE LOOSESTRIPE. Tom J. McAvoy, L. T. Kok\* and W. T. Mays\*, Dept. of Entomology, Va. Polytechnic Inst. and State Univ., Blacksburg, Va. 24061. Purple Loosestrife (*Lythrum salicaria* L.) is a weed of freshwater wetlands that forms extensive monospecific stands eliminating native plants. In 1989 three species of Coleoptera: *Hylobius transversovittatus* (Curculionidae), *Galerucella californiensis* and *G. pusilla* (Chrysomelidae) were received at the Quarantine Lab of the Department of Entomology at V. P. I. & S. U. for host specificity studies. Fifteen species of plants from nine families were tested to determine their suitability for feeding, oviposition, larval development and oogenesis. *Lythrum virgatum* and *L. alatum* were found to be hosts of all three species. In addition, *Decodon verticillatus* was found to be a host of *H. transversovittatus*. However, preference was for *L. salicaria*. As the three beetles were found to be adequately host specific, they were officially approved for field release in the United States in 1992. Releases of all three species were made in Coeburn, Va. in 1992 and *H. transversovittatus* and *G. pusilla* were released near Sweet Chalybeate, Va. in 1993. The two *Galerucella* species released in 1992 were recovered in May 1993 in Coeburn, Va.

A BUTTERFLY SURVEY AT THE VIRGINIA TECH HORTICULTURE GARDENS. Tom J. McAvoy, W. T. Mays\*, Dept. of Entomology, and B. Lyons\*, Dept. of Horticulture, Va. Polytechnic Inst. and State Univ., Blacksburg, Va. 24061. A weekly butterfly survey was conducted at the Virginia Tech Horticulture Gardens from April 27 to October 19, 1993. Twenty six butterfly species (Superfamily: Papilionoidea) were recorded. The five most abundant species and the total number found were *Pieris rapae* (108), *Danaus plexippus* (90), *Colias eurytheme/philodice* (34), and *Speyeria cybele* (14). One individual of a rare species was observed, *Speyeria atlantis*, this species has a state ranking of S2. Nectar was gathered from a total of 37 species of plants from 24 plant families. The five most attractive plant species and the total number of butterflies that gathered nectar from them were: *Buddleia davidii* (124), *Rudbeckia purpurea* (41), *Zizia elegans* (28), *Gomphrena globosa* (17) and *Coreiopsis* sp. (13). The total number of butterflies and the color of the flower that they gathered nectar from were: 243 from purple/blue, 36 from red/pink, 26 from white, 18 from yellow and 4 from orange.

AMPHIBIAN BIODIVERSITY AND COMMUNITY STRUCTURE IN FIVE FORESTED HABITATS ON SHENANDOAH MOUNTAIN, VIRGINIA. Joseph C. Mitchell, University of Richmond, VA 23173, Kurt A. Buhlmann, Savannah River Ecology Lab, Aiken, SC 29802, Christopher A. Pague, Colorado Natural Heritage Program, Boulder, CO 80309. We conducted a 2-yr study of amphibians communities in five montane habitats that reflect different management practices in the George Washington National Forest. A total of 1334 individuals representing 11 species of salamanders and 5 species of frogs were sampled with drift fence/pitfall trap arrays April 1987-October 1988. Numerically dominant species were *Ambystoma jeffersonianum*, *Plethodon cinereus*, and *Rana sylvatica*. Amphibian species richness and population sizes were highest in less disturbed habitats and those not affected by timber harvest practices, such as in older forests with downed woody debris. Species richness was also highest in habitats adjacent to springs and wildlife ponds. Aquatic resources and their surrounding forested habitats should be viewed as keystone resources for amphibians in temperate zone montane forests. (Supported by a Challenge Cost Share from the George Washington National Forest.)

DISCOVERY OF A VIRGINIA "SERPENTINE BARREN". Thomas J. Rawinski, Dept. of Conservation and Recreation, Div. of Natural Heritage, Main Street Station, 1500 E. Main St., Suite 312, Richmond, VA 23219. Serpentine barrens are rare and fascinating natural environments that support distinctive vegetation adapted to harsh edaphic conditions. The famous serpentine barrens of southeastern Pennsylvania and adjacent Maryland, and the Buck Creek serpentine barren in Clay County, North Carolina had no known Virginia counterpart until 1992 when such a barren was discovered along Jacks Creek in Franklin County. This barren contains natural grassland fringed by a woodland of Pinus virginiana, Juniperus virginiana, Quercus stellata, and Quercus marilandica. The grassland, which is dominated by Schizachyrium scoparium, Senecio plattensis, and Parthenium auriculatum, contains a unique assemblage of plants consisting of Sporobolus heterolepis (first Virginia record), the shale barren plant Trifolium virginicum (new southern range limit), the limestone glade plant Arenaria patula (first Piedmont record), and Talinum teretifolium. The shallow friable soil, derived from ultramafic rock of the Alligator Back Formation, has a pH of 7.0 and a calcium to magnesium ratio of 0.22. The site is privately owned and access is severely restricted at this time. Efforts to conserve this highly significant site are underway.

MAMMAL BIODIVERSITY AND COMMUNITY STRUCTURE IN FIVE FORESTED HABITATS ON SHENANDOAH MOUNTAIN, VIRGINIA. John F. Pagels & Sherry C. Rinehart, Dept. of Biol., Va Commonwealth Univ., Richmond, Va. 23284, Joseph C. Mitchell, Dept. of Biol., Univ. of Richmond, Richmond, Va. 23173, Kurt A. Buhlmann, SREL, Aiken, SC. 29802 & Christopher A. Pague, Natural Heritage Program, Boulder, Co. 80309. A total of 752 small mammals that represent 15 species was pitfall trapped in five stands that reflect different management practices. Species diversity ( $H'$ ) was highest in a severely thinned site (1.977) and lowest in a mature forest site (1.443). Five species of shrews (Blarina and 4 Sorex) comprised the majority of the total specimens (75.5%) and were present at all five sites. Cover objects and floral characteristics were critical habitat components. Results demonstrate that intermittent openings in the forest are beneficial to certain mammals on Shenandoah Mountain. Discussion will include thoughts on the influence of various management practices on small mammals.

THE ODONATE FAUNA OF FORT A.P. HILL. Steven M. Roble and Christopher S. Hobson\*, Dept. of Conservation and Recreation, Div. of Natural Heritage, 1500 E. Main St., Suite 312, Richmond, VA 23219. Fort A. P. Hill Military Reservation is located in Caroline County, an area rich in acidic wetland habitats. Extensive beaver activity has resulted in the creation of numerous pond habitats on the base. The odonate fauna was sampled during 1993, particularly during the summer and fall months. A total of 61 species (23 damselflies and 38 dragonflies) was documented. This represents 33% of the total Virginia fauna and an even greater percentage of the lentic species. Thirty (49%) of the species are considered rare (14) or uncommon (16) in the state by the Division of Natural Heritage. Several of these species are closely associated with acidic pond habitats. Significant findings include the first records of Nannothemis bella in Virginia in more than a century, one record of Lestes congener, a species previously unknown from the state, and the southernmost documented localities for Celithemis martha. Three exemplary acidic pond habitats supported the greatest species diversity. Two ponds support at least 22 different species; a minimum of 20 species inhabit the third pond. Additional surveys in the spring and early summer of 1994 are likely to add to the known odonate fauna of Fort A.P. Hill.

AN INSTRUCTIONAL DESIGN MODEL FOR THE USE OF UNIVERSITY RESEARCH COLLECTIONS IN UNDERGRADUATE EDUCATION. S. Lynn Sharp, Virginia Tech Museum of Natural History, 428 North Main Street, Blacksburg, Virginia, USA 24061-0542. The systematics and collections community has realized that it is imperative for the public and administrators to *personally* value the natural history collections in our care. University collections are particularly vulnerable to administrative and faculty changes of direction; their inherent value notwithstanding, collections which are not seen as directly related to the primary mission of undergraduate education may appear to be unaffordable luxuries in times of limited funding. Direct experience with the "real thing" makes science exciting and leads students to scientific inquiries of their own. Undergraduate education has always used teaching collections for hands-on experience: this can be enhanced by the resources of research collections. This model integrates research collections into the curriculum while minimizing risks to their preservation for future uses by using both physical and procedural controls. Student, faculty, and museum staff evaluations of its effects will be presented, as well as future plans based upon that feedback. The implementation of this model invites additional audiences to appreciate the wealth of information in natural history objects and understand their potential for future studies of biodiversity. These collections can be shown to be not unaffordable luxuries, but additional investments in educational excellence.

#### TEACHING LOCAL NATURAL HISTORY THROUGH SCHOOLYARD INQUIRY.

Frank Taylor, Virginia Tech Museum of Natural History, Virginia Tech, Blacksburg, VA 24061-0542. Virginia natural history and ecology can be taught through direct hands-on experiences using the schoolyard as a laboratory. MINTS -- Museum Inquiry-based Natural history guides for TeacherS is a five year project funded by the Howard Hughes Medical Institute's Precollege Science Initiative for Science Museums that provides teachers with both scientific content knowledge and a model for inquiry instruction in the outdoors. The scientific content in the guide is organized by habitat - parking lot, lawn, fencerow and overgrown areas, walls and eaves, and trees. Organisms and how they interact with the biotic and abiotic features of the environment are addressed in each section. The inquiry model is based on national science reform efforts -- using open ended questions to engage students in making observations, using simple science tools to collect data, organizing and communicating data, and making inferences and conclusions. MINTS will be of interest to all science educators whose goals are to involve students in direct experiences discovering natural history. The guide is currently being field tested and is available to educators by attending a workshop through the Virginia Tech Museum of Natural History.

THE PUBLIC'S ATTITUDES TOWARD SNAKES: PRELIMINARY SURVEY RESULTS FROM PARK-GOERS. Robert A. S. Wright, Central Va. Biological Research Consortium, 7551 Devil's Den Lane, Mechanicsville, VA 23111. During an 11-day interval in August 1985, a voluntary survey questionnaire was circulated in a public park as part of an educational display featuring snakes and their conservation. Respondents were asked to fill out the form which collected qualitative/demographic data such as age, gender, occupation, educational level, and residence. Questions were posed to determine the respondents' knowledge of local venomous snakes, their identification/differentiation from non-venomous species, and whether they had a fear or phobia of snakes. Respondents were asked to provide objective statements as to why or why not snakes were important to the environment; they were also asked to provide a brief statement that summarized their feelings about snakes. The details of this study are presented and discussed.

## Psychology

ESTABLISHING CONDITIONS: INCREASING TRAFFIC SAFETY BEHAVIORS WITH PERSON-BASED MESSAGES. Brenda R. Alderman, Jason N. Fortney, Trish Dorsey, Brenda R. Wetzel, & Mary Spiller, Dept. of Psyc., VA Tech, 5100 Derring Hall, Blacksburg, VA 24061-0436. In the first six months of 1993, over 2,300 rail-highway crossing incidents occurred nationwide—including 284 fatalities and 863 injuries—because automobile drivers violated traffic safety laws at crossings. A review of the literature identified antecedent and consequent conditions which may direct and motivate unsafe crossing behaviors, and examined past research and interventions. This study identified existing driver behavior at selected local crossings and applied a novel community intervention using a behavioral paradigm based upon person, environment and behavior factors.

A BEHAVIORAL ASSESSMENT OF THE RISK COMPENSATION HYPOTHESIS. Thomas E. Boyce, Jason N. Fortney, C. Matt Rashleigh, & Mark Newell, Dept. of Psyc., VA Tech, 5100 Derring Hall, Blacksburg, VA 24061-0436. The Risk Compensation hypothesis (Peltzman, 1975) was tested by exposing human subjects to a computer analogue of an industrial risk-taking situation. This ABA design included two manipulations of perceived risk. Group 1 experienced a lowered level of perceived risk, while Group 2 experienced an increased level of perceived risk. Subjects also completed Zuckerman's (1979) Sensation Seeking Scale and Geller's (1991) Risk Probability Survey. A manipulation check was performed by assessing subject's self-reports of the perceived risk manipulations. Results are discussed from the behavior analytic and social psychological perspectives.

RED CROSS BLOOD DONORS VS. A SAMPLE OF STUDENTS: AN ASSESSMENT OF DIFFERENCES BETWEEN GROUPS ON "ACTIVELY CARING" PERSON FACTORS. Curtis M. Buemeyer, David Rasmussen, D. Steve Roberts, Craig Martin & Amy Gershenoff, Dept. of Psyc., VA Tech, Blacksburg, VA 24061. "Actively Caring", as defined by Geller (1993), is behaving "beyond the call of duty" to help another person. Purportedly, three individual difference factors, self-esteem, empowerment and feelings of belonging to a group, give a person the propensity to "actively care" (AC). Though the AC paradigm possesses strong face validity, more evidence is needed to link AC person factors with actual behaviors. The "Blood Drive Questionnaire," an inventory comprised of six AC sub-scales, was administered to both a control group (n=270) and a group of Red Cross Blood Donors (n=170). A one tailed t-test was used to test for significant differences between groups. As hypothesized, blood donors did indeed evidence higher scores on all six scales: self-efficacy, optimism, personal control (which comprise the "empowerment" factor) belongingness, and self-esteem.

IMPROVING VIGILANCE PERFORMANCE THROUGH THE USE OF HIGHLY ACQUAINTED INDIVIDUALS. Peter J. Ceplenski, Mark Scerbo, Debra Major. Old Dominion Univ., Norfolk, Va. 23529. The effects of using two-person monitoring teams composed of highly acquainted individuals on vigilance performance and workload were examined. Previous findings suggest that using two-person monitoring teams improves detection probabilities over that of individual monitors (Schafer, 1943). It was hypothesized that friendship pairs would perform better than two-person teams of strangers or individuals, as well as rate the task lowest in workload. Sixty undergraduate subjects participated and were assigned to one of the three experimental conditions. The vigilance task was a visual successive judgement task using squares as stimuli. An ANOVA revealed no significant differences between conditions on both the performance measures and workload scale. Task complexity and verbal communication are discussed as explanations for the findings.

SCHEMATIC FACES AND CHOICE REACTION TIME. Samuel L. Chapman, Peter J. Mikulka\*, & Glynn D. Coates\*, Dept. of Psychology, Old Dominion University, Norfolk, VA 23508. The present study investigated categorization of schematic faces as a function of the amount of information presented. It was hypothesized that, as faces became more realistic, parallel processing would emerge. It was also hypothesized that: 1) choice reaction time (CRT) would increase with display set size, 2) CRT would remain constant with an increase in the number of features if the schematic faces were parallel processed, 3) accuracy would decrease with a subsequent increase in display set size and feature number, 4) learning would occur as accuracy increased with time. Subjects were 52 undergraduates, 45 females and 7 males. Schematic faces were presented on the screen of an IBM compatible 386 personal computer. The target face and display set were shown simultaneously. Subjects were required to decide if the target face was an exact match of any face in the display set. An analysis of variance (ANOVA) for CRT and accuracy was performed using 3 levels of display set size, 3 levels of number of features varied, 4 levels of blocks, and 2 levels of response condition (either the target was present in the display set or not). Every subject received all of the conditions. For CRT, eleven significant effects were found. For CRT, four effects were discussed because the omega-squared was greater than .02. A significant main effect was found for display set size; CRT increased as predicted as stimulus number increased. A significant main effect was found for features; CRT increased as the number of features increased indicating novel faces being processed serially. A significant main effect for trial blocks showed that subjects improved their performance over time which indicated learning. A significant interaction was found for display set size x response condition. For accuracy, seven effects were found to be statistically significant, but none reached an omega-squared of .02. It would be of interest to expand the display set and the number of features varied in order to assess subjects' capacity to perform the task efficiently and an assessment of strategy shifts. Also, in order to evaluate parallel processing, subjects could view the target face for a period of time before the task.

MEXICAN FREE-TAILED BATS AT MT. LAKE BIOLOGICAL STATION! Jack A. Cranford, and Deborah S. Fortune., Mt. Lake Biological Station, Biology Dept, Univ. of Virginia, Pembroke, VA. In the fall of 1994 during the course of routine mammal trapping, mist netting of bats and direct observation produced the normal expected results. Big and little brown bats, red bats, hoary bats and eastern pipistrellus were recorded. On one occasion a large bat was observed in the library area in the research building at the station. This animal was captured by hand and two days later another was captured in a bug net. These bats either entered through the open library windows or came down from the attic. Both were identified by the free-tail condition, ear shape and body coloration as Mexican free-tailed bats (*Tadarida brasiliensis*). After identification and measurement both were released and flew in the area of the laboratory driveway foraging and entering the eve of the building.

HABITUATION TO SPECIFIC SENSORY STIMULI IN SENSITIZED EPILEPTIC MONGOLIAN GERBILS (*Meriones unguiculatus*). Stephen R. Davenport, C. Grandinetti, & J.W. Collins, Dept. of Psychology, Washington & Lee University, Lexington, VA 24450. Five groups of genetically epileptic Mongolian gerbils were individually exposed to five distinct stimuli during sensitization and subsequent habituation phases. Inter-test intervals were seven days for sensitization and two days for habituation. Each group was exposed to a novel stimulus on the seventh test in each phase to determine stimulus generalization for seizure expression and severity. All animals were tested for emotionality in a two-compartment box (1mx1m floor space) after sensitization and habituation phases. Results suggest a stimulus generalization present across most of the stimulus conditions in both sensitized and habituated animals. High emotionality was associated with the sensitization phase with low emotionality scores noted after habituation, regardless of the stimulus condition. The presence of stimulus generalization to seizure-eliciting stimuli by this animal model could prove beneficial to the treatment of human epileptics.

DIFFERENCES IN MOTIVATIONAL AND COGNITIVE FACTORS BETWEEN TRADITIONAL AND NON-TRADITIONAL AGE COLLEGE STUDENTS. Teresa M. Dornan and Elaine M. Justice, Dept. of Psych., Old Dominion Univ., Norfolk, VA 23529. Differences in the academic performance of traditional and non-traditional age students were examined to investigate cognitive and motivational variables varying as a function of age and gender, at the college level. Three questionnaires were administered to 95 undergraduate students to determine differences in beliefs regarding memory capacity, motivated self-regulatory learning, study activities, and academic performance. Findings indicated traditional and non-traditional students were significantly different, with respect to age and gender for motivational factors and cognitive study activities. No differences were found between the traditional and non-traditional students for beliefs regarding memory capacity, or actual academic performance.

NARCISSISM AND HOSTILITY. Chet H. Fischer, Dept. of Psychology. Radford University., Radford, Va 24142. The DSMIII-R details the various features associated with Narcissistic Personality Disorder. One important criteria is the narcissist's tendency to become angry when his/her narcissistic needs are frustrated. This has been labeled "narcissistic rage". Numerous researchers and therapists have described this characteristic. McCann and Baggio (1989) focused on hostility in narcissistic subjects and demonstrated that individuals with high narcissism exhibited significantly greater anger arousal than subjects with low narcissism. In the present study, a stronger method of assessing hostility was used. One hundred six subjects were administered the Narcissistic Personality Inventory and the Cook-Medley Hostility Scale. The results demonstrated a strong significant correlation between high NPI scorers and high Cook-Medley scores ( $r=.69$   $p<.001$ ). The present research suggests that narcissistic subjects, rather than exhibiting hostility as a reaction, have a pervasive high level of trait, not state, hostility.

THE USE OF SOCIAL RESPONSIBILITY STATIONS AT UNIVERSITY ALCOHOL PARTIES: A TEST OF INDIVIDUALS' PROPENSITY TO "ACTIVELY CARE". Kent E. Glindemann, Anjali Mohla, Jennifer LaMonica, Mary L. Spiller, & E. Scott Geller. Dept. of Psys., Va. Tech., Blacksburg, VA 24061. Excessive alcohol consumption on college campuses and concomitant risks for DUI continue despite efforts to reduce their occurrence. This project assessed the validity of a theory-driven "actively caring model," designed to predict individuals who will volunteer to apply intervention techniques to reduce the probability of alcohol-related problems. The research also evaluated the extent that certain verbal report measures of person factors (i.e., specific intentions, risky lifestyles, and certain personality characteristics) predicted levels of alcohol consumption at two fraternity parties. Prior to the two parties, students' drinking intentions and person characteristics were measured. Before and after the parties, students' BAC was assessed with a breathalyzer. During the parties, students' participation in various intervention techniques was systematically observed. Results of the study are discussed, as are implications for preventing the occurrence of DUI.

CLOTHING SELECTION: A TEST OF KELLEY'S ATTRIBUTION THEORY. Amy H. Grimshaw and Barry Gillen\*, Dept. of Psychology, Old Dominion University, Norfolk, VA 23529. Kelley's attribution theory was tested in regard to clothing selection. Each of 121 male subjects and 133 female subjects was given two scenario and questionnaire series. The two scenarios described the clothes worn by an individual (Ann/Bill) to a five year reunion party. Each scenario given to experimental subjects included one of eight combinations of high or low consensus, high or low consistency, and high or low distinctiveness information. Each subject was asked to attribute the individual's clothing selection to internal factors, to external factors, or to some combination of each. As predicted external attribution was strengthened by the combined effect of high consensus, high consistency, and high distinctiveness and also by the independent effects of high consensus and high distinctiveness information. Similarly, internal attribution, as expected, was strengthened by the combined effect of low consensus, high consistency, and low distinctiveness and also by the independent effects of low consensus and low distinctiveness.

INTERACTION OF ETHANOL AND CAFFEINE ON RAT MOTOR ACTIVITY. Lester A. Hawkins & Perry M. Duncan, Dept. of Psych., Old Dominion Univ., Norfolk, VA 23508. The Effects of a range of doses of stimulant and depressant drugs and their combination on rat motor activity were observed. Eight long evans male rats were used as subjects. The IVs were ethanol (ETH) at three doses (0, .3, .6, and 1 g/kg), caffeine (CAFF) at two doses (0, 15, and 30 mg/kg), and six 10-minute post-injection time intervals. The DVs were the amount of motor activity, including ambulation, rearing, and total movement. ETH decreased and CAFF increased motor activity in a dose-related manner. ANOVAs revealed that both main drug effects were significant as was the drug interaction. The pattern of results suggest that a low ETH dose potentiated the CAFF effect, possibly due to a combination of disinhibition and arousal-increasing action.

EVENT-RELATED POTENTIALS AND METAPHOR PROCESSING. Charles B. Ireland, Dept. of Psych., Washington and Lee Univ., Lexington, VA. 24450, & Tom P. Urbach, Dept. of Phil., Washington and Lee Univ., Lexington, VA 24450. It is a point of debate whether or not metaphor comprehension requires a special form of linguistic processing. Activity of the human brain during linguistic processing can be studied using event-related potentials (ERP), recorded from the scalp (Kutas, Hillyard 1984). If the processing of metaphor differs from the processing of literal language, then these differences might appear in ERP data. This experiment recorded ERPs in response to reading sentences of three types: metaphorical, literal, and nonsense.

SEXUAL ASSAULT AND ITS IMPACT ON RELATIONSHIP PATTERNS: A DEVELOPMENTAL APPROACH. Kathryn J. Karageorge and Deborah G. Ventis, Dept. of Psychology, College of William & Mary, Williamsburg, VA 23185.

Sexual assault, including acquaintance rape, rape by a stranger, and attempted rape, is prevalent among adolescents and young adults and is of major concern for females in particular. Within the past 15 years, several researchers have focused their studies on the psychological effects produced by a sexually coercive incident on the victims. However, few studies have examined this relationship within a developmental framework. This study investigated the current level of emotional and physical intimacy experienced by victims of sexual assault and if the age at which the assault occurred influenced the severity of these effects. A total of 65 female students participated in the study (mean age=18.75). Data analyses revealed that the victims' age at the time of the incident was not significantly correlated with their ability to be emotionally and physically intimate with members of the opposite sex. However, the relationship between victim and offender as well as the level of coercion reported by the victim was significantly correlated with the ability to trust, make friends with, and get close to members of the opposite sex. Future implications will be discussed.

IMPLICIT AND EXPLICIT MEMORY IN CHILDREN. Douglas M. Kaufman, C. E. Southgate\*, and D.G. Elmes. Dept. of Psychology, Washington and Lee Univ., Lexington, VA 24450. As children develop their explicit memory increases dramatically. Field studies have indicated that implicit memory is good in young children, nearly as good as that of older children. The present work compared the implicit and explicit memory of children and college students on well-controlled laboratory tasks. Fourth-graders, eighth-graders, and college students were tested on the same implicit task, which was a rule-based sequential reaction-time task. The same subjects were also tested for their explicit free recall of a list of words, which was taken from fourth-grade spelling lists. Implicit memory differed much less across the three age groups than did explicit memory.

FACTORS INFLUENCING THE SUCCESS AND FAILURE OF COLLEGE FRESHMEN. Laura E. Kellard, Raymond H. Kirby, and Peggy A. Herzog-Simmer, Dept. of Psychology, Old Dominion Univ., Norfolk, Va. 23529. The factors influencing the performance of freshmen at Old Dominion University were investigated using qualitative methods. Students had the opportunity to identify and discuss the factors they found affected their academic success. Forty-eight, full-time male and female freshmen participated in one of six focus groups that were conducted. Two groups were academically successful freshmen (with a 3.0 or higher G.P.A.), two groups were academically unsuccessful freshmen (with a 1.99 or below G.P.A.), and two were "mixed" groups having a combination of successful and unsuccessful freshmen. Differences were noted in several factors affecting academic performance reported by the successful and unsuccessful groups. Particularly, goal setting behaviors, effective use of support services, and communication apprehension differed between the successful and unsuccessful groups. This study provides qualitative information which may help illuminate and explain quantitative data previously collected on the freshmen population.

PAVLOVIAN CONDITIONING OF BLOOD GLUCOSE RESPONSE IN RATS. Kristen E. Koontz, and Perry M. Duncan,\* Dept. of Psychology, Old Dominion Univ., Norfolk, Va. 23508. It remains unclear as to whether conditioning a rat to a hypoglycemic state will cause a decrease or an increase in locomotor activity. In the current study, 8 rats were conditioned to become hypoglycemic. Insulin (US) was administered for 5 conditioning days. The rats were placed in an activity detector for 30 minutes where their activity was recorded (UR). The odor in the box plus the insulin served as the conditioned stimulus. For the next 3 days, the rats were injected with saline. Blood glucose was measured before and after each conditioning and test day. The analysis of variance revealed that activity level declined over the conditioning days and on the test days. The blood glucose levels increased and decreased at different times. This may have been the result of an insufficient time in the activity detector.

DISPLAYING OF SAFE SEX INFORMATION AT A UNIVERSITY SANCTIONED FRATERNITY PARTY TO EXAMINE THE EFFECTS ON ALCOHOL CONSUMPTION. Kristy L. Maddox, Amy B. Greshenoff, Amie Gee, Brenda R. Wetzel, & Mary L. Spiller, Dept. of Psyc., VA Tech, 5100 Derring Hall, Blacksburg, VA 24061-0436. In our society, safer sex has become an issue of importance. Convincing the college age population of the dangers of being irresponsible when alcohol and sex are combined, however, is a challenge which has yet to be adequately addressed. The present study examined how a Safe Sex, Social Responsibility Information Station set up at a university sanctioned fraternity party would affect research participants Blood Alcohol Concentration (BAC) levels. Information and material available at the station included pamphlets about acquaintance rape, safe sex practices, and alcohol issues, as well as free condoms subjects were allowed to take with them. Relationships between alcohol intoxication levels, participation at the station, and various personality measures are discussed.

Discourse Context Effects in Locally Ambiguous Sentences: Evidence from Event-Related Potentials. Thomas R. Mason and Thomas P. Urbach, Dept. of Psychology, Washington and Lee University, Lexington, VA 24450. The disambiguating word in locally ambiguous "garden-path" sentences is known to elicit a late positive deflection in the event-related potential (ERP). The present study presented garden-path sentences that began with a singular definite noun phrase, e.g., "The patient presented by the doctor was nervous", preceded by a paragraph of text in which either one or two patients were mentioned. The prediction was that the processing difficulty at the disambiguating word, "by", would be greater when the discourse context contained a unique referent. Comparison of the ERPs at "by" showed a significant difference, but with a polarity the reverse of what was predicted. The single discourse referent condition also elicited a significant parietally maximal negativity at the final word which accords with reports from other garden-path studies. These results suggest that the discourse contexts do differentially affect the processing of the locally ambiguous sentence in the disambiguating region but the precise nature of the processing awaits further investigation.

THE CONTINGENT NEGATIVE VARIATION DURING OLFACTORY AND VISUO-SPATIAL LABELING. Douglas C. Matia, J.M. Turner\*, & T. S. Lorig, Dept.. of Psychology, Washington and Lee University, Lexington, VA 24450 & S. Warrenburg\*, International Flavors and Fragrances, Research and Development, 1515 Highway 36, Union Beach, NJ 07735. Fifteen subjects participated in an experiment designed to assess CNV during the labeling of odors and shapes. Odors or shapes were presented (S1) and followed three seconds later by a lexical label (A,B, or C.) (S2). The label (S2) identified the stimulus correctly in 75% of the trials and incorrectly in the remaining 25% of the trials. Subjects' olfactory ability (CCCRC) was determined and correlated with both the CNV during the S1/S2 interval and also the P300 to the S2 stimulus. Results of these correlations and analysis of variance indicated that the CNV over the left frontal area of the cortex was significantly larger in the olfactory phase of the experiment as compared with the visuo-spatial phase. CNV activity also correlated with olfactory performance. The data show that subjects with the largest odor-related CNV's had the best olfactory performance. While P300 differed as a function of label matches versus mismatches, no odor specific effects or correlations were found. Results are discussed as to the cognitive processes represented by the left frontal negativity. It is possible that subjects created an intermediate label for the odors which is not available for the shapes. A cognitive manipulation such as this would not necessarily make the task more difficult, only different.

THE ROLE OF VERBALIZATION AND SOCIALIZATION IN PEER TUTORING ACTIVITIES AND CHILDREN'S ABILITY TO LEARN. Suzanne Morrow, Elaine Justice\*, & Michael Colbert\*, Dept. of Psychology, Old Dominion Univ., Norfolk, Va. 23549. The effects of peer tutoring on third graders' use of an organizational memory strategy was examined. Children were first introduced to the memory task with highly associated items. Children either taught another child the task, tape recorded instructions to give another child, or did the task again. Organizational memory was then retested measuring recall, sorting style, and clustering on low associates. There were no significant differences due to peer tutoring. A significant gender difference was found with males showing higher levels of recall, sorting, and clustering.

THE INFLUENCE OF TASK-UNRELATED THOUGHTS (TUTS) ON VIGILANCE PERFORMANCE. Glenora Nelson & Fred G. Freeman, Ph.D, Dept. of Psychology, Old Dominion University, Norfolk, Va. 23529. Numerous studies have attempted to explain the factors responsible for vigilance decrement. The present study examined the relationship between the propensity to produce task-unrelated thoughts (TUTs) and vigilance performance. Twenty-five subjects participated in a 40-min vigilance task. The Boredom Proneness Scale (BPS) and the Cognitive Failures Questionnaire (CFQ) were used as measures of the propensity to produce TUTs. A correlation analysis of the data failed to show significant relationships between the variables measured; however, the results suggested an inverse relationship between duration of the task and vigilance performance. Further studies employing other measures of individual differences in the ability to sustain attention are needed to better understand the relationship between vigilance performance and the propensity to produce TUTs.

THE EFFECTS OF ATTENTIONAL DEMANDS ON PERFORMANCE RATINGS OF WOMEN AND MEN IN TRADITIONALLY FEMALE AND MALE OCCUPATIONS.

Beth Parsons and Glynn D. Coates, Dept. of Psychology, Old Dominion University, Norfolk, VA 23529. Previous research notes that various factors affect performance appraisals. This present study specifically examined the factors of attentional demands and gendered occupations and their impact on performance appraisals. Thirty-two subjects read vignettes of male and female police officers, and male and female nurses. Subjects rated the incumbent's work performance. Heightened attentional demands were imposed on the experimental group. Research has indicated heightened attentional demands lead to discrimination. As predicted no interaction of attentional demand was present. Thus, the basis for heightened attentional demands resulting in discrimination was not supported in this study. Of interest was the interaction of the gendered occupation and gender of the incumbent. Male nurses were rated higher in work performance than females. This role reversal held true for police officers also.

HOW ENVIRONMENTAL DIFFERENCES IN UNIVERSITY DINING HALLS AFFECT EMPLOYEES' "ACTIVELY CARING" BEHAVIORS. Olga Patarroyo, Kimberly Nuttycombe, D. Steve Roberts, Craig Martin, & Amy B. Gershenoff, Dept. of Psyc., VA Tech., Blacksburg, VA 24061. Actively Caring (AC) is defined as going beyond the call of duty to benefit others or the environment (Geller, 1992). A refined version of the AC Survey was given to employees in two Dining Halls to measure the person factors (e.g., self-esteem, empowerment, and belonging) related to the employees' propensity for AC as well as the extent to which employees are willing, feel they should, and do AC (Geller, Roberts, & Gilmore, 1993). An AC behavior checklist was used to evaluate employees' AC and non AC behaviors. The factors considered fell into three domains: person, environment, and behavior focused AC. The hypothesis, based on the senior author's previous work experience at both Dining Halls and knowledge of the AC model, is that Dining Hall B employees will have a higher propensity to Actively Care. Results and further implications will be discussed.

RELATIONSHIP BETWEEN CIRCADIAN PERIOD AND SEIZURE EXPRESSION IN THE MONGOLIAN EPILEPTIC GERBIL (Meriones unguiculatus). Jennifer J. Peszka & J.W. Collins, Dept. of Psychology, Washington & Lee University, Lexington, VA 24450. Mongolian epileptic gerbils were tested in the open palm once a day for six weeks every four hours in an attempt to establish the daily periodicity of their seizures. Daily periodicity has been established for epilepsy in humans (diurnal) and rats (nocturnal). Because the gerbil is considered diurnal, it was expected that the activity rhythms of the gerbil would more closely resemble those of the human than the rat. By implication any periodicity in seizure expression of gerbils should more closely match that of the human. No significant time of day effect was found for seizure expression. However, there was a trend towards this effect. A significant decrease from expected seizure expression occurred at the 8:00 P.M. testing time. This did not follow the original hypothesis that seizure incidence would increase during this time. Further research into the activity period of the gerbil is needed to counter this discrepancy.

ALCOHOL TESTING THROUGH COGNITIVE BEHAVIORAL FITNESS TESTS. Charles B. Pettinger, Jr., Michael J. Kalsher, D. Steve Roberts, & Kent E. Glindemann, Dept. of Psys., VA Tech, Blacksburg, VA 24061. Dependence on alcohol and other drugs is America's most common psychological condition and extends into the workplace. There have been inconsistent findings regarding the impact of alcohol and other drugs in terms of measurable outcomes in the workplace. The present study tested the sensitivity of a battery of tasks (termed Compensatory Tracking Task Battery, CTTB) to decrements in participants' performance under the influence of alcohol at a fraternity social event. The CTTB is comprised of a questionnaire and three variations of the Compensatory Tracking Task (CTT). After each subject developed a personal baseline on the CTTB, they provided a breathalyzer sample and completed between 4-8 sets of the CTTB at the social event. The study was conducted to determine whether the variations of the three CTT would improve the detection of decrements in subjects' cognitive/behavioral fitness over the CTT alone. Relevant results and implications to drug screening in the workplace will be presented and discussed.

THE EFFECTS OF PREMATURE BIRTH ON MATERNAL STRESS DEPRESSION AND MOTHER-INFANT INTERACTION. Daniel M. Phillips III and Michelle L. Kelley Ph.D.\*, Dept. of Psychology, Old Dominion Univ., Norfolk, VA, 23529. Parenting of premature infants has been associated with increased levels of maternal stress and depression. Decreased levels of mother-infant interaction followed by overstimulating maternal behavior have also been found within the first year of these infants' lives. This research attempted to replicate previous findings using the Parenting Stress Index and Beck Depression Inventory scales. The groups in comparison were 36 mothers of 5-month-old full-term infants and 34 mothers of 5-month-old adjusted age very low birthweight (VLBW) infants. Previous mother-infant interactive differences were also attempted to be replicated. However, the CARE-Index, a recently developed scale of mother-infant interaction, was used to reduce the influence of situation specific aspects of the interaction and maximize the influence of the mother and infant's expectations of one another. Findings demonstrate significantly higher levels of parenting stress associated with VLBW infants. Overstimulating interactive behavior also was observed in mothers of premature infants. However, full-term mothers reported higher levels of depressive behaviors. In conclusion, it is suggested that future educational intervention programs may prepare mothers of VLBW infants for the stresses and difficulties associated with their parenting.

INTRAHEMISPHERIC INTERFERENCE OF EMOTIONAL STIMULI AS A FUNCTION OF HAND USED, SEX, EAR OF INPUT, AND TASK DIFFICULTY ACROSS MOTOR AND COGNITIVE TASKS. Lawrence J. Prinzl III, & Frederick G. Freeman, Dept. of Psychology, Old Dominion Univ., Norfolk, Va. 23529. The effects of intrahemispheric interference on reaction times and accuracy were examined. A dichotic-listening task was presented to subjects that consisted of identifying an angry emotional target. For each subject, four trials were presented that varied in hand used for responding, motor difficulty, and the absence or presence of a white noise. The results evinced that intrahemispheric interference was reduced when a simple go/no-go motor response was employed relative to a more complex, two-choice motor response. These results confirmed earlier studies that showed similar findings. Subjects also responded faster when the left-hand was used for motor response and also when stimuli were inputted in the left ear, but not when white noise was presented in the background. Significant interactions were found for mean reaction times for hand used by motor condition, and for hand used by motor condition by cognitive condition. A marginally significant interaction for hand used by motor condition by ear of input was also found for mean reaction times. These results suggest that an increase in response processing demands increase right-intrahemispheric interference. A significant main effect was also found for sex for both mean reaction times and mean number of correct responses. The results were interpreted as stemming from differences in performance strategies between males and females.

HOW SELF-ESTEEM EFFECTS THE AMOUNT OF ALCOHOL UNIVERSITY STUDENTS CONSUME: A FIELD STUDY. Kareen L. Ramsby, Kristy L. Maddox, John P. Jones, III, Jamie Spisak, & Thomas E. Boyce, Dept. of Psyc., VA Tech, 5100 Derring Hall, Blacksburg, VA 24061-0436. Previous research has found that low self-esteem is a motivator for alcohol use because it provides positive feelings of self worth. Therefore, considering the large quantity of alcohol consumed by college students, it has been implicated that many college students who drink have low self esteem and a sense of unbelongingness. In this study, approximately 100 college students were randomly selected to complete a questionnaire pertaining to self-esteem and belongingness. These students then volunteered to have their BAC taken at a party which involved alcohol consumption. Relevant results are discussed, along with implications for preventing alcohol-related problems among college students.

A PSYCHO-MOTOR SOBRIETY TEST: OPEN STRATEGY VERSUS SPECIFIED STRATEGY. C. Matt Rashleigh, Kent E. Glindemann, Jeff Ammons, Jennifer Heath, & Soo Kang, Dept. of Psyc., VA Tech, 5100 Derring Hall, Blacksburg, VA 24061-0436. In applied behavioral research it is important to operationally define the behaviors to be observed. It is also important to specify what is expected from the subjects in order to achieve uniformity of behavior. In this way, there is more confidence that variances in behavior are due to the independent variables and not due to varying methods used in carrying out the behavior. This study focuses on the format in instructions given to subjects before the completion of a sobriety test (The Star Tracing Task). In the control condition, subjects were not given a strategy to be used in completion of the task. In the experimental condition, subjects were given a unifying strategy to be used while completing the task. Results are discussed along with implications towards reducing driving while intoxicated.

GOAL-SETTING AND SELF EFFICACY IN AMATEUR ATHLETES. Monica A. Rickard and Raymond H. Kirby, Dept. of Psychology, Old Dominion University, Norfolk, VA 23529.

The purpose of this study was to investigate the relationship between self-efficacy and goal setting in runners, and whether reaching or failing to reach the goal had any affect on self-efficacy. Runners participating in 5K races were questioned about their goals for the upcoming race and their self-efficacy was assessed both prior to and following the race. It was found that runners with higher self-efficacy set higher goals. However no difference was found in post-race self-efficacy scores between subjects that reached their goals, and those that did not. It was also found that subjects who spontaneously set goals without prompting tended to do better relative to their past performance than subjects who had to be prompted to set a goal.

INCREASING STAIR SAFETY ON A UNIVERSITY CAMPUS: A COMPARISON OF FIELD TESTS. D. Steve Roberts, E. Scott Geller, Kristy L. Maddox, & W. Geoffery Fitch, Dept. of Psyc., VA Tech., Blacksburg, VA 24061. People often disregard safety messages that focus on self-protection. However, other-focused messages may give people the more realistic belief that someone will be injured and their safe behaviors could help others by setting a safe example. This study included two field tests to assess the relationship between the content of a safety message and hand rail use on a university campus. In addition to a baseline (i.e., no sign) condition, both field tests included three sign conditions posted in university stairwells. One type of sign read "Please Hold the Handrail When Going Up and Down Stairs". Another type of sign read "Caution! Stairs May be Wet -- Please Hold the Handrail When Going Up and Down Stairs". The final type of sign read "Set a Safe Example for Others -- Please Hold the Handrail When Going Up and Down Stairs". In the first field test, areas where the "example" sign was presented showed the largest increase in handrail use over baseline (from 33% to 51%). Results from the second field test will be compared to the first and discussed in terms "actively caring" for others as a motivator for safety.

UNDERGRADUATE PERCEPTIONS OF CLINICAL PSYCHOLOGY IN COMPARISON TO NON-PROFESSIONAL, ALTERNATIVE METHODS OF CONSULTATION. Susan P. Sherburne & Louis H. Janda, Dept. of Psyc., Old Dominion Univ., Norfolk, Va. 23529. Undergraduates' perceptions of clinical psychology were measured in comparison to those of clergy, "psychics," and friends/family members as caregivers. Sixty-four females and 64 males read brief scenarios, varying according to type of caregiver and magnitude of problem for which help was received (low, moderate, high). Subjects rated caregiver according to status, competency, effectiveness, skills possessed beyond the average person, and deserved fee for services. Five 4x3x2 mixed ANOVAs revealed main effects for both consultant type and magnitude of problem, indicating a significant difference between "psychics" and the other methods of consultation on the dimensions of status, competency, and effectiveness, as well as a difference between clinical psychology and the other methods on deserved fee for services. These findings suggest that clinical psychology is not necessarily a preferred method of treatment, lending to the notions of psychology as "common sense" and suggesting that psychologists offer no more than the average person.

CHOICE REACTION TIME USING CONSISTENT AND VARIED MAPPING OF STIMULI. Steven M. Springer and Glynn D. Coates, Dept. of Psychology, Old Dominion University, Norfolk, VA 23508. This study examined the effects of consistent and varied mapping of letters on choice reaction time and to determine if the Hick-Hyman law, which states that reaction time increases as the amount of information transmitted increases, applies to intersection decisions during consistent and varied mapping conditions. In the consistent mapping condition, subjects had to determine if all members of the positive set were shown in the display set while the positive set was constant for each trial. In the varied mapping condition, subjects had to perform the same task while the positive set was different for each trial. Results found that reaction time was significantly longer for varied mapping conditions, suggesting that serial processing was used for varied mapping conditions and parallel processing for consistent mapping conditions. Reaction time significantly increased for varied mapping conditions as the size of the positive set increased, suggesting a similar function to the Hick-Hyman law. This effect was not found for consistent mapping conditions, but the trend was in the correct direction.

RE-ENCODING SPECIFICITY IN HUMAN MEMORY. Todd H. Stanton, M.R. Saunders\*, and D.G. Elmes, Dept. of Psychology, Washington and Lee Univ., Lexington, VA 24450. What is it that people remember when they attempt to recognize a target item? At least one thing that they remember is what has been rehearsed. If the match between what is learned and what is remembered is important--encoding specificity--then it is likely that the match between what is rehearsed and what is remembered is important--re-encoding specificity. The results of several experiments suggest that hearing a target item in a voice that is similar to your own voice enhances the recognition of the target if it is also heard in that voice during the recognition test. The implications of re-encoding specificity will be discussed.

THE EFFECTS OF LAMOTRIGINE ON SEIZURE EXPRESSION IN KINDLED MONGOLIAN GERBILS (Meriones unguiculatus). Karen L. Stutzmann, D.N. Bryant, & J.W. Collins, Dept. of Psychology, Washington & Lee University, Lexington, VA 24450. Mongolian gerbils are seizure susceptible and the seizure expression is readily kindled to a desired stimulus. This makes them suitable candidates for the testing of antiepileptic drugs (AEP). Lamotrigine (LTG), a relatively new AEP, has been noted for its ability to reduce the seizure severity of epileptic humans without producing the adverse side effects that frequently accompany the administration of other AEPs. The effects of various LTG dosages (1mg/kg, 5mg/kg, and 10mg/kg), delivered via i.p. injection, on seizures at one half hour and one hour post-injection times revealed that LTG significantly reduces seizure severity. LTG reduced seizure frequency at the one half hour, but not at the one hour post-injection time. These results suggest that LTG works by inhibiting seizure spread from the focus, but not by actively blocking seizure occurrence.

Event-Related Potentials and Syntactic Priming in Locally Ambiguous Sentences. Laura Ashley Myler and Thomas P. Urbach, Dept. of Psychology, Washington and Lee University, Lexington, VA 24450. Priming effects are well attested in lexical processing but less is known about priming for grammatical structure in sentence processing. The present study examined syntactic priming effects in the processing of locally ambiguous "garden-path" sentences. The S2 garden-path target sentences were preceded by S1 which was either a different garden-path sentence with the same structure or a control sentence. The prediction was that the processing difficulty of the primed targets would be reduced. Event-related potentials (ERPs) recorded on-line are known to be sensitive to the processing difficulty in garden-path sentences, and in particular, the disambiguating word elicits a characteristic late positive deflection in the ERP. Comparison of the ERPs in S1 showed that the garden-path items elicit the expected positivity relative to their controls. Comparison at the S2 garden-path target showed that the positivity was reduced in the primed condition, supporting the hypothesis that the processing difficulty is reduced.

"ACTIVELY CARING AND ALCOHOL CONSUMPTION: A FIELD STUDY OF COLLEGE STUDENTS. Jaime B. Wheeler, Charles B. Pettinger, Jr., Christopher Saunders, Ivan O. Haskell, & Tammy B. Shurts, Dept. of Psyc., 5100 Derring Hall, VA Tech, Blacksburg, VA 24061-0436. The Actively Caring Model and Alcohol Consumption hypothesis were tested by asking subjects to complete two types of evaluation. Two groups of college students (one fraternity, one sorority), participated in a university sanctioned social event. Subjects were asked to complete two standardized tests prior to the social. The Actively Caring Survey (Geller, 1993) and an opinion questionnaire were used to measure individual differences in attitudes and ideas related to involvement in social settings, and alcohol consumption. Test results were correlated with actual Blood Alcohol Concentration (BAC) during the social. Relevant findings and ideas for future research in this area are discussed.

## Statistics

SOME COMMENTS ON PEARSON AND TIKU'S WORK RELATING THE CENTRAL AND NON-CENTRAL F DISTRIBUTIONS. James M. Davenport, Dept. of Math. Sciences, Va. Commonwealth Univ., Richmond, VA. 23284-2014. Professor Egon S. Pearson of University College London visited the department of statistics at Southern Methodist Univ. on March 28, 1969. He consulted with faculty and gave a lecture to graduate students, faculty and invited guests; the title of his presentation was "Some Historical Reflections, Traced Through the Development of the Use of Frequency Curves." The primary result is the development of Karl Pearson's system of frequency curves, which is typically displayed via the familiar  $(\beta_1, \beta_2)$  plane (that is, the skewness and kurtosis parameters). This presentation reviews this historical development through Pearson and Tiku's paper (1970, *Biometrika*, 57, p.175-9), where they indicate that the  $(\beta_1, \beta_2)$  points for the non-central F distribution lie inside the Type VI region of Pearson's curves. It is demonstrated, for large degrees of freedom in the denominator, that the  $(\beta_1, \beta_2)$  points of a non-central F lie within the Type I region of Pearson's system. This result impacts the use of Pearson's curves in 4-moment approximations.

FISHER INFORMATION FOR LOCATION AND SPLINE ROOTGRAM ESTIMATION, Clark K. Gaylord, Department of Statistics, Virginia Polytechnic Institute and State University, Blacksburg, Va 24063. A non-parametric estimate of Fisher information for location is developed using linear B-spline root-density, or "rootgram," estimates. This method also provides a density estimate. A test of normality is derived that is shown via simulation to be comparable to, and sometimes superior to, the Shapiro-Wilk test, a popular test of normality.

DELETION, AUGMENTATION AND PRINCIPAL PREDICTORS. Donald R. Jensen, Dept. of Statistics, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. Effects of design augmentations and deletions are studied analytically as comparative Fisher efficiencies in estimation, Pitman efficiencies in hypothesis testing, and predictive efficiencies at points in the design space. Linear parametric functions most harmed by deletion and most enhanced by augmentation are identified and related to prediction at a point. Effects of augmenting or deleting sets of points are characterized using principal components of the predictive dispersion at those points. Coefficients of the affected parameters are given explicitly in terms of the points of augmentation or deletion. Eight small second-order designs are studied in detail with supporting numerical displays. Comparisons are drawn to other approaches from the literature.

TEST FOR NON-ZERO CORRELATION IN CONTINGENCY TABLES. Robert E. Johnson and Yong Zhu\*, Department of Mathematical Sciences, Division of Operations Research and Statistics, Virginia Commonwealth University, Richmond, VA, 23284-2014. Hypothesis tests concerning Kendall-type correlation between ordinal variables are well known for the hypothesis of independence, but not for the hypothesis of zero correlation. Two procedures, one by Brown and Benedetti and one by Goodman and Kruskal, have been proposed to approximate the asymptotic standard error of the sample correlation measure. Problems with these approximations and a new estimator based on a combination of these approximations are examined. The estimators are compared to both the asymptotic standard error and the true standard error using the maximum likelihood estimates of cell probabilities with the constraint of zero correlation. A Monte Carlo procedure is used to generate sampling distributions.

A PROCEDURE FOR COMPARING EXPERIMENTS BASED ON A MEASURE OF SUFFICIENCY (PRELIMINARY REPORT). Patty Kitchin & Robert V. Foutz\*, Dept. of Statistics, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. Often it is necessary to choose between two or more experiments or two or more statistics within the same experiment. One approach to this problem is to measure the amount of information about the parameter space provided by each experiment or each statistic and make a decision based on the information measure. However, the more common information measures such as Fisher's information and the Kullback-Leibler information function are only useful under certain assumptions. A new measure that provides a solution where other measures are not informative will be introduced along with some examples and preliminary results.

IMPROVING THE W50 TEST FOR EQUALITY OF SPREAD. R. H. Lamb, Dept. of Math. Sciences, Va. Commonwealth Univ., Richmond, VA 23284-2014. The Brown-Forsythe W50 test is a robust test for equality of spread in independent groups. While generally highly regarded, it however yields extremely conservative tests for small odd sample sizes. Two methods are discussed for improving the W50 test in these situations. Monte Carlo results are presented which illustrate and contrast the improvement due to each method for several sample sizes.

A NEW REPRESENTATION FOR BINARY-VALUED TIME SERIES DATA IN THE FREQUENCY DOMAIN. Hoonja Lee, Dept. of Statistics, Va. Polytech. Inst. & State Univ., Blacksburg, VA 24061, & Robert V. Foutz, Dept. of Statistics, Va. Polytech. Inst. & State Univ., Blacksburg, VA 24061. The Classical Fourier analysis of time series data can be used to detect periodic trends that are of sinusoidal shape. However, this analysis can be misleading when time series trends are not sinusoidal. In this paper, we develop theory and methods that can be applied to binary-valued data where patterns more naturally follow a rectangular shape. The theory parallels the Fourier theory and leads to a "Fourier-like" data transform that is specifically suited to the identification of rectangular trends.

A PROCEDURE FOR ESTIMATION OF PARTIAL GROUP DELAY (PRELIMINARY REPORT). Milan Maneshtkar & Robert V. Foutz\*, Dept. of Statistics, Va. Polytechnic Inst. & State Univ., VA 24061. Partial group delay has an interpretation as the time-lag between two channels of a multiple time series after adjustments have been made for the influence of the remaining channels. A two stage methodology is proposed in the spectral domain for estimating the group delay at a frequency of interest. In stage I preliminary values of the group delay are estimated, and in stage II the preliminary values are simultaneously transformed and modeled to obtain an estimate of the mean of the preliminary values (in original units). This estimate is uniformly minimum variance unbiased provided the periodogram and cross periodogram ordinates at each Fourier frequency are independent of the periodogram and cross periodogram ordinates at all other Fourier frequencies. The procedure will be introduced and demonstrated using a simulation study. The preliminary results obtained for the proposed methodology will be compared to the results obtained using an existing procedure.

## D- AND Q-OPTIMAL FACTORIAL DESIGNS IN THE PRESENCE OF DISPERSION EFFECTS.

Darcy P. Mays, Dept. of Mathematical Sciences, Va. Commonwealth Univ., Richmond, VA 23284-2014, & Stephen Easter\*, Dept. of Mathematical Sciences, Va. Commonwealth Univ., Richmond, VA 23284-2014. Traditional response surface methodology experimental designs for estimating location models involve the assumption of homogeneous variance throughout the design region. However, with heterogeneous variance these standard designs are not optimal. The D- and Q-optimality criteria will be used to find the optimal designs for different levels and types of heterogeneous variance. Tables of optimal designs will be presented and used to show the relative inefficiencies of the standard designs. The conclusions will suggest the need for an alternative procedure that will estimate the variance structure and use it to obtain a better estimate of the location model.

COMPROMISE ON PROTECTION FOR MODEL MISSPECIFICATION. Young Moon, Dept. of Statistics, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. The model misspecification and its robustness has always been a serious objection to the utilization of super-population models in finite populations. Instead of imposing restrictions on choosing samples to make the working model as robust to bias, we select a optimal model among the choice of models by Bayes factor. With the chosen model, we design optimally in the sense of minimizing the posterior variance. Without deemphasizing the role of either design or model-based probability sampling, we develop two stages scheme which can be used profitably to protect from model misspecification by compromising between design and model-based approach. Some properties like unbiasedness and mean square error of the derived predictors are studied. An empirical investigation, based on a simulated population, is made to compare the performance of the suggested predictors.

COMPUTING THE SIZE OF A CONFIDENCE REGION. Donald E. Ramirez, Dept., of Math., University of Virginia, Charlottesville, VA 22903. A geometric approach to compare design efficiencies is given for linear models. Using a recent ACM algorithm for computing the surface measure of an ellipsoid, an omnibus geometric criterion for optimal designs is discussed. Comparisons to the A-optimality and D-optimality criteria are demonstrated with selected second-order designs.

## A NONLINEAR STATE-SPACE MODEL OF CHINOOK SALMON POPULATION DYNAMICS.

Steven R. Rein, Dept. of Math. Sciences, Va. Commonwealth Univ., Richmond, VA 23284-2014. We present a nonlinear state-space model of the population dynamics of the Chinook salmon of the San Joaquin River system in CA. In this model, an unobserved state vector comprised of the number of Chinook in each adult age group along with the number of spawning adults is assumed to evolve in a Markovian fashion. In the model, we emphasize a relationship key to the management of the salmon fishery, that between the number of spawning salmon and the number of their offspring that reach maturity (these we call recruits). Because of an assumed relationship between the survivability of the young salmon (smolts) and springtime water flow, we allow this spawner-recruit relationship to be moderated by flow. We then suggest a method which we call the generalized Kalman filter (GKF), for estimating the parameters of such nonlinear state-space models via maximum likelihood. In the GKF, the distributions of the unknown state, and hence, the likelihood, are approximated numerically. We then apply this GKF to our model of the San Joaquin Chinook salmon to estimate the parameters of the spawner-recruit relationship jointly with the yearly recruit series.